مجلة المختار للعلوم

AL-Mukhtar Journal of Sciences

Volume: 34 Issue:4 2019

ISSN:26-17-2178 (Print) ISSN:26-17-2186 (Online)

دار الكتب الوطنية - رقم الإيداع القانوني 280-2013

مجلة المختار للعلوم

جامعة عمر المختار

البيضاء، ليبيا

مجلة علمية محكّمة، المجلد الرابع والثلاثون، العدد الرابع، 2019

تصدر عن جامعة عمر المختار، البيضاء، ليبيا.

مجلة المختار للعلوم

رقم الايداع في المكتبة الوطنية 2013/280/بنغازي

جامعة عمر المختار – البيضاء – ليبيا

مجلة محّكمة تصدر عن جامعة عمر المختار، البيضاء، ليبيا

مجلة علمية محكّمة، المجلد الرابع والثلاثون، العدد الرابع، 2019

بريد إلكتروني: omu.j.sci@omu.edu.ly

ص.ب. 919 البيضاء – ليبيا، فاكس: 7053 463 69 218+

أعضاء هيئة التحرير

مجلة المختار للعلوم 34:(4)، 2019

Al-Mukhtar Journal of Sciences 34: (4), 2019

Al-Mukhtar Journal of Sciences 34 (4): 275-287, 2019

Effect of Sucrose Concentrations and Incubation Periods on in Vitro Rooting of Moris Pineapple (*Ananas comosus*)

Abdelhamid M Hamad

Department of Horticulture, Faculty of Agriculture, Omar Al Mukhtar University, Al-Bayda, Libya

Received: 19 July 2018/ Accepted: 1 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.145

Abstract: The effect of 6 sucrose concentrations (5, 10, 15, 20, 25, 30 g/l) over 4 incubation periods (30, 45, 60, 75 days) on *in vitro* rooting of Moris pineapple cultured in liquid half strength MS medium enriched with IBA at 2.0 mg/l was investigated. At all incubation periods, all shoots in medium enriched with sucrose at 5 g/l failed to root, and no roots formed within the first 30 days in medium enriched with sucrose at 10 g/l. After 30 days of incubation, the highest rooting percentage (66 %), tallest plantlets (23 mm tall), highest (3.4 roots) and longest (5.3 mm) root per shoot were obtained in medium enriched with sucrose at 25, 10, 15, 15 g/l respectively, while after 45 days, the highest of all rooting aspects (75 %, 32.3 mm tall, 3.7 roots, 7 mm long), were obtained in medium enriched with sucrose at 15 g/l. After 60 days, the highest rooting percentage (91.7 %) and tallest plantlets (36.7 mm tall) were obtained in medium enriched with sucrose at 20 g/l while highest roots per shoot (3.7 roots) and longest root (10.7 mm) were obtained in medium enriched with sucrose at 15 g/l. After 75 days, all shoots rooted (100 %) in medium enriched with sucrose at 10 and 20 g/l, while sucrose at 25 g/l resulted in tallest plantlets (46.3 mm tall) and at 20 g/l resulted in highest (4.7 roots) and longest roots (27.3 mm). At each incubation period, there was a different optimum sucrose enrichment for different rooting parameters.

Key words: Sucrose; Incubation Periods; *In Vitro* Rooting; Moris Pineapple; *Ananas comosus*.

INTRODUCTION

Different combinations of sucrose and incubation periods were used for the *in vitro* rooting of pineapple. In *vitro* rooting was reported using sucrose at10 g/l and incubation for 30 days and 70 days (Soneji et al., 2002b), sucrose at 20 g/l for 30 days (Ko et al., 2006; Mengesha et al., 2013; Souza et al., 2016; Sunitibala Devi et al., 1997) and 70 days (Soneji et al., 2002b), sucrose at 30 g/l for 30 days (Almeida et al., 2002; Aydieh et al., 2000; Bhatia & Ashwath, 2000; Fitchet, 1990; Singh & Manual, 2000; Teng, 1997), 45 (Khan et al., 2004; Sripaoraya et al., 2003), 60 (Gangopadhyay et al., 2005; Hamad et al., 2013; Mathews & Rangan, 1979, 1981) and 75 days (Hamad & Taha, 2008) and sucrose at 35 g/l for 30 days (Kofi & Adachi, 1993) and sucrose at 40 g/l for 60 days of incubation (De Almeida et al., 1997). In all of these studies, each of the sucrose and incubation periods was fixed at one level and the focus was on hormone types and concentrations and medium strength. The effect of different sucrose concentrations and incubation periods were neither compared individually nor in combinations of the two factors. In addition, many times the results were reported as a general statement or the rooting response was assessed based only on one parameter, rooting percentage (Bhatia & Ashwath, 2000), root number (Danso et al., 2008). In some cases, two parameters, root number and length (Aydieh et al., 2000; Khatun et al., 1997) and in few cases, three parameters: rooting percent-

***Corresponding Author:** Abdelhamid M Hamad *abdelhamidhamad@gmail.com* , Department of Horticulture, Faculty of Agriculture, Omar Al Mukhtar University, Al-Bayda, Libya.

age, root number, and length (Amin et al., 2005; Soneji et al., 2002a), were used for the assessment of rooting treatments. The plantlets' height, on the other hand, was rarely reported (Be & Debergh, 2006; Hamad et al., 2013; Souza et al., 2016). Sucrose and incubation period are not only important for its effect on rooting, but also for their effect on cost and management of the rooting stage and plantlets survival of acclimatization. Sucrose made the highest proportion of the medium components. And for the incubation period, lamps and air conditioning is required to maintain constant temperature and photoperiod. In large scale propagation, using higher sucrose and longer incubation would make the medium cost and electricity bill too expensive. Using the lowest possible concentration of sucrose and the shortest incubation period would reduce the cost of rooting stage and the overall cost of propagules production. The objective of this study is to compare the effect of different sucrose concentrations over different incubation periods on all rooting aspects of Moris pineapple cultivar. And to determine the best compromise of lowest possible concentration and shortest incubation period at which the best rooting responses, particularly the plantlets' height, could be obtained. The goal is to minimize the cost in terms of the sucrose amount and monthly electricity bill per single propagule.

MATERIALS AND METHODS

A half-strength MS medium (450 ml) enriched with IBA at 2.0 mg/l (Murashige and Skoog, 1962) was prepared and divided into 6 glass jars (75 ml each) marked 1 to 6. Sucrose at 5, 10, 15, 20, 25 and 30 g/l were added to each glass jar respectively. The medium was adjusted to pH 5.0 and autoclaved at 121^0 C and 1.5 kg/ cm^2 for 20 minutes. The content of each glass jar was dispensed into 12 culture tubes (6 ml each) under a laminar cabinet using a sterilized syringe and the tubes marked with the same glass jar mark. Shoots from Moris pineapple stock cultures were cultured at a density of five shoots per culture. The cultures were incubated under constant temperature (25^0 C) and 16 hours of light provided by fluorescent lamps for 30, 45, 60 and 75 days. After 30 days of incubation, three culture tubes of each sucrose concentration were taken for data collection. The shoots were picked out to count the number of rooted shoots, number of roots per shoot, and to measure the roots length and plantlet height. A table for each rooting parameter of the different sucrose concentrations with three replicates was established and named the 30 days incubation tables. After 45, 60 and 75 days, three culture tubes of each sucrose concentration were taken out of the culture room, and a table for each rooting parameter of the different sucrose concentrations at each incubation period was established as were done after 30 days incubation. The tables of the same parameter obtained after different incubation periods (30, 45, 60 and 75 days) were combined in one table containing all combinations of sucrose and incubation periods and used for the analysis of variance and testing the significance of means by Duncan Multiple Range Test at $p \leq 0.05$ using SPSS statistical package No.11.

RESULTS

Two-way analysis of variance (Table 1) showed that both of the sucrose and incubation periods had a significant effect on all *in vitro* rooting aspects of pineapple. However, the sucrose seemed to have a higher influence on rooting percentage, root number, and length than the incubation period, while incubation periods affected plantlets' height more than the sucrose. The two factors exerted their influence independently from each other except in root length, where a significant interaction was detected at $p < 0.055$. Overall sucrose concentrations, incubation for 30 and 45 days, had statistically an equal effect in root formation (2 roots), elongation (4 mm) and plantlets height (24 mm) but the rooting percentage increased from 32 to 43.1 % as the incubation increased from 30 to 45 days (Table 2). Incubation for 60 days resulted in intermediate responses where 55.6 % of the shoots rooted, forming 2.5 roots/shoots, 6.7 mm long roots, and the plantlets reached 31.7 mm in

ISSN: online 2617-2186 print 2617-2178

height. Incubation for 75 days, on the other hand, (76.4%), more roots per shoot (3.1 roots), longest roots (12.1mm long), and tallest plantlets (39.17 mm). Similarly, across all incubation periods, none of the shoots cultured on MS enriched with sucrose at 5 g/l produced roots, and the plantlets were the shortest (20.1 mm tall) of all sucrose concentrations. No significant difference between the plantlets' height in media enriched with sucrose at 10, 15, 20, 25, and 30 g/l (31.3 mm on average). In medium enriched with sucrose at 10 g/l, 35.4 % of the shoots rooted, forming 1.5 roots per shoot each 5.5 mm long, and the plantlets were 30.1 mm tall. No significant difference in rooting percentage in media enriched with sucrose at 15, 20, 25, and 30 g/l (68.75 % on average). Medium enriched with sucrose at 15 g/l resulted in highest root formation (3.8 roots) and medium enriched with sucrose at 10 g/l resulted in fewest roots (1.5 roots), while intermediate root formation (3 roots) was obtained in a media enriched with sucrose at 20 and 25 g/l. Medium enriched with sucrose at 20 g/l resulted in longest roots (11.5 mm) and those enriched with sucrose at 10 and 30 g/l resulted in shortest roots (5.4 mm), while intermediate root length (8.4 mm) obtained in media enriched with sucrose at 15 and 25 g/l.

Under 30 days of incubation, none of the shoots rooted in medium enriched with sucrose at 5 and 10 g/l and the plantlets were the shortest (15.7 mm) compared to plantlets rooted in the other sucrose concentrations (22.3 mm). The highest rooting percentage (67%) was obtained in medium enriched with sucrose at 25 g/l while the highest roots per shoot (3.4 roots) and longest roots (5.3 mm) were obtained in medium enriched with sucrose at 15 g/l. For 30 days incubation, the best sucrose enrichment was 25 g/l according to rooting percentage and 15 g/l according to the other parameters (root per shoot, root length, and plantlet height). Under 45 days of incubation also none of the shoots rooted in medium enriched with 5 g/l. The highest rooting percentage (75%), roots per shoot (4 roots) and longest roots (7 mm) were obtained in medium-enriched with sucrose at 15 g/l and the tallest plantlets (32.3 mm) were obtained in medium enriched with sucrose at 20 and 15 g/l while medium enriched with sucrose at 5 g/l resulted in the shortest plantlets (19 mm) and a medium enriched with sucrose at 10 g/l resulted in the lowest rooting percentage (16.7 %), fewest roots per shoot (1 root) and shortest roots (1.7 mm). For 45 days incubation, the best sucrose enrichment was 15 g/l according to all parameters. Under 60 days of incubation, none of the shoots rooted in medium enriched with 5 g/l. The highest rooting percentage (91.7%), roots per shoot (4 roots), and tallest plantlets (36.7 mm) were obtained in medium enriched with 20 g/l and the longest roots (11.7 mm) were obtained in medium enriched with sucrose at 25 g /l.

Table (1). Significant of main and interaction effect of incubation periods and sucrose concentrations on *in vitro* rooting response of Moris pineapple cultures on a liquid half-strength medium enriched with IBA at 2.0 mg/l.

Factors	df	Rooting parameters			
		Plantlet height	Rooting %	Root No.	Root length
Incubation periods	3	6.4E-08**	9.8E-06**	0.0500*	0.0002**
Sucrose	5	0.0015**	2.3E-10**	7.3E-07**	7.5E-05**
Incubation*Sucrose	15	0.8063	0.0879	0.4769	0.0054**
Error	48				
Total	72				

ISSN: online 2617-2186 print 2617-2178

Table (2). Effect of incubation periods and sucrose concentrations on *in vitro* rooting of Moris pineapple cultured on liquid half-strength MS medium enriched with IBA at 2.0 mg/l

Incubation periods	Sucrose concentrations (g/l)						
(Days)	5	10	15	20	25	30	Average
Plantlet height (mm)							
30	15.7 h	23.0 defgh	21.7 defgh	22.3 defgh	20.3 efgh	22.0 defgh	20.8 C
45	19.0 gh	28.0 cdefgh	32.3 abcdefg	31.3 abcdefg	19.7 fgh	25.7 defgh	26.0 C
60	21.3 defgh	34.0 abcdefg	36.0 abcde	36.7 abcd	29.7 bcdefgh	32.7 abcdefg	31.7 B
75	24.3 defgh	35.3 abcdef	43.0 abc	43.7 ab	46.3 a	42.3 abc	39.17 A
Average	20.1 B	30.1 A	33.3 A	33.5 A	29.0 A	30.7 A	
Rooting %							
30	0.0 f	0.0 f	50 bcde	41.7 cdef	66.7 abcd	33.3 cdef	32.0 D
45	0.0 f	16.7 ef	75 abc	50 bcde	66.7 abcd	50 bcde	43.1 C
60	0.0 f	25 def	75 abc	91.7 ab	75 abc	66.7 abcd	55.6 B
75	0.0 f	100 a	91.7 ab	100 a	91.7 ab	75 abc	76.4 A
Average	0.0 C	35.4 B	72.9 A	70.8 A	75.0 A	56.3 A	
Root No.							
30	0.0 d	0.0 d	3.4 abc	1.7 bcd	2.7 abcd	2.3 abcd	1.7 B
45	0.0 d	1 cd	3.7 abc	2.0 abcd	2.7 abcd	2.3 abcd	2.0 B
60	0.0 d	1 cd	4.0 ab	4 ab	3.3 abc	2.7 abcd	2.5 AB
75	0.0 d	4 ab	4.3 ab	4.7 a	3 abc	2.7 abcd	3.1 A
Average	0.0 D	1.5 C	3.8 A	3.1 AB	2.9 AB	2.5 BC	
Root length (mm)							
30	0.0 d	0.0 d	5.3 cd	3.7 cd	6 cd	3.0 cd	3.0 B
45	0.0 d	1.7 cd	7 bcd	5.7 cd	5.3 cd	5.7 cd	4.2 B
60	0.0 d	4.3 cd	10.7 bc	9.3 bcd	11.7 bc	4.7 cd	6.8 B
75	0.0 d	16 b	10.3 bcd	27.3 a	10.7 bc	8.0 bcd	12.1 A
Average	0.0 C	5.5 B	8.3 AB	11.5 A	8.4 AB	5.3 B	

Data were means of 15 shoots cultured at a density of 5 shoots per culture tube containing 6 ml of liquid, half-strength MS medium enriched with IBA at 2.0 mg/l.
Means of each rooting parameter followed by the same letters were not significantly different at $p \leq 0.05$ according to Duncan Multiple Range Test.

In summary, no rooting was obtained in medium enriched with 5 g/l no matter how long the shoots were incubated. None of the shoots in medium enriched with 10 g/l produced roots during the first 30 days of incubation, and only a few shoots rooted after 45 and 60 days. However, all shoots rooted if the incubation extended to 75 days. The lowest root formation (1 root per shoot) and root elongation (1.7 mm long) obtained in medium enriched with sucrose at 10 g/l and incubated for 45 and 60 days and the shortest plantlets (15.7 mm) obtained in medium enriched with sucrose at 5 and 10 g/l for 30 days. The highest rooting percentage (100 %), the highest root formation (4.7 roots/shoot), root elongation (27.3 mm) and tallest plantlets (46.3 mm) were all obtained after 75 days incubation but at different sucrose enrichment, 10, 20, 20 and 25 g/l respectively.

DISCUSSION

Enrichment of medium with sucrose at 30 g/l and incubation for 30 days which is the most common practice for *in vitro* rooting was not the proper treatment for Moris pineapple. It resulted in the rooting of only 33 % of the shoots, and the plantlets were shorter than 25 mm. At any fixed incubation period sucrose at 15, 20 and 25 g/l were a better choice for rooting than sucrose at 30 g/l, and at any fixed sucrose content any incubation periods resulted in a better rooting response than the 30-day long incubation (Table

ISSN: online 2617-2186 print 2617-2178

2). Out of 24 combinations of sucrose concentrations and incubation periods, sucrose at 30 g/l and incubation for 30 days resulted in lower a rooting percentage than 15 of the combinations, shorter plantlets than 13, fewer roots than 8, and shorter roots than 9 of the tested combinations. Incubation for 75 days was the best incubation period for all rooting parameters. However, each parameter had different optimal sucrose concentration. The tallest plantlets (46.3 mm) were obtained in medium enriched with sucrose at 25 g/l, the highest (4.7 roots) and the longest (27.3 mm) roots were obtained in medium enriched with sucrose at 20 g/l, while the highest rooting percentage (100 %) was obtained in medium enriched with sucrose at 10 and 20 g/l. Not only at each incubation period different rooting parameters had different optimum sucrose, but also the same rooting parameter had different optimum sucrose at different incubation periods. The best sucrose concentration for the highest rooting percentage of shoots incubated for 30, 45, 60, and 75 days was 25, 15, 20, and 10 g/l respectively. On the contrary, the best sucrose concentration for plantlet height of the shoot incubated for 30, 45, 60 and 75 days was 10, 15, 20, and 25g/l respectively. The optimum sucrose concentration for root formation (root number) and root elongation (root length) if shoots were incubated for 30, 45, and 60 days was 15 g/l, and if shoots were incubated for 75 days was 20 g/l.

Since different rooting parameters have different optimum combinations of sucrose and incubation periods, different combinations could be recommended depending on whether one, two, or all of the parameters were used for assessment. For obtaining over 90 % rooting and roots longer than 10 mm, the choice would be between sucrose at 10 g/l and incubation for 75 days and sucrose at 15 g/l and incubation for 60 days. For the formation of more than three roots per shoot, the choice is sucrose at 10 g/l and incubation for 75 days and sucrose at 15 and incubation for 30 days. Plantlets obtained after 45 days of incubation in medium enriched with sucrose at 15 and 20 g/l and after 60 and 75 days of incubation irrespective of sucrose enrichment were taller than 35 mm. Sucrose at 15 g/l and incubation for 45 days and sucrose at 10 g/l and incubation for 60 days was the best compromise for lowest sucrose and shortest incubation in which plantlets were taller than 35 mm. The combination of sucrose and incubation for lowest cost of rooting (Table, 3) appears to be one of the following: the low sucrose level of 10 g/l but longer incubation of 75 days, intermediate sucrose of 15 g/l and shortest incubation of 45 days and high sucrose of 20 g/l and intermediate incubation of 60 days. Low sucrose reduces the sucrose cost, but long incubation increases the monthly electricity bill. Selection among these alternatives would depend on the cost of each added or saved 5 g/l of sucrose and the electricity bill of each increase or decrease of 15 days of incubation according to the price prevailed in the district at which the propagation takes place. The calculation of cost (Table, 3) showed that the cost of rooting was mainly due to incubation periods more than the concentration of sucrose. At a density of 5 shoots per culture, the minimum rooting cost per shoot was 3.95 cents, obtained when the shortest incubation (30 days) and lowest sucrose (5 g/l) was applied while the highest cost was 5.88 cents when the longest incubation (75 days) and highest sucrose (30 g/l) was applied. At any incubation period, the difference in rooting cost per shoot at different sucrose concentrations was negligible (less than 0.02 cents), while incubation of 30 days decreased the cost by 2 cents compared to 75 days of incubation. In a previous report, we estimated the multiplication cost per shoot after 4 cycles of multiplication to be 0.9 (Hamad, 2017a) and if one liter of medium was used, to be 1.6 (Hamad, 2017b) cents. This study showed that the rooting cost per shoot (rooting stage) ranges from 3.95 to 5.88 cents, which is 2 to 6 times the multiplication cost per shoot (multiplication stage). Hence, to efficiently minimize the cost of micropropagation, the effort should be concentrated on reducing the cost of rooting rather than the cost of multiplication. Otherwise, the complaints about the high cost of micropropagated materials would always be there even if the

ISSN: online 2617-2186 print 2617-2178

multiplication was fully automated and at the highest rate.

Table (3). Effect of incubation periods and sucrose concentrations on the rooting cost per shoot of Moris pineapple

Incubation periods	Sucrose concentration (g/l)						
(Days)	5	10	15	20	25	30	Average
	Rooting cost per shoot (cents)						
30	3.95	3.97	3.98	4.00	4.02	4.03	3.99
45	4.57	4.58	4.60	4.62	4.63	4.65	4.61
60	5.18	5.20	5.21	5.23	5.25	5.26	5.22
75	5.80	5.81	5.83	5.85	5.86	5.88	5.84
Average	4.87	4.89	4.91	4.92	4.94	4.96	4,92

Mediums were prepared in glass jars, autoclaved at 121^0C and 1.5 kg/cm^2 for 20 minutes and dispensed into culture tubes under a laminar cabinet. Shoots were rooted at a density of 5 shoots per culture tubes containing 6 ml of liquid half-strength MS medium enriched with IBA at 2.0 mg/l. and incubated under constant temperature (25^0C and 16 hours of light provided by cool white fluorescent lamps.

The selection of the best combination of incubation and sucrose should depend on whether the purpose of the experiment would be the reduction of propagation cost and obtaining plantlets that could survive acclimatization or physiological study of rooting. Minimum sucrose and shorter incubation which result in plantlet quality above that required for highest acclimatization survival are very important for low-cost micropropagation, while the determination of the time at which rooting takes place, and monitoring of increase in root number and length, and plantlet height over time, are important for the physiological study of roots and proper timing of histological and physiobiochemical analysis. Published studies did not elaborate on the relationship between rooting percentage, root per shoot and root length, and plantlet survival. It is not known which one or two of these parameters are very crucial for the survival of acclimatization. (Escalona et al., 1999) reported that the survival percentage of *ex vitro* acclimatized rootless shoots increased from 20 to 100 % as the size of the shoots increased from 20 to 80 mm long. (Be & Debergh, 2006; Dal Vesco et al., 2001; DeWald et al., 1988; Ko et al., 2006; Soneji et al., 2002a) respectively reported that over 90 % of 35, 50, 60, 70 and 80 mm long-rooted pineapple shoots survived the acclimatization stage. For pineapple, plantlet height is probably more crucial for acclimatization survival. Therefore, the selection should be for a combination of sucrose and an incubation period that results in plantlets taller than the minimum required height (35 mm) for survival at the lowest cost. If plantlets taller than 35 mm are suitable for successful acclimatization, there will be two combinations of sucrose and incubation period (sucrose at 15 g/l and 60 days and sucrose at 15 g/l and 75 days) to choose from.

But if the plantlet has to be taller than 40 mm, sucrose at 15 g/l and incubation for 75 days is the cheapest combination. In this study, all of the plantlets obtained after each incubation, irrespective of sucrose enrichments and its rooting response, were used for acclimatization. Following Hamad, (2016) recommendation, plantlets were placed in pots full of sand under a polyethylene enclosure for 21 days and a shade house for 60 days. The survival of plantlets that were rooted for 30, 45, 60 and 75 days was 70.0; 80.5; 84.5, and 94.3 % respectively. Some of the plantlets of the 30 days incubation were rootless, and some were with fewer and shorter roots and the plantlets were less than 35 mm in height. The low survival of these plantlets (70 %) may be due to one or more of these rooting parameters. If the survival of acclimatization is not of major interest, as in the case of physiological study of rooting, different sucrose enrichment has to be used at different incubation periods depending on which parameter was of major interest. After 45 days incubation, sucrose at 15 g/l, and after 60 days of incubation, sucrose at 20 g/l was the best enrichment for obtaining taller plantlets, highest rooting percentage and

ISSN: online 2617-2186 print 2617-2178

more and longest roots while after 30 and 75 days of incubation, three sucrose enrichments could be used depending on the parameter of major interest. In the case of 30 days incubation, sucrose at 10 g/l for tallest plantlet, sucrose at 25 g/l for highest rooting percentage, sucrose at 15 g/l for more and longer roots, while in the case of 75 days incubation, sucrose at 25 g/l for tallest plantlets, sucrose at 10 g/l for highest rooting percentage and sucrose at 20 g/l for more and longer roots.

The optimum sucrose for rooting percentage under 30, 45, 60, and 75 days of incubation was 25, 15, 20 and 10 g/l (Table, 2). On the contrary, the optimum sucrose for plantlet height under 30, 45, 60, and 75 days of incubation was 10, 15, 20, and 25 g/l. This means that high sucrose enrichments improved shoot rooting (rooting percentage) under a short incubation regime but retarded the shoot growth (plantlet height). While under a long incubation regime they retarded shoot rooting but improved shoot growth. This indicated that the two processes of root initiation and plantlet elongation did not occur simultaneously, but one of them followed the other. Under low sucrose enrichment, the shoot directed the sucrose use for shoot growth and then for root initiation, and under high sucrose enrichment, the shoot directed the sucrose use first for root initiation and then for shoot growth. Both of the two parameters increased as the incubation periods increase up to 75 days, but the time at which most shoots rooted and the highest increase in plantlet height occurred varied over each 15 day period among the different combinations of incubation period and sucrose concentration. Being that no rooting occurred in medium enriched with 5 g/l even if the incubation period increased to 75 days while the plantlet height reached 24 mm tall indicated that initiation of the rooting process in the presence of 5 g/l requires shoots longer than 24 mm. Failure of shoots to form roots for the first 30 days in medium enriched with sucrose at 10 g/l while 75 % of shoots form roots in the period between 60 and 75 days indicated that the shoot length limit for rooting in the presence of sucrose at 10 g/l is 35 mm long shoots. Noticing the period at which 50 % of the shoots rooted indicated that the required shoot length for rooting in medium enriched with 15, 20, and 20 g/l was 22 mm. Similarly, it can be noticed that the required shoot length for rooting of over 75 % of shoots in medium enriched with 10, 15, 20, 25, and 30 g/l was 35, 32, 37, 30, and 42 mm respectively. It seemed that the rooting started after the shoots attain a certain size, and the sucrose is not involved in rooting directly, but by enhancing the shoot to reach the size required for the shoot to gain root forming ability.

Sucrose was involved in controlling the time at which the root initiation occurred and also the pattern of root formation and elongation over time. In medium enriched with sucrose at 5 g/l, the shoots failed to root even if the incubation extended to 75 days. In medium enriched with sucrose at 10 g/l, no rooting occurred in the first 30 days and only 25 % rooted in the first 60 days of incubation, but all of the shoots rooted when the incubation extended to 75 days. That is, 75 % of rooting occurred in the last 15 days of incubation. Incubation shorter than 75 days will result in poor rooting. On the contrary, in medium enriched with sucrose at 15 g/l, 75 % of rooting occurred within the first 45 days of incubation, no rooting occurred in the period between 45 and 60 days and only 17 % rooted in the period between 60 and 75 days of incubation. Under this sucrose enrichment, incubation should be terminated after 45 days. In medium enriched with sucrose at 20 and 25 g/l, 92 % of shoots rooted within the first 60 days and only 8 % rooted in the period between 60 and 75 days of incubation. In medium enriched with sucrose at 30 g/l, 67 % of shoots rooted in 60 days, 8 % in the period between 60 and 75 days, and 25 % of the shoots failed to root even if the incubation extended to 75 days. That is if the medium is enriched with sucrose at 20, 25, and 30 g/l the incubation should be terminated after 60 days of incubation.

Similarly, depending on sucrose enrichment, the process of root formation (root number)**,** and elongation **(**root length**)** ranged from did not start, stopped after 30, 45 or 60, days to be a continu-

ISSN: online 2617-2186 print 2617-2178

ous process for 75 days. In medium enriched with sucrose at 10 g/l, no root formation occurred in the first month and most of the roots occurred in the last 15 days of the 75 days incubation (60 to 75 days). On the contrary, in medium enriched with sucrose at 30 g/l, shoot rooting occurred in the first month and no root formed after that even if the incubation extended to 75 days. In medium enriched with sucrose at 15 and 25 g/l, root formation occurred in alternative cycles. Root formation occurred in the first month of incubation and the period between 45 – 60 days, and no formation occurred in the period between 30- 45 and 60- 75 days of incubation. In medium enriched with sucrose at 20 g/l, root formation was a non-stop continuous process of alternative slow and fast root growth over 75 days of incubation. Similarly**,** root elongation was also a continuous non-stop process for 75 days in medium enriched with 10 and 20 g/l. However, in medium enriched with sucrose at 15, 25, and 30 g/l no root elongation occurred after 60 days of incubation. Daily and weekly records of the changes in rooting parameters would determine the time of fast, slow and no growth, and the best time for histological and biochemical analysis.

Although the weight and length of the shoots used during rooting were not taken into consideration,(Ramirez-Malagon et al., 2001) found that heavy shoots of *Spathiphyllum floribundum* obtained during multiplication had a higher chance of survival during acclimatization. Hamad (2017c) found that the period of the highest increase in shoot weight and length of Smooth cayenne pineapple over each 15 days of 105 days of incubation varied depending on the hormone treatments and occurred after the shoots incubated for more than 45 days. Weight, length, and density of shoots at the beginning of the rooting stage may have great influence in its rooting response to sucrose and incubation period and proposed for future testing. (Hamad et al., 2013) found that the different rooting parameters of Moris pineapple had different optimum hormone type and concentration and medium strength and the rooting percentage ranged from 30 to 100 %, root number from 1 to 10 roots, root length from 5 to 65 mm and plantlet height from 19 to 65 mm. For taller plantlets they recommended the use of IBA at 0.5 mg/l in quarter strength solid MS and IAA at 2.5 mg/l in full strength liquid MS. Quarter strength MS and IAA at 2.5 mg/l is suggested for future testing in combination with shoots of different length and density under different photoperiods at 5, 10 and 15 grams of sucrose per liter of medium over 30 and 45 days of incubation. Such testing may come up with a treatment that overcomes the no rooting in medium enriched with sucrose at 5 g/l and incubated for 30 days, or shorten the incubation in medium enriched with sucrose at 10 g/l from 75 to 30 days and would reduce the cost and result in plantlets with the quality required for survival of acclimatization.

REFERENCES

Almeida, W., De Matos A., and Souza A. d. S. (1997). Effects of benzylaminopurine (BAP) on in vitro proliferation of pineapple (Ananas comosus (L.) Merr.). Pages 235-242 *in* II International Pineapple Symposium 425.

Almeida, W. A. B. D., Santana, G. S., Rodriguez, A. P., & Costa, M. A. P. D. C. (2002). Optimization of a protocol for the micropropagation of pineapple. *Revista Brasileira de Fruticultura, 24*(2), 296-300.

Amin, M., Rahman, M., Rahman, K., Ahmed, R., Hossain, M., & Ahmed, M. (2005). Large Scale Plant Regeneration in vitro from Leaf Derived Callus Cultures of Pineapple [Ammas comosus (L.) Merr. cv. Giant Kew].

Aydieh, A., Ibrahim, M., & Ibrahim, A. (2000). In vitro propagation and fruiting of pineapple. *Egyptian Journal of Horticulture, 27*(3), 289-304.

Be, L., & Debergh, P. (2006). Potential low-cost micropropagation of pineapple

ISSN: online 2617-2186 print 2617-2178

(Ananas comosus). *South African Journal of Botany, 72*(2), 191-194.

Bhatia, P., & Ashwath, N. (2000). Development of a rapid method for micropropagation of a new pineapple [Ananas comosus (l.) Murr.] clone,'Yeppoon gold'. International Symposium on Tropical and Subtropical Fruits 575,

Dal Vesco, L. L., de Almeida Pinto, A., Zaffari, G. R., Nodari, R. O., dos Reis, M. S., & Guerra, M. P. (2001). Improving pineapple micropropagation protocol through explant size and medium composition manipulation. *Fruits, 56*(3), 143-154.

Danso, K., Ayeh, K., Oduro, V., Amiteye, S., & Amoatey, H. (2008). Effect of 6-benzylaminopurine and naphthalene acetic acid on in vitro production of MD2 pineapple planting materials. *World Applied Sciences Journal, 3*(4), 614-619.

De Almeida, W., De Matos, A., & Souza, A. d. S. (1997). Effects of benzylaminopurine (BAP) on in vitro proliferation of pineapple (Ananas comosus (L.) Merr.). II International Pineapple Symposium 425,

DeWald, M., Moore, G., Sherman, W., & Evans, M. (1988). Production of pineapple plants in vitro. *Plant cell reports, 7*(7), 535-537.

Escalona, M., Lorenzo, J., González, B., Daquinta, M., González, J., Desjardins, Y., & Borroto, C. (1999). Pineapple (Ananas comosus L. Merr) micropropagation in temporary immersion systems. *Plant cell reports, 18*(9), 743-748.

Fitchet, M. (1990). Clonal propagation of Queen and Smooth Cayenne pineapples. International Symposium on the Culture of Subtropical and Tropical Fruits and Crops 275,

Gangopadhyay, G., Bandyopadhyay, T., Poddar, R., Gangopadhyay, S. B., & Mukherjee, K. K. (2005). Encapsulation of pineapple micro shoots in alginate beads for temporary storage. *Current Science*, 972-977.

Hamad, A. M. (2016). Effect of peatmoss and sand mixing ratio on the acclimatization of Smooth cayenne pineapple (*Ananas comosus* (L) Merr.). *J. of Science and Humanities*, 22: 1-6.

Hamad, A. M. (2017a). Effect of incubation periods, medium volumes and explants density on the *in vitro* shoot formation and growth and cost of multiplication of Moris pineapple. *El Mukhtar J. of Sciences,* 33 (1): 10 -16.

Hamad, A. M. (2017b). Effect of explants density, medium volumes and subcultures on the in vitro shoot formation and cost of multiplication of Moris pineapple (*Ananas comosus* L. Merr). *Libyan J of Basic Science*s 7 (1): 78- 90.

Hamad, A. M. (2017c). Biweekly changes in the *in vitro* shoot formation and growth pattern of pineapple (*Ananas comosus* L Merr) cv Smooth cayenne over 105 days of incubation on different hormone treatments. *Globial Libyan J.* 18: 1- 17

Hamad, A. M., and Taha R. M. (2008). Effect of sequential subcultures on in vitro proliferation capacity and shoot formations pattern of pineapple (Ananas comosus L. Merr.) over different incubation periods. Scientia Horticulturae 117(4):329-334.

Hamad, A. M., Taha R. M., and Mohajer S. (2013). In vitro induction and proliferation of adventitious roots in

ISSN: online 2617-2186 print 2617-2178

pineapple (Ananas comosus L.) cultivars of smooth cayenne and morris. Australian Journal of Crop Science 7(7):1038-1045.

Hamad, A. H. M., Taha, R. M., & Mohajer, S. (2013). In vitro induction and proliferation of adventitious roots in pineapple (Ananas comosus L.) cultivars of smooth cayenne and morris. *Australian Journal of Crop Science, 7*(7), 1038-1045.

Hamad, A. M., & Taha, R. M. (2008). Effect of sequential subcultures on in vitro proliferation capacity and shoot formations pattern of pineapple (Ananas comosus L. Merr.) over different incubation periods. *Scientia Horticulturae, 117*(4), 329-334.

Khan, S., Nasib A., and Saeed B. A. (2004). Employment of in vitro technology for large scale multiplication of pineapples (Ananas comosos). Pakistan Journal of Botany 36(3):611-616.

Khatun, M., Khanam D., Hoque M., and Quasem A. (1997). Clonal propagation of pineapple through tissue culture. Plant Tissue Cult 7(2):143-148.

Ko, H., Campbell P., Jobin-Décor M., Eccleston K., Graham M., and Smith M. (2006). The introduction of transgenes to control blackheart in pineapple (Ananas comosus L.) cv. Smooth Cayenne by microprojectile bombardment. Euphytica 150(3):387.

Kofi, O., and Adachi T. (1993). Effect of cytokinins on the proliferation of multiple shoots of pineapple in vitro. SABRAO Journal 25(1):59-69.

Mathews, V. H., and Rangan T. (1979). Multiple plantlets in lateral bud and leaf explant in vitro cultures of pineapple. Scientia Horticulturae 11(4):319-328.

Mathews, V. H., and Rangan T. (1981). Growth and regeneration of plantlets in callus cultures of pineapple. Scientia Horticulturae 14(3):227-234.

Mengesha, A., Ayenew B., and Tadesse T. (2013). Energy sources affect in vitro propagation and subsequent acclimatization of Ananas comosus, var. smooth cayenne plants. The Journal of Microbiology, Biotechnology and Food Sciences 2(6):2372

Murashige, T. and F. Skoog. 1962. A revised medium for rapid growth and bioassay with tobacco tissue. Physiol. Plan/ 1962, 15: 473- 497

Ramirez-Malagon, R., Borodanenko A., Barrera-Guerra J. L., and Ochoa-Alejo N. (2001). Shoot number and shoot size as affected by growth regulators in in vitro cultures of Spathiphyllum floribundum L. Scientia Horticulturae 89(3):227-236.

Singh, D., and Manual A. (2000). Assessment of pineapple plants developed from micropropagation instead of conventional suckering. Tropical Science 40(4):169-173.

Soneji, J. R., Rao P., and Mhatre M. (2002a). In vitro Regeneration from Leaf Explants of Pineapple (Ananas comosus L, Merr). Journal of plant biochemistry and biotechnology 11(2):117-119.

Soneji, J. R., Rao P., and Mhatre M. (2002b). Somaclonal variation in micropropagated dormant axillary buds of pineapple (Ananas comosus L., Merr.). The Journal of Horticultural Science and Biotechnology 77(1):28-32.

Souza, F. V. D., Da Silva M. D. J., Souza A. D. S., and Costa M. A. P. D. C. (2016). Growth regulators and physical state of

ISSN: online 2617-2186 print 2617-2178

culture media in the micropropagation of ornamental pineapple hybrids. Plant Cell Culture & Micropropagation 8(1-2):10-17.

Sripaoraya, S., Marchant R., Brian Power J., and Davey M. R. (2003). Plant regeneration by somatic embryogenesis and organogenesis in commercial pineapple (Ananas comosus L.). In Vitro Cellular and Developmental Biology-Plant 39(5):450-454.

Sunitibala Devi, Y., Mujib A., and Kundu S. (1997). Efficient regenerative potential from long term culture of pineapple. Phytomorphology 47(3):255-259.

Teng, W.-L. (1997). An alternative propagation method ofAnanas through nodule culture. Plant cell reports 16(7):454-457.

Khan, S., Nasib, A., & Saeed, B. A. (2004). Employment of in vitro technology for large scale multiplication of pineapples (Ananas comosos). *Pakistan Journal of Botany, 36*(3), 611-616.

Khatun, M., Khanam, D., Hoque, M., & Quasem, A. (1997). Clonal propagation of pineapple through tissue culture. *Plant Tissue Cult, 7*(2), 143-148.

Ko, H., Campbell, P., Jobin-Décor, M., Eccleston, K., Graham, M., & Smith, M. (2006). The introduction of transgenes to control blackheart in pineapple (Ananas comosus L.) cv. Smooth Cayenne by microprojectile bombardment. *Euphytica, 150*(3), 387.

Kofi, O., & Adachi, T. (1993). Effect of cytokinins on the proliferation of multiple shoots of pineapple in vitro. *SABRAO Journal, 25*(1), 59-69.

Mathews, V. H., & Rangan, T. (1979). Multiple plantlets in lateral bud and leaf explant in vitro cultures of pineapple. *Scientia Horticulturae, 11*(4), 319-328.

Mathews, V. H., & Rangan, T. (1981). Growth and regeneration of plantlets in callus cultures of pineapple. *Scientia Horticulturae, 14*(3), 227-234.

Mengesha, A., Ayenew, B., & Tadesse, T. (2013). Energy sources affect in vitro propagation and subsequent acclimatization of Ananas comosus, var. smooth cayenne plants. *The Journal of Microbiology, Biotechnology and Food Sciences, 2*(6), 2372.

Ramirez-Malagon, R., Borodanenko, A., Barrera-Guerra, J. L., & Ochoa-Alejo, N. (2001). Shoot number and shoot size as affected by growth regulators in in vitro cultures of Spathiphyllum floribundum L. *Scientia Horticulturae, 89*(3), 227-236.

Singh, D., & Manual, A. (2000). Assessment of pineapple plants developed from micropropagation instead of conventional suckering. *Tropical Science, 40*(4), 169-173.

Soneji, J. R., Rao, P., & Mhatre, M. (2002a). In vitro Regeneration from Leaf Explants of Pineapple (Ananas comosus L, Merr). *Journal of plant biochemistry and biotechnology, 11*(2), 117-119.

Soneji, J. R., Rao, P., & Mhatre, M. (2002b). Somaclonal variation in micropropagated dormant axillary buds of pineapple (Ananas comosus L., Merr.). *The Journal of Horticultural Science and Biotechnology, 77*(1), 28-32.

Souza, F. V. D., Da Silva, M. D. J., Souza, A. D. S., & Costa, M. A. P. D. C. (2016). Growth regulators and physical state of culture media in the micropropagation of ornamental pineapple hybrids. *Plant*

ISSN: online 2617-2186 print 2617-2178

Cell Culture & Micropropagation, 8(1-2), 10-17.

Sripaoraya, S., Marchant, R., Brian Power, J., & Davey, M. R. (2003). Plant regeneration by somatic embryogenesis and organogenesis in commercial pineapple (Ananas comosus L.). *In Vitro Cellular and Developmental Biology-Plant, 39*(5), 450-454.

Sunitibala Devi, Y., Mujib, A., & Kundu, S. (1997). Efficient regenerative potential from long term culture of pineapple. *Phytomorphology, 47*(3), 255-259.

Teng, W.-L. (1997). An alternative propagation method ofAnanas through nodule culture. *Plant cell reports, 16*(7), 454-457.

ISSN: online 2617-2186 print 2617-2178

مجلة المختار للعلوم 34 (4): 275-287، 2019

تأثير تركيزات السكروز وطول فترة التحضين على تجذير الأناناس صنف Moris (أناناس كوموسوس) مخبرياً

عبد الحميد مختار حمد

قسم البستنه، كلية الزراعة، جامعة عمر المختار، البيضاء –ليبيا

تاريخ الاستلام: 19 يوليو 2018 / تاريخ القبول: 1 ديسمبر 2019

Doi:https://doi.org/10.54172/mjsc.v34i4.145

المستخلص: اختبر تأثير ستة تركيزات من السكروز (5، 10، 15، 20، 25 و 30 جرام/لتر) وأربع فترات تحضين (30، 45، 60 و 75 يوماً) في تجذير فريع أناناس صنف Moris مخبريا والمزروع في نصف قوة وسط موريسيوز و سكوق MS المزود بهرمون IBA بتركيز 2.0 مل/ لتر. في كل فترات التحضين الأربعة فإن الفريعات المزروعة في الوسط المزود بسكروز بتركيز 5 جرام/لتر فشلت في تكوين جذور. كذلك لم تتكون جذور في الوسط المزود بسكروز بتركيز 10 جرام/لتر خلال 30 يوماً من التحضين. بعد 30 يوماً من التحضين أعلى نسبة تجذير (66 %) وأطول نبيته (23 ملم) وأكثر عدد (3.4 جذر) وأطول (5.3 ملم) جذور تم الحصول عليها في وسط مزود بسكروز بتركيز 25، 10، 15، و15 جرام/لتر على التوالي، بينما بعد 45 يوماً من التحضين فإن أعلى قيمة لأي وجه من أوجه التجذير الأربعة (75 % ، 32.3 ملم ، 3.7 جذر ، بطول 7 ملم) تم الحصول عليها في وسط مزود بسكروز بتركيز 15 جرام / لتر. بعد 60 يوماً أعلى نسبة تجذير (91.7 %) وأطول نبيته (36.7 ملم) تم الحصول عليهما في وسط مزود بسكروز بتركيز 20 جرام/لتر بينما أكثر عدد (3.7 جذر) وأطول (10.7 ملم) جذور تم الحصول عليها في وسط مزود بسكروز بتركيز 15 جرام/لتر. بعد 75 يوماً كل الفريعات أعطت جذوراً (100 %) عندما كان الوسط مزوداً بسكروز بتركيز 10 وتركيز 20 جرام/لتر بينما تزويد الوسط بسكروز بتركيز 25 جرام/لتر أدى للحصول على أطول نبيته (46.3 ملم) وسكروز بتركيز 20 جرام/لتر أدى إلى أكبر عدد (4.7 جذور) وأطول (27.3 ملم) جذور. عند كل طول فترة تحضين هناك تركيز مثالي مختلف من السكروز لكل وجه من أوجه التجذير المختلفة.

الكلمات المفتاحية: سكروز، فترة التحضين، التجذير مخبرياً، الأناناس، أناناس كوموسوس.

*عبد الحميد مختار الرفادي: abdelhamidhamad@gmail.com قسم البستنه، كلية الزراعة، جامعة عمر المختار، البيضاء–ليبيا

Al-Mukhtar Journal of Sciences 34 (4): 288-292, 2019

Safety and Effectiveness of Total Thyroidectomy for Benign Multinodular Goitre

Naser Musbah, Hasan I. Fadel Saad* and Salma Saleh Mohamed.

Department Of Surgery, Faculty Of Medicine Omer-Al Mukhtar University, Al-Bayda- Libya

Received: 08 April 2019/ Accepted: 30 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.171

Abstract: Total thyroidectomy is considered the best choice for thyroids carcinoma. However, it is still controversial for benign thyroid diseases because of higher complication rates. But meticulous surgical techniques by expert surgeons can avoid most of the complications and thereby avoid the risk of reoperation for any recurrences. The objective of the study was to evaluate and justify the use of total thyroidectomy in benign thyroid diseases especially in multinodular goiter and Grave's disease. We have carried out an ongoing prospective study of thyroidectomy cases for different indications over a span of 5 years, from 2012 to 2016; in the Surgery department, Al-Thowra teaching hospital, Al-Bayda. The total number of operated cases was 353. Cases were distributed according to age, sex, diagnosis and operative procedures. Various complications encountered were enlisted. Total thyroidectomy was performed in 247 cases for MNG and Thyroid malignancy. Hemithyroidectomy or lobectomy was done in 82 cases for solitary nodules. Enucleation of cysts was done in 6 cases. Operations were done for recurrent nodules in 18 cases. Overall complications were few and only minor. We recommend total thyroidectomy for all cases of MNG; which will reduce the risk of recurrence and development of malignancy in residual thyroid tissue. It also can prevent secondary thyrotoxicosis.

Keywords: MNG, Malignant thyroid, Total thyroidectomy.

INTRODUCTION

The goiter is a term used for abnormal thyroid gland enlargement which may be physiological due to repeated physiological stress as in puberty, pregnancy and during lactation or pathological. It is a common endocrine problem in especially endemic mountainous areas like our city, mainly due to iodine deficiency. The term nodular goiter either multiple or solitary which means the presence of a solitary nodule or multiple nodules termed as discrete thyroid nodules. The multinodular goiter is a common benign thyroid pathology, where the thyroid gland affected by several different size nodules which is a more common condition than diffuse enlargement goiter, thyroiditis, cysts, and solitary nodule. The functional disorders of the thyroid gland which may be due to an increase in the secretion of thyroxin (toxic) or a decrease in the hormone level in the blood (hypothyroidism). Of course, different types of thyroid carcinomas (like papillary, follicular, anaplastic and medullary carcinomas) are also seen. The main indication for total thyroidectomy is the presence of cancer in the thyroid gland, also used for multinodular goiter and grave's disease.

The increasing use of total thyroidectomy in this decade for the treatment of benign thyroid diseases because of higher incidences of recurrence which may require reoperation for thyroid gland may by dangerous and risky in such cases. Many surgeons perform conservative thyroid surgery rather than total thyroidectomy for benign thyroid diseases to decrease the risk of postoperative hypothyroidism and recurrent laryngeal nerve injury. This controversy still exists

***Corresponding Author:** Hasan I. Fadel Saad *hasanfadeel70@gmail.com*, Department Of Surgery, Faculty Of Medicine Omer-Al Mukhtar University, Al-Bayda- Libya

between thyroid surgeons regarding the use of total or conservative thyroid surgery. Yang W, Shao T on 2009 stated; total thyroidectomy provides decisive advantages over partial or subtotal thyroidectomies in terms of recurrence and reoperation rate with comparable postoperative complications (Tezelman et al., 2009; Yang et al., 2009). Efremidou El, Papageorgiou MS, 2009 reviewed 932 total thyroidectomies performed for benign thyroid diseases when surgery was indicated. And inferred that, total thyroidectomy is safe and is associated with a low incidence of disabilities and complications comparable with the endocrine surgery unit (Efremidou et al., 2009).

(Mauriello et al., 2016) stated that the Dunhill procedure seems to be a good compromise between radially and prevention of complications, avoiding reoperation for recurrence or completion thyroidectomy for incidental thyroid carcinoma but needs more study for benign thyroid diseases (Mauriello et al., 2016). This study aimed to evaluate and justify the use of total thyroidectomy in benign thyroid diseases especially in multinodular goiter and diffuse hyperplastic goiter.

MATERIALS AND METHODS

This study was carried out in El-Thowra teaching hospital, Al-Bayda, Libya over a span of 5 years, starting from 2012 up to 2016. This has been an ongoing prospective study.

The total number of cases that were operated on was 353. Year, age and sex were studied. The investigations carried out are routine hematological investigations CBC, Thyroid function test, and FNAC, Chest X-Ray, ECG, and indirect laryngoscopy in a selected number of cases where there were compression symptoms (23 cases). FNAC was done in all cases of solitary thyroid nodules or dominant thyroid nodules or cysts; before surgery to exclude malignancy. Diagnosis of Thyroid disease cases are presented in Table 1.

Indications for thyroidectomy: goiter with compression features, multinodular goiter with toxicity, patient demand: because of huge size, and fear of developing toxicity or malignancy and malignant neoplasm. The surgical procedures carried out: total thyroidectomy (247) cases, hemi thyroidectomy / lobectomy (82) cases, enucleation of cysts (6 cases) and re-operation for recurrent thyroid nodule (18 cases). Different surgical procedures carried out are presented in Table 1

RESULTS

The total number of cases operated for thyroid disease was 353. Out of which; total thyroidectomy was done in 247 cases for MNG and malignancy. Hemi thyroidectomy or lobectomy was done in 82 cases for solitary nodule. Enucleation of cysts was done in 6 cases; where the cysts were either composite or recurred after 3 times aspiration. Operations was done for recurrent nodules in 18 cases. Overall complications were minor and few.

Complications encountered in our study: Hematoma: 3 cases, which appeared within 48 hours after removal of drain. All, hematoma cases were evacuated under GA. Hypocalcaemia: 4 cases showed clinical features of tetany 5 days postoperatively and were hospitalized for treatment with injectable calcium gluconate. They have recovered. Hoarseness of voice: 9 cases of which 3 cases were operated for recurrence of goiter or tumors. Initially, they were put on injectable Hydrocortisone for 3 days with a tapering dose and subsequently slowly tapered. All of them recovered within a span of 8 to 12 weeks. Wound infection: 2 cases, where one of them was put on antibiotic treatment. Complications encountered in our study are presented in Table 1.

ISSN: online 2617-2186 print 2617-2178

Table:(1). Diagnosis, surgical procedures and complications

diagnosis	Number of cases	percentage
MNG	221	62.60%
Solitary adenoma	82	23.22%
Composite cyst / recurrence after 3 aspirations	6	1.69%
Recurrence of thyroid nodule	18	5.09%
Malignancy	26	7.37%
Toxicity	39	11.04%
Types of surgery		
-Total thyroidectomy	247	69.97%
-Hemithyroidectomy/ lobectomy	82	23.22%
-Enucleation of cyst	6	1.69%
-Reoperation for recurrent thyroid nodule	18	5.09%
Complications :		
-Haematoma formation	3	0.84%
-hypocalcaemia	4	1.13%
-Hoarseness of voice	9	2.54%
-Wound infection	2	0.56%

DISCUSSION

Normally partial or subtotal thyroidectomy is done in cases of MNG; to avoid complications such as injury to the RLN or parathyroid glands. Secondly, patients have to take thyroxine lifelong; which is costly and the patient must be educated enough to understand the importance of continuing the medicine regularly. Padur AA, Kumar N in 2016 stated in their review article regarding the appropriateness and safety of total thyroidectomy and compared with sub-total thyroidectomy and other thyroid surgeries. Many retrospective studies and few prospective studies suggested that the incidence of transient hypocalcaemia is higher after total thyroidectomy than after subtotal thyroidectomy, but the incidence of other complications including recurrent laryngeal nerve palsy and postoperative haematoma is not significantly different between the two procedures (Padur et al., 2016). Hence, in our review study, we found that total thyroidectomy is safe and cost-effective with low complication rates and provides a small yet significant advantage of being a safer procedure compared to subtotal thyroidectomy. (Rosto et al., 2000) have reviewed 14,934 thyroidectomies performed in 42 surgery units in Italy; compared the complications associated with total thyroidectomy versus subtotal thyroidectomy with unilateral and bilateral remnants.

The cases reviewed consisted of 9,599 TT (64%0, 3,130 TLI (21%) and 757 ST-BR (5%), 13,023 (87%) cases were suffering from benign diseases and 1,911 (13%) from malignancies. Recurrent laryngeal nerve injuries were present in 4.3% of TT with 2.4% transient and 1.35 definitive (as against 3% in ST-BR and 2% in ST-UR with 1.4% and 1.1% transient and 1% and 0.6% definitive). Hypocalcaemia after TT was transient in 14% and definitive in 2.2% (as against transient rates of 5% in ST-BR and ST-UR and definitive in 0.6% and 0.8% respectively). Haemorrhage occurred in 1.6% of TT cases (as against 2.1%, 0.5% and 0.4% in ST-BR, ST-UR respectively) (Rosto et al., 2000). Circchi R, Trastulli S. in 2015 inferred that goitre recurrence had reduced following total thyroidectomy (Cirocchi et al., 2015). Gangappa RB, Kenchannavar MB, in 2016 stated that total thyroidectomy shows benefits in eradicating multinodular goitre, alleviating Grave's ophthalmopathy, treating Hashimoto's thyroiditis and preventing recurrence (Gangappa et al., 2016). Agawal G, Aggarwal V in 2008 inferred that total thyroidectomy is the procedure of choice for the surgical management of benign multinodular goitre (Agarwal & Aggarwal, 2008).

Whereas (Thomusch et al., 2003) mentioned; total thyroidectomy is associated with an increased rate of RLN palsies, hypoparathyroidism and postoperative morbidity in comparison to less extensive thyroid surgery. (Thomusch et al., 2003). We have carried surgical procedures irrespective of the political instability and financial constraints in our country. Hence the number of surgeries varied in different years. In our study, we did carry out total thyroidectomy for our be-

ISSN: online 2617-2186 print 2617-2178

nign multinodular goiter cases with bare minimum complications.

CONCLUSION

The study carried out Total thyroidectomy for all cases of MNG and Malignant thyroid. We have encountered very few complications including RLN palsy and injury to parathyroid glands. Textbook advice for MNG is partial or subtotal thyroidectomy. But we recommend total thyroidectomy for MNG cases; because complications will be very few if proper surgical techniques are used.

REFERENCES

Agarwal, G., & Aggarwal, V. (2008). Is total thyroidectomy the surgical procedure of choice for benign multinodular goiter? An evidence-based review. *World journal of surgery, 32*(7), 1313 .

Cirocchi, R., Trastulli, S., Randolph, J., Guarino, S., Di Rocco ،G., Arezzo, A., D'Andrea, V., Santoro, A., Barczynski, M., & Avenia, N. (2015). Total or near-total thyroidectomy versus subtotal thyroidectomy for multinodular non-toxic goitre in adults. *Cochrane Database of Systematic Reviews*(8 .(

Efremidou, E. I ،.Papageorgiou, M. S., Liratzopoulos, N., & Manolas, K. J. (2009). The efficacy and safety of total thyroidectomy in the management of benign thyroid disease: a review of 932 cases. *Canadian Journal of Surgery, 52*(1), 39 .

Gangappa, R. B., Kenchannavar, M .B., Chowdary, P. B., Patanki, A. M., & Ishwar, M. (2016). Total thyroidectomy for benign thyroid diseases: What is the price to be paid? *Journal of clinical and diagnostic research: JCDR, 10*(6), PC04 .

Mauriello, C., Marte, G., Canfora, A., Napolitano ،S., Pezzolla, A., Gambardella, C., Tartaglia, E., Lanza, M., & Candela, G. (2016). Bilateral benign multinodular goiter: what is the adequate surgical therapy? A review of literature. *International Journal of Surgery, 28*, S7-S12 .

Padur, A. A., Kumar, N ،.Guru, A., Badagabettu, S. N., Shanthakumar, S. R., Virupakshamurthy, M. B., & Patil, J. (2016). Safety and effectiveness of total thyroidectomy and its comparison with subtotal thyroidectomy and other thyroid surgeries: a systematic review. *Journal of thyroid research, 2016* .

Rosto, L., Avenia, N., De Palma, M., Gulino, G., Nasi, P., & Pezzulo, L. (2000). Complications of total thyroidectomy; Incidence, preventin and treatment. *Chir Ital, 54*(5), 635-642 .

Tezelman, S., Borucu, I., Senyurek, Y., Tunca، F., & Terzioglu, T. (2009). The change in surgical practice from subtotal to near-total or total thyroidectomy in the treatment of patients with benign multinodular goiter. *World journal of surgery, 33*(3), 400 .

Thomusch, O., Machens, A., Sekulla, C., Ukkat, J., Brauckhoff, M., & Dralle, H. (2003). The impact of surgical technique on postoperative hypoparathyroidism in bilateral thyroid surgery: a multivariate analysis of 5846 consecutive patients. *Surgery, 133*(2), 180-185 .

Yang, W., Shao, T., Ding, J ،.Jin, X., Li, Q., Chu, P. G., Yen, Y., & Qiu, W. (2009). The feasibility of total or near-total bilateral thyroidectomy for the treatment of bilateral multinodular goiter. *Journal of Investigative Surgery, 22*(3), 195-200 .

ISSN: online 2617-2186 print 2617-2178

مجلة المختار للعلوم 34 (4): 288-292، 2019

أمان وكفاءة الازالة الكاملة للغدة الدرقية للغدة العنقودية الحميدة

ناصر مصباح، حسن فضيل*، سالمة صالح محمد

قسم الجراحة، كلية الطب البشري، جامعة عمر المختار، البيضاء، ليبيا

تاريخ الاستلام: 08 أبريل 2019 / تاريخ القبول: 30 ديسمبر 2019
Doi:https://doi.org/10.54172/mjsc.v34i4.171

المستخلص: الازالة الكاملة للغدة الدرقية في حال وجود الاورام الخبيثة أمر متفق عليه أما في الحالات الحميدة لازال محل خلاف حيث ان معدل المضاعفات يكون أعلى في الازالة الكاملة. دقة الجراحة عن طريق جراح خبير تمكننا من اجتناب اغلب المضاعفات ومن ثم تجنب اجراء جراحات متكررة الغدة. هدف هذه الدراسة لمعايرة وتبرير الازالة الكاملة للغدة للأمراض الحميدة خاصة في الغدة العنقودية ومرض غرايفس. أجرينا دراسة استطلاعية لحالات عمليات غدة درقية على مدى 5 سنوات من فترة 2012 حتى 2016 في قسم الجراحة مستشفى الثورة البيضاء–لعدد 353 حالة. وزعت الحالات حسب العمر والجنس والتشخيص ونوع العملية المستخدمة. واجهنا مضاعفات مختلفة تم دراستها. عدد حالات الازالة الكاملة للغدة الدرقية 247 حالة للغدد العنقودية واورام الغدة. ازالة نصف الغدة أجريت في 82 حالة لكتلة وحيدة في الغدة. إزالة كيس فقط في الغدة اجري في 6 حالات. اجريت عمليات على غدة متكررة في 18 حالة. المضاعفات العامة كانت قليلة وبسيطة. نحن نوصي بالإزالة الكاملة للغدة لجميع حالات الغدة العنقودية لإنقاص خطر التكرر وتطور الاورام الخبيثة في بقايا أنسجة الغدة. وكذلك لمنع تسمم الغدة الثانوي.

الكلمات المفتاحية: الازالة الكاملة للغددة، اورام الغدة الخبيثة، الغدة العنقودية.

*حسن فضيل hasanfadeel70@gmail.com قسم الجراحة، كلية الطب البشري، جامعة عمر المختار، البيضاء، ليبيا

Al-Mukhtar Journal of Sciences 34 (4): 293-300, 2019

Effect of Flame Retardants and 1% Stabilizer on Burning and Melt Dripping Behaviour of PP Thermoplastic Polymers

Mastura Abdoalsalam A. Efhema[1*], Price B. Mottershead[2]

[1*] *Department of Physics, Faculty of Science, Omer Al - Mukhtar University Al-Bayda, Libya*

[2] *Institution for Materials Properties Research and innovation Centre, UK*

Received: 04 May 2019/ Accepted: 30 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.141

Abstract: This study aimed to understand the mechanism of combining the action of different types of flame retardants (FR) on melting, flammability behaviour and burning behaviour, and its moderation of the Polypropylene (PP) polymer. PP Polymer was chosen to be blent in a twin-screw extruder with the flame retardants and an additive, which is a 1% Stabilizer, to investigate Polypropylene's melting, flammability and burning moderation in order to reduce it. Burning and flammability behaviour test conditions, which are known as UL49 vertical and horizontal burning tests, were applied in this study. The flame was applied for 10 seconds and the length of time that the sample burned was measured. The flame was reapplied 10mm below the burned edge of the sample for a further 10 seconds. The length of time the sample burned for a second time was measured. The melting, dripping, and burning behaviour was recorded using high-speed video. These PP Polymer samples behave very differently in terms of upward flame spread. The study also indicates that the melting behaviour of thermoplastic materials is an important characteristic in fires which should be taken into account in the development of models, in particular for upward flame spread models. To study melt dripping behaviour, a burning methodology was developed. The results from these experiments have been analyzed to draw a relationship between melt dripping and burning behaviour. Most of the previous work on melt and dripping behaviour was concentrated on the study of fire operating conditions and modelling of the thermal process, however, no work has been reported on the quantitative relationship between melt and burning behaviour of thermoplastic polymers.

Keywords: Flammability, PP Polymer, Flame retardants, Thermoplastic, Burning, Stabilize.

INTRODUCTION

The present study is part of a larger project exploring the production of fire retardant synthetic nano/micro composite fibres. This work concentrated on Polypropylene also known as Polypropylene (PP) which is a useful commodity polymer mainly used in clothing, furniture, floor coverings, geotextiles, medical, and automotive applications, due to its low cost, lightweight, good mechanical properties and low reactivity towards other chemicals. Polypropylene (PP) had higher values for tensile strength at break. Polypropylene polymer degradation occurs at high temperatures. The Polypropylene polymer (PP) melting temperature is 174^{o}C if pp is 100% isotactic, and the temperature of the glass transition of pp polymer is -17^{o}C. The main advantage is that PP is an addition polymer made from the monomer propylene, causing it to be unusually resistant to many chemical solvents, acids, and bases. However, being a wholly aliphatic hydrocarbon structure, it burns

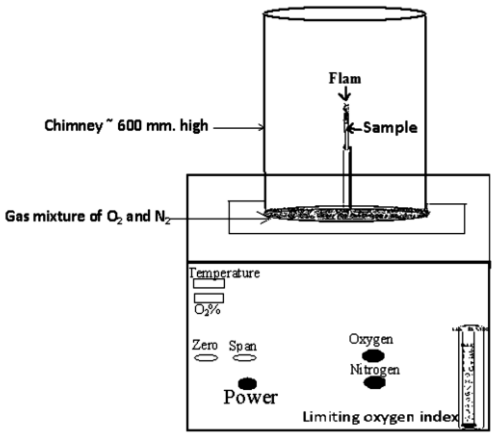
***Corresponding Author:** Mastura A. Efhema *abdoalshafie_mastura@yahoo.com*Department of Physics, Faculty of Science, Omer Al - Mukhtar University Al-Bayda, Libya.

very rapidly with a relatively smoke-free flame and without leaving any char residue (Zhu et al., 2001). Lack of polar groups in the structure makes it difficult to react with reactive flame retardants. Additive flame retardants if used, are needed in large amounts (> 20% w/w) to provide the required fire protection to products(Zhang et al., 2005). This flame retardancy effect increases with increasing irradiation and vanishes with decreasing irradiation (Qin et al., 2005). However, such high levels of additives cause polymer processing problems, in particular for their extrusion into thin films or fibres. The flame retardancy is sensitive to modification of the flame retardant, the use of synergists/adjuvants, and changes to the polymeric material. A detailed understanding facilitates the launch of tailored and targeted development (Morgan & Wilkie, 2007). Flammability tests still require some amount of conventional flame retardants. It must be noted, however, that with this approach of using flame retardants as additives, the polymer content in the formulation is reduced compared to the unmodified polymer. In our earlier publications, we have demonstrated that nanoclays can be nanodispersed in polypropylene with a proper choice of compatibilizer, and the compounded polymer can be extruded into fibres (Gilman, 2007; Qin et al., 2005). Nanoclays, although increasing the thermal stability of polypropylene and helping in char formation (Xie et al., 2001), they do not reduce the flammability of PP fibres to a large extent (Qin et al., 2005). Clay, Nano clay, and a small amount of flame retardant (5%) when added together to PP containing certain compatibilizers, the extruded fibres could be self-extinguished. In our previous work, we have only used ammonium polyphosphate (Qin et al., 2005) whereas, in this study, we use different phosphorus. The main aim of this work is to understand the mechanism of combining the action of different types of flame retardants on thermal stability and flammability of PP. Several polypropylene samples containing compatibilizer, clay, stabilizer, and different flame retardants have been compounded in a twin-screw extruder.

MATERIALS AND METHODS

The following materials were obtained from commercial sources: the seven different thermoplastic Polypropylene polymers (PP). Samples are tested after blended with UV-Stabilizer (Nor) and Flame Retardants.

Polymer Preparation: The 7 polypropylene samples composition (wt %) and additives were blended with 1% Stabilizer (Nor 116), and 5% FR as shown in Table 1. For Limiting oxygen index LOI; (LOI schematic as seen below) and burning tests, coarse monofilaments (strands) were blended to the PP wt. %, stabilizer 1 wt. %, and FR 5 wt. % (Table 1). However, the nanoclays which could be used (Cloisite 20A, and Southern Clay Products, USA) are montmorillonite clay modified with dimethyl and dihydrogenated tallow quaternary ammonium chloride. This modified clay was chosen because of its nonpolar alkyl substituents. A Thermoelectron Prism EuroLab 16 twin-screw extruder with a temperature profile over six heating zones between 179–1900C was used for compounding. The polymer samples (diameter 1.8 ± 0.2 mm) were collected before pelletizing.



The schematic of the (LO1) tests

ISSN: online 2617-2186 print 2617-2178

Table (1). Mass percentages of various components in the formulations where Stabilizer 1% is NOR 116.

Sample5(%)	*pp %*	*Clay 3%*	*Graft 1%*	*FR*
1- PP-Nor 116	100	--	--	--
2- PP-APP 107	96	107	Polybond (pb)	--
3- *PP-NOR-NH*	91	107	Polybond	APP
4- PP FR 107	91	107	Polybond	[1]FR245
5- PP Amgard 107	91	107	Polybond	Amgrad NH
6- PP 3OB	96	3OB	Polybond	--
7- PP APP 3OB	92	3OB	--	APP

Note: [1] *FR = APP, NH, FR245, also PP-NOR-NH is* PP 107,FR372 or *FR245.*

Characterisation and Testing: Halogenated flame retardants FR245 and 372 had little effect on the rate of decomposition (Efhma, 2018).The addition of clay with or without flame retardants increased the thermal stability of all samples as indicated by respective DTG (The differential thermal analysis (DTA) was performed on a TA instruments SDT 2960 simultaneous TGA instrument under flowing air) maximum temperature values (Efhma, 2018). Clay, together with melamine phosphate, had no further effect (Schartel et al., 2006; Xie et al., 2001) on the flame retarded sample or the incompatibility of melamine phosphate with the organically modified clay. This has also been observed in my previous study (Efhma, 2018). Thus, the addition of clay together with conventional flame retardants enhances both the overall melt and burn with flaming drips during UL-94 testing. UL-94 test of Flame spread and burning behaviour and Flammability in horizontal and vertical modes as seen in fig.1.

The differences are due to the effect of different flame retardants on the dispersion of the clay (Morgan & Wilkie, 2007; Xie et al., 2001) They also reduce the rate of gas escape from polymer melt affecting the viscosity and hence, prevents the melt dripping of the polymer during vertical UL-94 testing and holds the polymer together (Hu & Song, 2007). As can be seen from Figure 1 FR245 in PP helps samples self-extinguish (SE) i.e. flameout (FO).

Flame spread and burning behaviour: Flammability of the compounded polymer strands was studied using UL-94 testing (Figure1 a, b, c, d, e, f, and g [1, 2]), igniting the sample and recording times taken to reach 50 (T1) (Table 2 and 3) and 100 mm (T2) marks and to extinguish (flameout, FO) in both horizontal and vertical modes. Selected images are shown in Figure 1 and Table 2. In the horizontal mode the PP sample melted and burned with flaming drips. In both horizontal and vertical modes, all samples with flame retardants and no clay, burnt completely (Fig. 1b and e), which is not unexpected, given the low levels (5%) of flame retardants used here. However, the flame spread was low as seen in Table 3. On addition of clay to the compounded polymer, a change in burning behaviour was observed and recorded, e.g. samples self-extinguished (SE), except for the one containing a melamine phosphate sample PP-NOR-NH (see Table 2 and 3, also Figure 1f). In some samples (e.g. containing APP) the flame flickered, which was probably due to poor dispersion of the flame retardant in the polymer (Hu & Song, 2007).

The UL-94 vertical burning test (Morgan & Wilkie, 2007; Zhu et al., 2001) is a widely used fire test for industrial polymeric materials and products. The flaming time and the dripping phenomena are two observed test results that have been reported for many materials. Good flame retardant formulations that gift polymers with short flaming times and non-dripping are also screened by the two test results. However, the test results have generally no use for the theoretical understanding of the advantages of the good formulations because the results are not related to the fire dynamics. Especially, the ignition process, the burning rate, the flame

ISSN: online 2617-2186 print 2617-2178

spread rate, and the rate of dripping for polymers in the UL-94 vertical burning test as they have not been focused on. In fact, although numerous good flame retardant formulations for polymers are often reported, few fundamental studies on the basics of the fire dynamics of the test have been conducted. Furthermore, the absence of the fire dynamic behaviours of polymers in the UL-94 test also makes it difficult to correlate the UL-94 test with other fire tests such as the cone calorimeter test, in which more scientific parameters such as heat release rate and mass loss rate are presented.

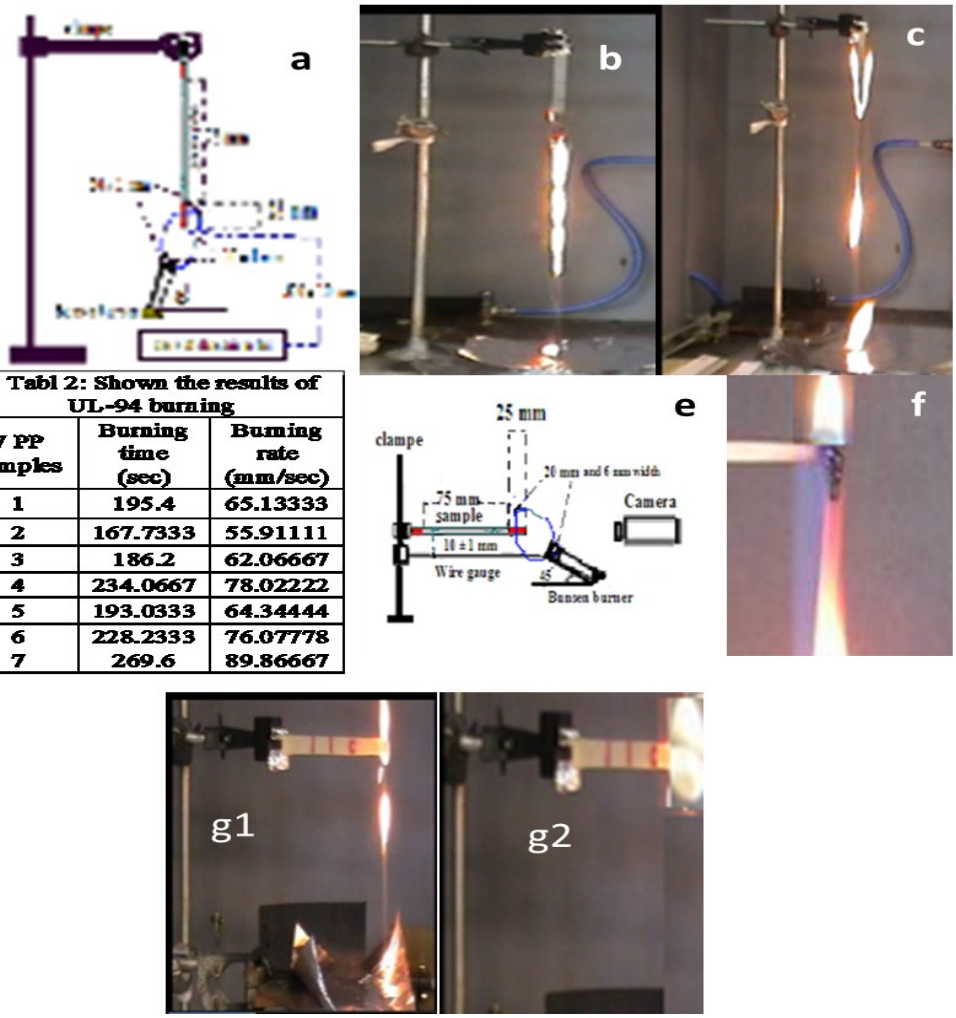


Figure: (1). Summery of the results of UL-94 test (both horizontal and vertical modes) of 7 PP samples composition (ww%) blended with 1% Stabiliser,1% Graft, 3% Clay and 5% FR, as seen in Table1, their size is 125 mmx 10 mmx 3 mm thick.

Note: T1 = time to 50mm; T2 = time to 100mm; FO = flameout time; M = melting; BD = burning drips; LBD = low burning drips SE = self-extinguished; * = burnt completely.

In the vertical mode, burning of the control sample was more vigorous with melting drips (see Tables 2 and 3 and Figures 1b and c). With flame retardants, there was not much effect on burning, except for the sample containing FR372 which self-extinguished (Figure 1g). The clay presence in PP reduced melt-dripping e.g. sample PP-NOR-NH – sample 3- (Fig.1e), but had minimal effect on burning, however, with Clay no FR, FR 245, Amgrad NH, and FR APP respectively (Tables 1 and 2), the effect was promising and the

ISSN: online 2617-2186 print 2617-2178

samples which self-extinguished were samples 2, 4, 5 and 7 (Table 2) also Figure 1g, furthermore, the Melting behaviour and Physics properties were recorded as seen in Fig.1.

Melting behaviour and Physical properties: In the UL94 vertical burning test, the mass of the first drop increases with the first dripping time. The high dripping frequency and the small size and mass of PP agree with the observation that in the UL94 vertical burning test the rate of dripping decreases while the size and mass of drops increase (fire drip, 1996). These results and more can be seen in Table 3 by recording the times and masses for the first dripping. Furthermore, for PP it can be found that the first dripping time does not significantly increase with the specimen thickness.

Table (3). Record the times and masses for the first dripping to investigate the melting behaviour

	Specimen A			Specimen B				
Polymers	Thickness (mm)	TD (s)	MD (g)	TD (s)	MD (g)	ATD (s)	AMD (g)	ADD (mm)
	2	13	0.0158	12	0.0186	12	0.0172	3.3
	4	15	0.0146	14	0.0287	14	0.0217	3.6
PP	6	16	0.0078	15	0.0147	15	0.0113	2.9
	8	14	0.0067	16	0.0012	15	15 0.0040	2.0
	10	14	0.0086	15	0.0110	15	0.0098	2.8

Note: TD, the time of the first dripping; MD, the mass of the first drop; ATD, average time of the first dripping; AMD, average mass of first drops; ADD, average diameter of first drops.

It seems that the PP mass of the first drop has a minor increase with the specimen thickness. This finding is related to the decomposition mechanism and dripping of PP polymers.

As thick specimens have a larger cross-sectional area and larger melt strength than thin specimens, they can undergo longer times or larger melt mass weight without break. However, the dripping of PP is small-size dripping. The decomposition significantly reduces the molecular weight, followed by the easy flowing of polymer melts. The melting wax can flow over surfaces of the specimen and drip.

Flame retardant mechanism: Polypropylene (PP) undergoes decomposition via random chain scission involving the formation of some unsaturated end groups, e.g. –C(CH3)=CH2 (Xie et al., 2001). Accompanying oxidation via hydroperoxide formation yields further scission products comprising alcohols, ketones, and acidic functionalities. There is little evidence of any tendency to cross-link and form char during this process, thereby presenting a significant flame retardant challenge (Gilman, 2007). It can be seen from the discussion in previous sections that the molecular weight decreases, followed by easy flowing of polymer melts, which was in PP containing PP-g-MA. It has been reported in the literature (Council, 1977; Hu & Song, 2007) that thermal degradation of organoclays can create acidic sites on the clay, which catalyse the initial decomposition stages of a polymer, resulting in a lowering of ignition time and LOI values for many polymer-nanocomposite samples (Efhma, 2018). The acidic sites, however, catalyse formation of a protective surface coating on the surface of polymer, which acts as a thermal barrier leading to delay of thermo-oxidative degradation. In some cases, clays can also catalyse dehydrogenation and crosslinking of polymer chains, thus reducing combustion.

Phosphorus- and nitrogen-containing flame retardants acting in condensed phase produce char, which acts as a thermal barrier for the decomposing polypropylene. There is no

ISSN: online 2617-2186 print 2617-2178

evidence of chemical interaction between the flame retardants and PP in this work or from the previous study (Efhma, 2018) and the literature. Halogenated flame retardants acting in the vapour phase help in removing active free radicals from the combustion zone, thus reducing the combustion of the polymer. In PP-PB-clay-FR samples, char formation has been generally enhanced for both phosphorus- and halogen-containing flame retardants, with the former yielding greater increases. (Hu & Song, 2007) has suggested that in case of phosphorus–containing flame retardants, phosphoric acid released can react with the quaternary ammonium salt of the Nanoclay (Xie et al., 2001), thus creating acidic sites on the clay as observed by (Qin et al., 2005), which enhance char formation. Similarly, HB released from PB flame retardants can react with the quaternary ammonium salt of the clay (Hu & Song, 2007). Although supporting this mechanism, we have not found any evidence of these reactions in this work.

CONCLUSIONS

The dispersion of nanoclay can be improved by compounding polymer-clay samples (Hu & Song, 2007) and by adding compatibilizer. LOI values are not changed significantly following the addition of clay and even in the presence of other flame retardants (Mastura A. Efhma, 2018). However, the presence of nanoclay alone changes the thermal stability and burning behaviour of the polypropylene. With additional flame retardant presence, the polymer can show self-extinguishing properties as seen in sample 4.

The effect of different flame retardant types on the thermal stability, flammability, and the char formation tendency of optical micrographs of tape samples showing the effect of Polybond (Pb) on clay dispersion (Efhma, 2018) which effected on flammability behaviour and dripping polypropylene (PP) is studied. PP, compatibilizer, Clay, stabiliser, and different flame retardants have been compounded in a twin-screw extruder to produce polymers with improved thermal and flame retardant properties. Thermal analysis has been used to study the thermal properties, and a slightly modified UL-94 test for testing the flammability of the samples. All flame retardants acting in the condensed phase (phosphorus- and nitrogen-containing) (Xie et al., 2001) lowered the rate of decomposition, whereas halogenated flame retardants had a little effect (Efhma, 2018). All PP samples with flame retardants and no clay, burnt completely, which is not unexpected, given the low levels (5%) of flame retardants used here. However, the flame spread was low. Flammability behaviour testes using UL-94 were carried out to measure flammability properties and have been examined with digital images. Also, both flammability and melt dripping behaviour of burning polymers were measured by using the UL-94 test. However, the dripping of PP is small-size dripping. The decomposition significantly reduces the molecular weight, followed by the easy flowing of polymer melts. The melting wax can flow over surfaces of the specimen and drip. Thus, it is expected that the small-size dripping is independent of the cross-sectional area of the specimen, that is, the first dripping time or the mass of the first drop has little to do with the thickness of the specimen.

Outcome and future work: Nanocomposites have suggested that by the addition of just a small quantity (< 5%) of organically modified layered silicate nanoclay (montmorillonite) (Morgan & Wilkie, 2007) to a PP polymer matrix could enhance many of the properties of that polymer (Efhma, 2018), including the fire performance (Beyler & Hirschler, 2002). We watched the effect of flame retardancy, FR and additives on the Polymers burning behaviors, Chemical, and Physical properties, and then dripping to try to stop the fire and potentially save lives (Efhma, 2018). Therefore it's very important to collect and record all the results related to these aims and more for future studies of flammability behaviour and dripping.

ISSN: online 2617-2186 print 2617-2178

ACKNOWLEDGEMENTS

I wish to thank the Engineering and Physical Sciences Research Council (EAPSR) and the Ministry of Defence, UK, for funding; and Rhodia Consumers Specialities Ltd and Camira Ltd., UK for their collaboration and advice

REFERENCES

Beyler, C. L., & Hirschler, M. M. (2002). Thermal decomposition of polymers. *SFPE handbook of fire protection engineering, 2* .

Council, N. R. (1977). *Materials: state of the art* (Vol. 1). National Academies .

Efhma A.,Mastura (2018). Effect of Flame Retardants and 1% Stabilizer on Burning, Flammability Behaviour, and Thermal Decomposition Properties Via Polypropylene Material Treatment.; Al-Mukhtar Journal of Sciences 33 (2): 119-125, 2018

Gilman, J. W. (2007). Flame retardant mechanism of polymer-clay nanocomposites. *Flame retardant polymer nanocomposites*, 67-87 .

Hu, Y., & Song, L. (2007). Nanocomposites with halogen and nonintumescent phosphorus flame retardant additives. *Flame Retardant Polymer Nanocomposites; Morgan, AB, Wilkie ، CA, Eds*, 191-234 .

Morgan, A. B., & Wilkie, C. A. (2007). *Flame retardant polymer nanocomposites*. John Wiley & Sons .

Qin, H., Zhang, S., Zhao, C., Hu, G., & Yang, M. (2005). Flame retardant mechanism of polymer/clay nanocomposites based on polypropylene. *Polymer, 46*(19), 8386-8395 .

Schartel, B., Bartholmai, M., & Knoll, U. (2006). Some comments on the main fire retardancy mechanisms in polymer nanocomposites. *Polymers for Advanced technologies, 17*(9 - 10), 772-777 .

Xie, W., Gao, Z., Pan, W.-P., Hunter, D., Singh, A., & Vaia, R. (2001). Thermal degradation chemistry of alkyl quaternary ammonium montmorillonite. *Chemistry of materials, 13*(9), 2979-2990 .

Zhang, X., Guo, F., Chen, J., Wang, G., & Liu, H. (2005). Investigation of interfacial modification for flame retardant ethylene vinyl acetate copolymer/alumina trihydrate nanocomposites. *Polymer Degradation and Stability, 87*(3), 411-418 .

Zhu, J., Uhl, F. M., Morgan, A. B., & Wilkie, C. A. (2001). Studies on the mechanism by which the formation of nanocomposites enhances thermal stability. *Chemistry of materials, 13*(12), 4649-4654 .

ISSN: online 2617-2186 print 2617-2178

تأثير مثبطات اللهب وعامل مثبت 1% على سلوك الاحتراق والذوبان التنقيطي على بوليمر البولي بروبيلين الملدن حرارياً

مستورة عبد السلام افحيمه [1*] وبرايس ب. موتشرهيد[2]

[1] قسم الفيزياء، كلية العلوم، جامعة عمر المختار، البيضاء –ليبيا

[2] معهد أبحاث المواد والابتكار، المملكة المتحدة

تاريخ الاستلام: 15 مايو 2017 / تاريخ القبول: 4 أغسطس 2018

Doi:https://doi.org/10.54172/mjsc.v34i4.141

المستخلص : تهدف هذه الدراسة إلى فهم آلية الجمع بين عمل أنواع مختلفة من مثبطات اللهب flame retardants (FR) على الذوبان، وسلوك القابلية للاشتعال وسلوك الاحتراق وتعديله للبوليمر البولي بروبيلين Polypropylene (PP). تم اختيار البوليمر PP لمزجه في twin-screw extruder مع مثبطات اللهب flame retardants (FR) ومادة مضافة، وهي عبارة عن 1٪ مثبت، لدراسة ذوبان البولي بروبيلين، والقابلية للاشتعال وحرق الاعتدال للحد منه. وقد طبقت في هذه الدراسة اختبارات سلوك الإحتراق والقابلية للاشتعال المعروفة باسم UL-49 اختبارات الحرق الرأسي والأفقي. تم تطبيق اللهب لمدة 10 ثوان وقياس طول الفترة التي تم فيها احتراق العينة. تم إعادة تطبيق اللهب 10mm تحت الحافة المحترقة من العينة لمدة 10 ثوان أخرى، ثم قياس طول وقت احتراق العينة للمرة الثانية. تم تسجيل سلوك الذوبان والتنقيط والاحتراق باستخدام فيديو عالي السرعة. تتصرف عينات البولي بروبيلين هذه بشكل مختلف جداً من حيث انتشار اللهب التصاعدي. وتشير الدراسة أيضا إلى إن السلوك الذائب للدائن الحرارية هو سمة هامة في الحرائق التي ينبغي أن تؤخذ في الاعتبار عند وضع النماذج، ولا سيما بالنسبة لنماذج انتشار اللهب الصاعد. لدراسة سلوك الذوبان التنقيطي، تم تطوير منهجية للاحتراق. وقد تم تحليل نتائج هذه التجارب لرسم علاقة بين الذوبان التنقيطي وسلوك الاحتراق. وتركز معظم الأعمال السابقة المتعلقة بسلوك الذوبان والتنقيط علي دراسة ظروف تشغيل الحرائق، ونمذجة العملية الحرارية، غير إنه لم يتم تسجيل أى عمل بشان العلاقة الكمية بين سلوك الذوبان والاحتراق في البوليمرات الحرارية.

الكلمات المفتاحية: الاشتعال، بوليمر البولي بروبيلين، مثبطات اللهب، الاحتراق، تثبيت.

* مستوره افحيمه abdoalshafie_mastura@yahoo.com قسم الفيزياء، كلية العلوم، جامعة عمر المختار، البيضاء– ليبيا

Al-Mukhtar Journal of Sciences 34 (4): 301-309, 2019

Effects of Folic Acid Consumption on Newborn Defects and Miscarriage, and Content Uniformity Analysis of Three Different Brands of Folic Acid Tablets Dosage Forms

Adel B,. Mohamed [1*],Azza M,. Ali[2], Samia A,. Magid[2]

[1]*Department of Pathology, faculty of Veterinary Medicine, Omar Al-Mukhtar University. Al-Bayda. Libya*

[2]*Department of Pharmaceutics and industrial pharmacy, faculty of pharmacy, Omar Al-Mukhtar University. Al-Bayda. Libya*

Received: 04 May 2019/ Accepted: 30 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.147

Abstract: There is a recent rise in the number of birth defects. This could be related to folic acid deficiency. Folic acid, as an antioxidant, is an important factor in preventing birth defects during embryonic development. This study, via content uniformity measurements and medical history, aimed to investigate the role of folic acid before and during pregnancy and to measure the content uniformity of different brands of folic acid tablets. The statistical study aimed to determine the relationship between folic acid consumption, miscarriage, and anomalies in newborn babies. The study studied a sample of 300 women based on their medical records. There was no significant effect (p-value = 0.143) of folic acid consumption on the frequency of anomalies. On the other hand, there was a high significant relation (p-value = 0.003) between folic acid consumption and miscarriage. The correlation, principally with miscarriage, coincides with previous studies and highlights the importance of folic acid supplementation before and during gestation. Content uniformity measurements were made on three famous folic acid brands (Folic Acid-Nile, Folicum-Julphar and Wockhardt-UK) available at local pharmacies. Measurements on the three folic acid brands were conducted in compliance with the British Pharmacopoeia (BP) (2010) test for content uniformity. Ten tablets from each brand were tested using the UV spectrophotometric method. The results showed that only the first brand name passed the content uniformity test, while the other two brands did not comply with the standards. This result highlights the problem of under-dosing in commercially available folic acid dosage forms, and identifies the need for taking action towards the implementation of quality control on all medical drugs.

Keywords: Folic acid; Anti-oxidant; Newborn defects; Miscarriage

INTRODUCTION

Folic acid, also known as pteroyl-L-glutamic acid or N-[4-[[(2-amino-1,4-dihydro-4-oxo-6-pteridinyl) methyl] amino] benzoyl]-L-glutamic acid, is a member of the B vitamin group (Matias et al., 2014). Folic acid is the synthetic form of folate and is found in different kinds of fortified foods (Ribeiro et al., 2016). As a vitamin, folic acid is not produced by natural metabolism; it is obtained from the diet. Most dietary folic acid loses its bioavailability during cooking and food processing. Yet folic acid is often recommended as a supplement when the amount of dietary folate is not sufficient (Matias et al., 2014).

Natural folate exists in the form of polyglutamates which can be hydrolyzed to monoglutamates by the action of intestinal enzymes in the jejunum. In intestinal villi, folic acid is reduced by NADPH reductase to tetrahydrofolic acid

***Corresponding Author:** Adel. Mohamed . adel.mohamed@omu.edu.ly Department of Pathology, faculty of Vet. Medicine, Omar Al-Mukhtar University. Al-Bayda. Libya.

(THFA). THFA then undergoes methylation to form N5 methyl THFA, which then binds to plasma proteins. THFA is vital in several metabolic pathways for nucleic acid synthesis, functioning as a donor of chemical groups with one carbon atom. Disturbances in folate and 1 Carbone metabolism have been linked with a group of congenital disorders known as Neural-Tube Defects (NTDs) (Pulikkunnel & Thomas, 2005).

Folic acid has antioxidant properties that may prevent or reduce defects and congenital abnormalities in the neural tube and the heart. NTD and heart defects are congenital abnormalities that occur at an early stage of pregnancy. Unfortunately, almost 5% of newborn babies are born with serious congenital anomalies that tend to be permanent, and in some cases, are associated with little chance of recovery after birth (Andres et al., 2008). The only effective strategy for the prevention of these disorders is periconceptional treatment with folic acid in sufficient doses (Czeizel et al., 2013). Oral administration of folic acid prior to and during the early first trimester of pregnancy plays an important role in preventing NTDs and congenital anomalies in the heart, urinary tract, oral cavity and limbs (Bower & Stanley, 1989; Goh et al., 2006). Sufficient levels of folate in the blood serum are associated with a reduction in NTD (Green, 2002).

Additionally, a high risk of giving birth to children with NTDs is associated with women with type I diabetes, with epilepsy or who are under carbamazepine or antifolate medication (French et al., 2003; Wald et al., 2001).

First (Hibbard, 1965), reported the relationship between deficiency of folic acid and NTDs. He noticed that women with a history of fetal anomalies had a high incidence of abnormal folate metabolism. Later, Smithells and colleagues noticed low levels of folate in the red blood cells of women who had a fetus with an NTD in comparison to control mothers (Smithells et al., 1976). This finding led to investigations of the probability of preventing NTDs by the administration of folate supplements prior to planning for pregnancy (Smithells et al., 1980).

For the sake of reducing the risk of NTDs, supplementation of folic acid has been recommended before and during the first three months of pregnancy (McStay et al., 2017). The recommended daily dose of folic acid depends on the patient's history of birth abnormalities; the recommended preventative daily allowance of folic acid for women with no prior history of birth defects dose is 4.0 mg per day starting at least 30 days before conception and continuing throughout the first trimester of pregnancy (Al-Mashhadane et al., 2018).

Folic acid is a water-soluble substance so that any excess is excreted with the urine (Ahn et al., 2004; Brown et al., 1997). A 4.0 to 10 mg daily supplement of folic acid is not known to cause any toxicity to the mother or the fetus during the pregnancy. Green and colleagues stated that folic acid is not toxic but that it may mask pernicious anemia if consumed in high doses (Green, 2002).

Quality measurements of dietary folic acid are not applied worldwide, giving rise to the possibility of products with insufficient amounts of the active component (Đuriš et al., 2017). Over the years, several methods have been developed for the quantification of folic acid in pharmaceutical formulations. The present study seeks to investigate whether oral folic acid supplements commercially available in the Libyan market meet the criteria of the (Pharmacopoeia, 2010) using UV spectrophotometry for the quantification of folic acid in pharmaceutical formulations.

This study aims to investigate any prospective relation between folic acid consumption and pregnancy anomalies or miscarriage. Furthermore, the study aimed to run content uniformi-

ISSN: online 2617-2186 print 2617-2178

ty measurement of three different common brands of folic acid tablets dosage form to check whether these brands contain the actual percentage of folic acid assigned on (Pharmacopoeia, 2010).

MATERIALS AND METHODS

Collection of data for the correlation between folic acid consumption and anomalies and miscarriage: To study the relationship between folic acid consumption and birth anomalies and miscarriage, 300 tested women were selected randomly for the assessment based on a written questioner and medical history at maternity centers. The assessment focused on evaluating the number of miscarriage and anomalies cases in relation to the consumption of folic acid before and during pregnancy. Statistical analysis was performed by The R Project for Statistical Computing. *p*-values were calculated based on Fisher's Exact Test for Count Data.

For quality control measurements, samples of three commercial brands of 5mg folic acid tablets were purchased from several private pharmacies in Al-Bayda, Libya as shown in Table 1. All samples were assessed within their valid shelf-life. Folic acid standard (Alfa Aesar, United Kingdom, Lot No J1791A) was obtained from the central store of the University of Omar Al-Mukhtar, Al-Bayda, Libya. For the preparation of the solutions of the standards and tested samples, distilled water and high-grade glassware were used throughout the work.

Table:(1). Folic acid 5mg tablets evaluated in the study

Brand	Brand name	Manufacture Date	Expiry Date	Batch No	Manufacturer
A	Folicum	04/2013	07/2018	0009	Julphar,UAE
B	Folic acid	10/2015	10/2018	T651516	Nile, Egypt
C	Folic acid	04/2017	03/2020	532823	Wockhardt,UK

Ultraviolet Spectrophotometry: Ultraviolet (UV) measurements were made on GENESYS 10S UV-Vis spectrophotometer (Thermo Fisher Scientific, USA) with 1 cm optical path. Quartz cells were used to measure absorbance of all the solutions.

Preparation of Standard Stock Solution:
Standard Stock Solution of Folic Acid: An accurately weighed quantity of folic acid (10 mg) was transferred into a 100 ml volumetric flask. This small quantity of drug was dissolved in distilled water and shaken manually for 10 min and diluted up to the mark with distilled water to give a stock solution (100 µg/ml). BP. Vol.1. (2009).

Working standard solution of Folic Acid: An aliquot (0.1 ml) from a standard stock solution (100µg/ml) was transferred to a 10 ml volumetric flask and diluted to the mark with distilled water to obtain a working standard solution

(1 µg/ml) of folic acid. The solution was scanned by UV-Visible spectrophotometer within the range 200-300 nm using water as a blank.

Preparation of Calibration Curve: From the standard stock solution of folic acid (100 µg/ml) 1, 3, 5, 6, 7, or 8 ml of solution were pipetted out into a series of 100 ml volumetric flasks. The volume in each flask was made up to 100 ml with distilled water to obtain concentrations of 1, 3, 5, 6, 7, and 8 µg/ml folic acid. The absorbance of the above solutions was measured at a maximum absorbance (λmax). The calibration curve was constructed by plotting absorbance vs. concentration. Line-

ISSN: online 2617-2186 print 2617-2178

arity and a regression equation were also calculated. Each response shown was the average of three determinations.

Estimation of Three Marketed Formulations: 10 tablets from each brand were chosen randomly and assayed individually: the tablets were weighed and powdered using a porcelain mortar and pestle. An amount of the powder equivalent to 0.05g of tablet was dissolved in 100 ml of distilled water in a volumetric flask and shaken for 10 minutes. The solution was filtered through Whatman filter paper no. 54. 20 ml of the above filtrate was diluted to 100 ml with distilled water and the absorbance was measured at λ max. The average amount of drug per tablet present in each batch was calculated with the help of an appropriate calibration curve constructed from the absorbance values of folic acid.

A selection of an absorbance wavelength for folic acid (λmax) was calculated by scanning the standard solution of folic acid between 200-300 nm. An absorbance maximum was obtained at 287 nm.

RESULT AND DISCUSSION

Statistical analysis showed a non-significant relation (p-value = 0.143) between folic acid consumption and anomalies in Figure.1. Among women who were taking folic acid during pregnancy, 166 had no anomalies while 13 had one anomaly. Data also showed that women who took folic acid in both before and during pregnancy had reduced the risk of having babies with birth defects than those who had never taken folic acid. For the remaining 121 cases, the study result showed a weak relation between folic acid consumption and anomalies.

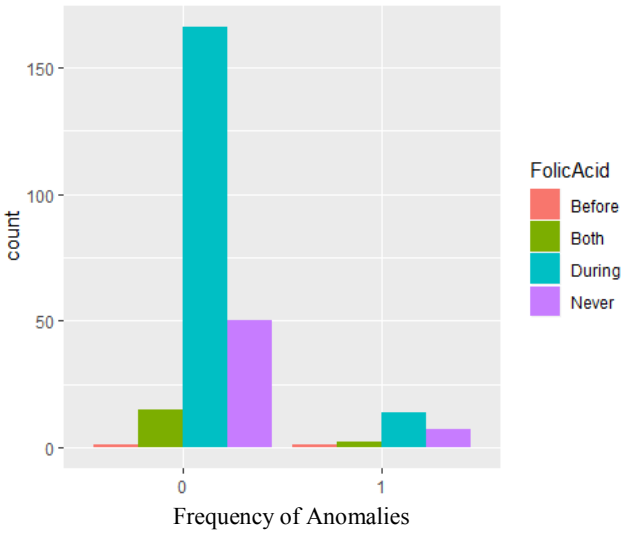


Figure:(1). Comparison between folic intakes before and during pregnancy and the frequency of anomalies.

Figure.2 showed a significant relationship (p-value = 0.0039) between folic acid consumption and miscarriage. Among women who were under folic acid medication during their pregnancies, the majority (124) did not experience a miscarriage. However, the frequency of miscarriage rises to 1 and 2 for many of those who never took folic acid during their pregnancies.

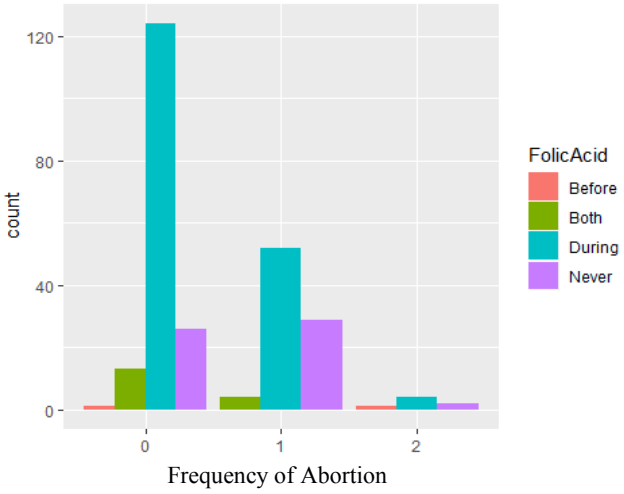


Figure: (2). Comparison between folic acid intakes before and during pregnancy and the frequency of miscarriage (abortion).

Although many previous studies showed a strong relationship between folic acid intake during pregnancy and the absence of anomalies

ISSN: online 2617-2186 print 2617-2178

in newborn babies, it was not the case in this study. This might be attributed to the power of the sample or the presence of a bias during the sampling that might not represent the population. Lack of awareness campaigns of the importance of folic acid before and during pregnancy might be the main reason behind the increase in birth defects. 5mg is the recommended daily dose of folic acid for maintaining pregnancy. Folic acid is available at local pharmacies under different brand names, most of which were imported without quality measurements. Folic acid is also available in 500mcg doses, which is recommended at least for 3 months before planning pregnancies. Sometimes, due to human error, lower doses (500 mcg) replace the recommended dose (5mg) during pregnancy, which eventually affects the integrity of folic acid during important periods in embryonic development. It is worth mentioning that there are many different factors such as genetic, environmental, infection and nutrition that are associated with increasing the rate of birth anomalies and miscarriage thus these factors might interfere with the lack of folic acid consumption during pregnancy.

The content uniformity measurement for three of the most frequently consumed folic acid brands in the local pharmacies: The linearity range of folic acid absorbance detection was found to be between 1-8 µg/ml as shown in Figure. 3. The correlation coefficient and regression line equation of folic acid at 287 nm are shown in table 2.

Table: (2). Correlation coefficient and regression line equation for calibration curve for folic acid. (n=6).

Wavelength	Correlation co-efficient (R^2)	Regression line equation
287 nm	0.998	y = 0.049x + 0.008

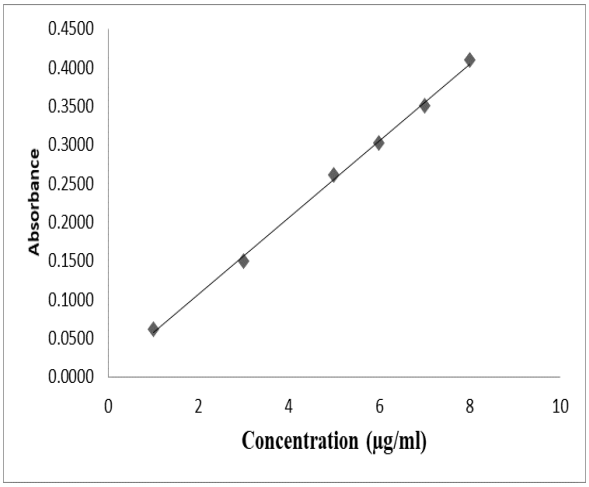


Figure: (3). Linearity Spectra of Folic Acid.

The results obtained from the estimation of 3 different brands (A, B, and C) of folic acid available in local pharmacies in Al-Bayda show that the percentage of drug content of brand B tablets as shown in Table 3 is within the limit (85% and not more than 115% of the labeled drug). This means that this brand complies with the British pharmacopoeia guideline of the content uniformity test.

Table:(3). The average weight, amount of drug, and percentage of drug content for each tablet of brand B.

Tablet no	1	2	3	4	5	6	7	8	9	10
Average weight of each tablet (mg)	129.2	128.3	142.5	128.6	132.1	131.5	131.8	128.7	136.5	129.5
Amount of drug in each tablet(mg)	5.2	4.9	5.9	5.4	4.7	4.9	5.2	5.1	5.4	5.2
% of content	104	98	118	108	94	99	104	102	109	104

ISSN: online 2617-2186 print 2617-2178

The percentage of drug content of brand A and C tablets, as shown in Tables 4 and 5, respectively, is below the lower limit (85% of the labeled drug). This means that these brands are not compliant with the British pharmacopeia content uniformity test. No previous similar studies have been found, which investigated the content uniformity of these tested brands of folic acid. However, if there was any similar study, it would consider important factors such as brand name and batch number which might affect the final decision.

Table: (4). The average weight, amount of drug, and percentage of drug content for each tablet of brand A.

Tablet no	1	2	3	4	5	6	7	8	9	10
Average weight of each tablet (mg)	117.2	121.4	120.3	118.9	117.7	119.4	117.1	114.2	119.3	119.0
Amount of drug in each tablet(mg)	2.5	2.5	2.6	2.3	2.4	2.6	2.5	2.1	2.3	2.2
% of content	49	50	51	46	48	52	50	43	46	45

Table. (5). The average weight, amount of drug, and percentage of drug content for each tablet of brand C.

Tablet no	1	2	3	4	5	6	7	8	9	10
Average weight of each tablet (mg)	64.7	65.4	65.7	65.7	65.9	65.3	64.9	65.0	64.4	64.5
Amount of drug in each tablet(mg)	4.0	3.8	4.0	3.7	3.9	2.9	3.3	3.4	3.2	3.5
% of content	80	77	81	74	78	58	67	67	64	69

CONCLUSION

This study showed a significant relationship (p-value = 0.0039) between folic acid consumption and miscarriage. More confirmative quality control tests should be implemented to evaluate the dissolution profile of folic acid tablets. This study emphasized the need for continuous surveillance of folic acid tablets present at Libyan markets by the government to ensure the supply and availability of good quality medicines for the patients in Libya.

Quality measurement shows variation in the active components of the tested folic acid brand names. Concentrations in some folic acid tablets (brand B) were within the acceptable limits of the British pharmacopoeia. Other folic acid tablets (brands A and C) did not comply with the content uniformity test certified in the British pharmacopoeia. This means that these two brands might not give the expected therapeutic effect and might reduce patient compliance.

ACKNOWLEDGEMENT

The authors are thankful to the following individuals:

- Mr. Aun. O. Younis, for his help with statistical analysis.

ISSN: online 2617-2186 print 2617-2178

- Mr. Omran Ibrahim for his help with sample preparation.

REFERENCES

Ahn, E., Nava-Ocampo, A. A., & Koren, G. (2004). Multivitamin supplements for pregnant women. New insights. *Canadian family physician, 50*(5), 705-706 .

Al-Mashhadane, F. A., Al-Mashhadane, A. A., & Taqa, A. A. R. (2018). Folic Acid Supplementation: A Review of the Known Advantages and Risks .

Andres, J., Evans, J., & Royle, C. (2008). Prevalence of congenital anomalies. *Canadian Perinatal Health Report*, 158-163 .

Bower, C., & Stanley, F. J. (1989). Dietary folate as a risk factor for neural ‐ tube defects: evidence from a case ‐ control study in Western Australia. *Medical Journal of Australia, 150*(11), 613-619 .

Brown, J. E., Jacobs, D. R., Hartman, T. J., Barosso, G. M., Stang, J. S., Gross, M. D., & Zeuske, M. A. (1997). Predictors of red cell folate level in women attempting pregnancy. *Jama, 277*(7), 548-552 .

Czeizel, A., Dudás, I., Vereczkey, A., & Bánhidy, F. (2013). Folate deficiency and folic acid supplementation: the prevention of neural-tube defects and congenital heart defects. *Nutrients, 5*(11 .4775-4760 ،(

Đuriš, J., Čalija, B., Vidović, B., Dobričić, V., Milić, J., & Ibrić, S. (2017). Comparative analysis of mechanical and dissolution properties of single-and multicomponent folic acid supplements. *Journal of Food Composition and Analysis, 60* .24-17 ،

French, A. E., Grant, R., Weitzman, S., Ray, J. G., Vermeulen, M. J., Sung, L., Greenberg, M., & Koren, G. (2003). Folic acid food fortification is associated with a decline in neuroblastoma. *Clinical Pharmacology & Therapeutics, 74*(3), 288-294 .

Goh, Y. I., Bollano, E., Einarson, T. R., & Koren, G. (2006). Prenatal multivitamin supplementation and rates of congenital anomalies: a meta-analysis. *Journal of obstetrics and gynaecology Canada, 28*(8), 680-689 .

Green, N. S. (2002). Folic acid supplementation and prevention of birth defects. *The Journal of nutrition, 132*(8), 2356S-2360S .

Hibbard, B. M. (1965). The role of folic acid in pregnancy with particular reference to anaemia, abruption and abortion. *Obstetrical & Gynecological Survey, 20* .39-35 ،(1)

Matias, R., Ribeiro, P., Sarraguça, M., & Lopes, J. (2014). A UV spectrophotometric method for the determination of folic acid in pharmaceutical tablets and dissolution tests. *Analytical Methods, 6*(9), 3065-3071 .

McStay, C., Prescott, S., Bower, C., & Palmer, D. (2017). Maternal folic acid supplementation during pregnancy and childhood allergic disease outcomes: a question of timing? *Nutrients, 9*(2), 123 .

Pharmacopoeia, B. (2010). Vol. 1, The Department of Health. *British Pharmacopoeia Commission, London, 1*, 219-222 .

ISSN: online 2617-2186 print 2617-2178

Pulikkunnel, S. T., & Thomas, S. (2005). Neural tube defects: pathogenesis and folate metabolism. *JAPI, 53*, 127-135 .

Ribeiro, M. V. d. M., Melo, I. d. S., Lopes, F. d. C. d. C., & Moita, G. C. (2016). Development and validation of a method for the determination of folic acid in different pharmaceutical formulations using derivative spectrophotometry. *Brazilian Journal of Pharmaceutical Sciences, 52*(4), 741-750 .

Smithells, R., Sheppard, S., & Schorah, C. (1976). Vitamin dificiencies and neural tube defects. *Archives of disease in childhood, 51*(12), 944-950 .

Smithells, R., Sheppard, S., Schorah, C., Seller, M., Nevin, N., Harris, R., Read, A., & Fielding, D. (1980). Possible prevention of neural-tube defects by periconceptional vitamin supplementation. *The Lancet, 315*(8164), 339-340 .

Wald, N., Law, M., Morris, J., & Wald, D. (2001). Quantifying the effect of folic acid. *The Lancet, 358*(9298), 2069-2073 .

ISSN: online 2617-2186 print 2617-2178

تأثير تناول الحمض الفوليكي على التشوهات الجنينية وحالات الإجهاض وتحليل وحدة مكونات الجرعة لثلاث علامات تجارية للحمض الفوليكي على شكل اقراص

عادل بالقاسم محمد[1]*، عازة منبي علي[2]، سامية الصاوي مجيد[2]

[1] *قسم الأمراض، كلية الطب البيطري، جامعة عمر المختار، البيضاء. ليبيا.*

[2] *قسم الصيدلانيات والصناعات الصيدلانية، كلية الصيدلة، جامعة عمر المختار، البيضاء. ليبيا.*

تاريخ الاستلام: 04 مايو 2019 / تاريخ القبول: 30 ديسمبر 2019

Doi:https://doi.org/10.54172/mjsc.v34i4.147

المستخلص: لوحظ مؤخراً ازدياد عدد حالات التشوهات في المواليد. وهذا قد يرجع سببه لنقص في حمض الفوليك. حمض الفوليك كمضاد للأكسدة، هو عامل مهم في الوقاية من التشوهات أثناء مرحلة تطور الجنين. من خلال التحقق من التاريخ الطبي للحالات وقياس وحدة الجرعة، هدفت هذه الدراسة الى فحص دور حمض الفوليك قبل واثناء الحمل وكذلك للتحقق من محتويات ووحدة الجرعة في الأصناف التجارية المتوفرة من الحمض الفوليكي. الدراسة الاحصائية هدفت الى تحديد العلاقة بين استهلاك حمض الفوليك وحالات الاجهاض والتشوهات الجنينية في المواليد. قامت الدراسة بفحص عينة من 300 إمرأة اعتمادا على بيانات سجلاتهن الطبية. لُوحظ ترابط ضعيف (قيمة P = 0.143) بين معدلات استهلاك حمض الفوليك وتكرار حدوث التشوهات الجنينة. وعلى العكس من هذا، فقد لاحظنا ترابط قوي (قيمة P= 0.003) بين معدلات استهلاك حمض الفوليك وحدوث الإجهاض. هذا الترابط، خاصة مع معدلات الإجهاض، يتماشى مع دراسات سابقة ويعطي أهمية لتناول حمض الفوليك قبل وأثناء الحمل. تم قياس محتويات ووحدة الجرعة لثلاث علامات تجارية معروفة لحمض الفوليك (Folic Acid-Nile و Folicum-Julphar و Wockhardt-UK) ومتوفرة في الصيدليات المحلية. تم اجراء القياسات على العلامات التجارية الثلاثة لحمض الفوليك وفقا لاختبار توحيد المحتوى لدستور الادوية البريطاني British Pharmacopoeia (BP) (2010) تم اختبار عشرة أقراص من كل علامة تجارية باستخدام طريقة جهاز UV Spectrophotometric. أشارت النتائج إلى أن العلامة التجارية الاولى فقط اجتازت اختبار توحيد المحتوى، فيما لم تتطابق العلامتان التجاريتان الاخريان مع المعايير القياسية. هذه النتائج تسلط الضوء على مشاكل الجرعات الناقصة من حمض الفوليك في الأقراص المتاحة تجاريا. وتحدد الحاجة لاتخاذ اجراءات لتطبيق الرقابة على جودة جميع الادوية الطبية.

الكلمات المفتاحية: حمض الفوليك. مضاد الأكسدة. تشوهات حديثي الولادة. الإجهاض.

*عادل محمد adel.mohamed@omu.edu.ly قسم الأمراض، كلية الطب البيطري، جامعة عمر المختار، البيضاء. ليبيا.

Al-Mukhtar Journal of Sciences 34 (4): 310-315, 2019

Successful Treatment of Mesentric Panniculitis by Using Small Doses of Steroid for a Short Period: Case Report

Olla A M Ibrahim*, Salah M Alwamy and Enas M Alhaen
Department of Radiology, Faculty of Medicine, Omar Al Mukhtar University Al-Bayda, Libya

Received: 13 June 2019/ Accepted: 30 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.198

Abstract: Mesenteric panniculitis is a rare inflammatory disease affecting the adipose tissue of the mesentery and colon**.** Less than 300 cases had been reported worldwide by 2016. There is a lack of universal consensus regarding management guidelines, and the cases are treated on an individual basis. Therefore, successful management of this case by using small doses of steroid would empower clinician's experience of how to manage such cases. A 62-year-old female has a known case of hypertension and bronchial asthma, presented by exacerbation and acute abdominal pain. Lab results revealed a mild elevation in inflammatory markers and bilirubin. Computed tomography showed typical findings of mesenteric panniculitis. The case was managed by a small steroid dose for a short period till the symptoms were controlled, thereafter the dose was safely tapered gradually. A follow-up scan revealed complete resolution of the disease. The literature reports different types of therapy, ranging from observation to medical therapy and even surgical interventions. Reported cases were treated by different protocols using steroids, cytotoxic drugs, antibiotics and radiotherapy has been used in some cases, Reporting this case would raise awareness of how symptoms would present, what is the essential diagnostic tool to be used, and highlighting the possibility of using a small dose of steroid to successfully manage such cases.

Keywords: Mesentery; Panniculitis; Colon; Computed Tomography; Abdominal Pain; Acute Abdomen

INTRODUCTION

Mesenteric panniculitis is a rare inflammatory disease affecting the adipose tissue of the mesentery and colon, characterized by chronic nonspecific fibrotic inflammatory involvement of adipose tissue of the mesentery (Issa & Baydoun, 2009). In 2016 less than 300 cases have been reported worldwide (Kgomo et al., 2017). Mesenteric panniculitis was first described by Jura in 1924 as retractile mesenteritis. The name mesenteric panniculitis was firstly given by Odgen 1960.

Although different names have been given for this disease in literature, such as mesenteric sclerosis, retractile mesenteritis, Weber-Christian disease, lipomatosis, it can be categorized into three types according to the degrees of pathological changes in terms of inflammation, fat necrosis, and fibrosis (Nicholson et al., 2010).

Clinical presentation of the disease varies widely from nonspecific symptoms such as abdominal pain, nausea, anorexia, fullness, pyrexia; to more alarming presentations like acute abdomen, intestinal obstruction, jaundice, and per rectal bleeding (Issa & Baydoun, 2009; Kgomo et al., 2017).

As this disease is quite rare, there is a lack of universal management guidelines, and cases are treated on an individual basis. In this case

***Corresponding Author:** Olla A M Ibrahim *dr_all2000@yahoo.com* , Department of Radiology, Faculty of Medicine, Omar Al Mukthar University Al-Bayda, Libya .

report, the clinical presentations and the diagnostic approach will be described. The management protocol and follow up will be illustrated in comparison with other published cases to raise awareness of this rare condition.

Case presentation: A 62 years old female Syrian patient was admitted to Al-Tamuz private hospital with two main complaints. The first is a 5 days abdominal pain, moderate to severe in intensity, mainly in epigastric and right hypochondrium regions, continues, colicky, burning in nature, poorly radiates to the rest of the abdomen; associated with nausea, vomiting, low-grade fever. No change in bowel habits. There is a history of multiple similar episodes, but they were less in intensity.

The second complaint is a mild productive cough associated with a wheezy chest. Her past medical history included hypertension for 10 years on Atenolol 100mg/day. Bronchial asthma on bronchodilator inhaler. Asthmatic attack precipitated by dust and cold exposure.

The past surgical history included classic cholecystectomy 3years ago. No known history of allergy, apart from the precipitating factors for asthma.

Clinical examination revealed: overweight patient, vitally stable, temperature 38c°, mild jaundice, and congested throat.
Local examination of the chest revealed a bilateral occasional expiratory wheeze.

Adnominal examination showed moderate to severe tenderness over epigastric and right upper quadrant regions, rebound was positive, bowel sound was positive.

Lab results: leukocyte counts $13x10'^{3}$, total Bilirubin 2.4mg/dl, mainly direct, mild elevation in liver enzymes, sedimentation rate 60 mm/one hour, C-reactive protein positive.

Renal function, the rest of liver function, serum amylase, urine amylase, cardiac enzymes, and coagulation profile were all within normal ranges.

ECG: showed no significant abnormality. Chest x-Ray: bi-lateral mild perihilar infiltration.

Abdominal ultrasound examination demonstrated a thick gastric wall with an increase in fluid content. Surgically removed gall bladder, mild fatty liver changes, and otherwise normal findings.

CT of the Abdomen performed initially without contrast, followed by intravenous contrast injection (figure-1).

Revealed veil-like opacity radiating from the mesenteric root, which is extending peripherally, and more prominent around jejunum, with sandstorm appearance. An increase in the thickness of the stomach wall and small intestine are highly suggestive of mesenteric panniculitis.

ISSN: online 2617-2186 print 2617-2178

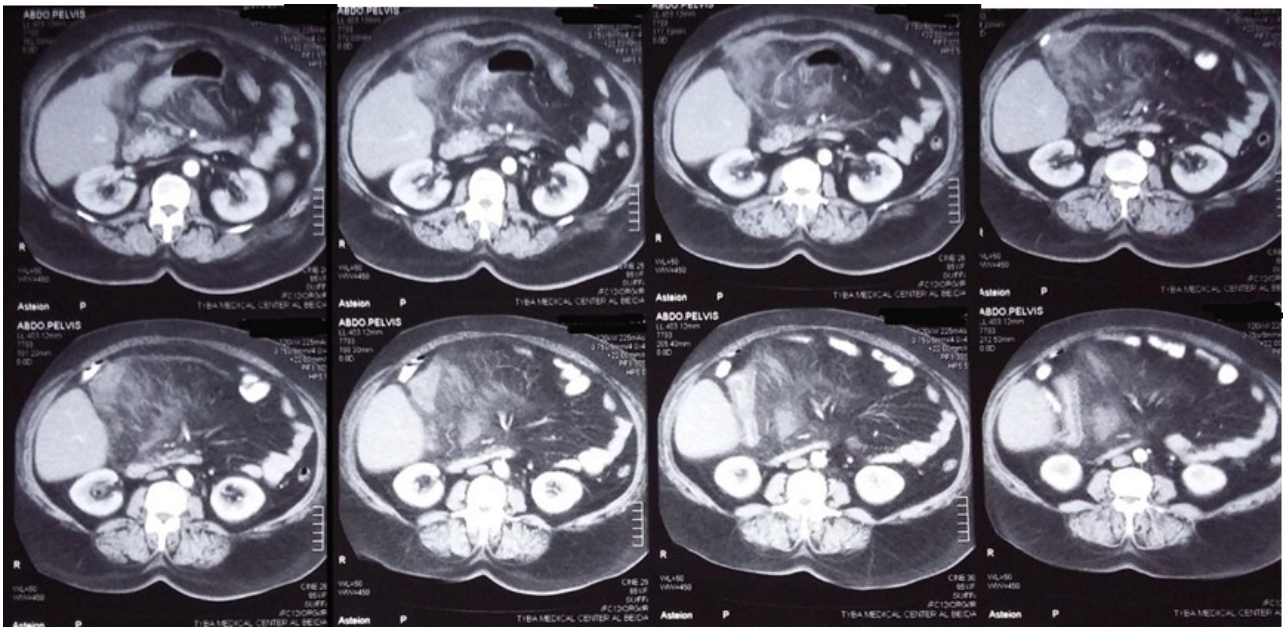


Figure (1): Abdominal and pelvic CT scan with contrast showing sandstorm appearance of mesenteric panniculitis (cross sectional view).

Management and Outcome: Patient was treated by 30mg prednisone once daily, bilirubin repeated after two days of therapy and returned to normal value, and the pain significantly reduced. The patient discharged home with the same dose until the pain almost subsided. On week 2 post-presentation, the dose was reduced to 20 mg /day for another two weeks and then tapered over one month. The Patient underwent follow up CT after two months of presentation.

The second CT showed a complete resolution of pathology (figure-2). The patient followed for 6months, and the patient was symptoms free during the follow-up period**.**

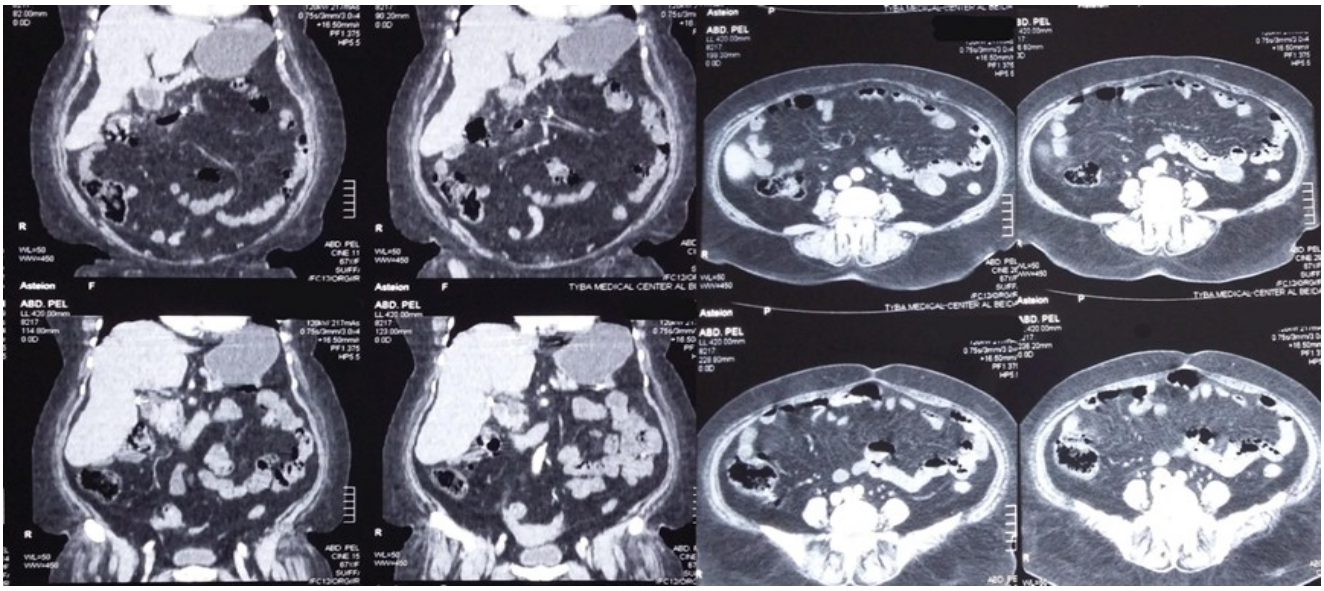


Figure (2): Abdominal pelvic CT scan with contrast showing resolution of mesenteric panniculitis (coronal and cross-sectional views).

ISSN: online 2617-2186 print 2617-2178

DISCUSSION

Mesenteric panniculitis is a fibrotic inflammatory disease that involves the adipose tissue of mesentery. By 2016, Less than 300 cases had been reported in literature under different names: mesenteric lipomatosis, lipogranuloma of mesentery, retractile mesenteritis and other names (Grieser et al., 2008; Issa & Baydoun, 2009).
This disease is more common in males with 2-3:1 ration, incidence increases with age (Irwin et al., 2018).

The precise etiology is not fully understood. However, the pathogenesis of this disease is thought to be a nonspecific inflammatory response linked to a wide variety of stimuli. For example, abdominal trauma, surgery, autoimmune related disorders, chemical injuries, drugs, retained intra-abdominal materials, leakage into the abdominal cavity (urine, bile, chyle), peptic ulcer and even tobacco consumption has been reported to increase the risk (Irwin et al., 2018; Issa & Baydoun, 2009; Kaya et al., 2018). In addition, the retractile form of mesenteric panniculitis is associated with some types of Malignancies, such as lung cancer, lymphoma, melanoma, gastric cancer, carcinoid tumor (Cuff et al., 2001; Irwin et al., 2018; Kaya et al., 2018; Kgomo et al., 2017). In our case, no clear causal factors can be linked, and cholecystectomy was done 3 years earlier, makes surgical procedure unlikely to be related here. The most common site is mesenteric of small bowels, However, mesenteric of sigmoid, mesocolon, peri-pancreatic region, omentum, retroperitoneum, and pelvic involvement had been reported (Akram et al., 2007; Horton et al., 2003). In our case, small bowels' mesentery and part of the omentum were the main sites of involvement.

The mode of presentation widely ranges from asymptomatic, mild symptoms to a picture of an acute abdomen. The symptoms might include: abdominal pain, pyrexia, anorexia, nausea, weight loss, abdominal fullness, and less occasionally, the patient might present with jaundice, anemia, per rectal bleeding, abdominal mass and intestinal obstruction (Kgomo et al., 2017; Pickhardt & Bhalla, 2005). In this case, the patient is present with abdominal pain similar to acute abdomen, in addition to jaundice, which can be explained by edematous of peri-biliary tree tissues as a part of mesenteric inflammation and subsided after administration of prednisone.

Diagnosis of the disease is mainly achieved by the usage of computerized tomography, and Magnetic resonance imaging. The definitive diagnosis is reached by biopsy, which is seldom required unless there is doubt in regarding diagnosis (Horton et al., 2003; Pickhardt & Bhalla, 2005). In this case, CT was enough to make a diagnosis and the close follow up with improvement in symptoms minimize the need for biopsy.

The laboratory results usually tend to be within normal ranges, apart from elevated neutrophils, raised sedimentation rate, and occasionally, anemia (Kaya et al., 2018). Our case shows almost the same biochemistry of the majority of cases, in addition, an increase in total bilirubin, mainly direct type, this might be explained by the edematous biliary tree due to the extension of inflammation of omentum that relived after administration of prednisone.

As with most rare diseases, there is a lack of universal consensus regarding management guidelines, and the cases are treated on an individual basis. Literature reports different types of therapy, ranging from observation to medical therapy and even surgical interventions. In general, medical therapy is used for symptomatic cases. The usual medications are, steroids, thalidomide, cyclophosphamide, colchicine, azathioprine, tamoxifen, antibiotics, and radiotherapy has been used in some cases, while surgical intervention is usually served if medical treatment had failed (Issa & Baydoun, 2009; Kaya et al., 2018).

ISSN: online 2617-2186 print 2617-2178

As our patient is symptomatic, Prednisone was the main medication for this case, 30mg was used for two weeks, and as the pain subsided, 20mg started for almost another two weeks, then tapered over one month. In comparison to (Issa & Baydoun, 2009; Kgomo et al., 2017), we have used a smaller dose of prednisone 30mg instead of 40mg, and for only 2 months with tapering approach instead of six months in the former and a little longer than that of the later, where (Kgomo et al., 2017) used a small dose for two weeks, and tapering of steroid was omitted, which might jeopardize the health status of their patient. Antibiotics (cephalosporins) have been used for 5days as part of the management of bronchial asthma exacerbation, not as an intention for curing panniculitis.

CONCLUSION

Mesenteric panniculitis is a rare disease, with variable clinical presentations, mostly it is a benign condition. However, it can be presented as a secondary manifestation of some malignancies. There is no universal consensus regarding treatment guidelines. Hopefully, improving doctors' knowledge would raise awareness of how such a case would present, what essential diagnostic tool to be used, and that a small dose of a steroid with good follow-up would be effective management rather than a larger dose over a longer time frame.

Abbreviation

CT: Computerized tomography**.**

REFERENCES

Akram, S., Pardi, D. S., Schaffner, J. A., & Smyrk, T. C. (2007). Sclerosing mesenteritis: clinical features, treatment, and outcome in ninety-two patients. *Clinical Gastroenterology and Hepatology, 5*(5), 589-596.

Cuff, R., Landercasper, J., & Schlack, S. (2001). Sclerosing mesenteritis. *Surgery, 129*(4), 509-510.

Grieser, C., Denecke, T., Langrehr, J., Hamm, B., & Lopez Hänninen, E. (2008). Sclerosing mesenteritis as a rare cause of upper abdominal pain and digestive disorders. *Acta Radiologica, 49*(7), 744-746.

Horton, K. M., Lawler, L. P., & Fishman, E. K. (2003). CT findings in sclerosing mesenteritis (panniculitis): spectrum of disease. *Radiographics, 23*(6), 1561-1567.

Irwin, C. P., Lee, J. B., Kim, A., Eme, I., Schofield, C., & Mount, G. (2018). Mesenteric panniculitis presenting as fever of unknown etiology in a patient with history of abdominal surgery. *Case reports in gastrointestinal medicine, 2018*.

Issa, I., & Baydoun, H. (2009). Mesenteric panniculitis: various presentations and treatment regimens. *World journal of gastroenterology: WJG, 15*(30), 3827.

Kaya, C., Bozkurt, E., Yazıcı, P., İdiz, U. O., Tanal, M., & Mihmanlı, M. (2018). Approach to the diagnosis and treatment of mesenteric panniculitis from the surgical point of view. *Turkish journal of surgery, 34*(2), 121.

Kgomo, M., Elnagar, A., & Mashoshoe, K. (2017). Mesenteric panniculitis. *Case Reports, 2017*, bcr-2017-220910.

Nicholson, J., Smith, D., Diab, M., & Scott, M. (2010). Mesenteric panniculitis in Merseyside: a case series and a review of the literature. *The Annals of The Royal College of Surgeons of England, 92*(6), e31-e34.

Pickhardt, P. J., & Bhalla, S. (2005). Unusual nonneoplastic peritoneal and subperitoneal conditions: CT findings. *Radiographics, 25*(3), 719-730.

ISSN: online 2617-2186 print 2617-2178

تقرير عن حالة نجاح علاج التهاب السنبلة الشحمية المساريقي باستخدام جرعة صغيرة من الستيروييد ولفترة قصيرة

علا عبد الرحمن محمد إبراهيم *، صلاح مفتاح العوامي وإيناس مصطفى الهاين

قسم الأشعة، كلية الطب البشري، جامعة عمر المختار، البيضاء، ليبيا

تاريخ الاستلام: 13 يونيو 2019 / تاريخ القبول: 30 ديسمبر 2019

Doi:https://doi.org/10.54172/mjsc.v34i4.198

المستخلص: التهاب السبلة الشحمية المساريقية هو مرض التهابي نادر يؤثر على الأنسجة الدهنية للمساريق والقولون. أقل من 300 حالة سجلت في العالم حتى عام 2016. لا يوجد توافق عالمي حول القواعد العامة لعلاج هذا المرض، كما أن الحالات المسجلة تم علاجها بصورة فردية. لذلك فان نجاح علاج هذه الحالة بجرعات صغيرة من العقار الكورتيزوني من شانه إثراء الخبرة السريرية للأطباء في كيفية التعامل مع حالات مماثلة. التقرير يُعني بحالة سيدة تبلغ من العمر 62 سنة وتعاني من ارتفاع الضغط الشرياني والربو. تم ادخالها المستشفى بشكوة نوبة ربو وألم حاد في البطن. الفحص المعملي اظهر ارتفاع متوسط في مؤشرات الالتهابات وكذلك البليروبين (الصفراء). الصورة المقطعية اظهرت النمط النموذجي لالتهاب السبلة الشحمية المساريقية. عُلجت الحالة باستخدام جرعات صغيرة من الكورتيزون لفترة قصيرة حتى زوال الاعراض المرضية، ومن ثم ايقافها بشكل تدريجي وآمن. بمتابعة الصورة المقطعية، اظهرت الاختفاء الكامل لنمط الالتهاب السبلة الشحمية المساريقية. ذكرت الابحاث العلمية المنشورة طرق علاج مختلفة لهذه الحالة تتباين من مجرد الملاحظة والمتابعة إلى استخدام العقارات الطبية والتدخلات الجراحية. سُجلت حالات شفاء باستخدام بروتوكولات علاجية مختلفة باستخدام الكورتيزون، ومضادات الأورام، والمضادات الحيوية والعلاج الاشعاعي. تسجيل نجاح علاج هذه الحالة من شأنه أن يوسع افاق الوعي الطبي لعوارض هذه الحالة الطبية، وطرق التشخيص الأساسية لها ويسلط الضوء على أن استعمال جرعات صغيرة من العلاج الكوتيزوني ممكن ان يكون خيار فعال لهذه الحالات.

الكلمات المفتاحية: مساريقي، التهاب السنبلة الشحمية، القولون، الصورة المقطعية، ألم البطن، البطن الحادة.

*علا عبد الرحمن محمد إبراهيم dr_all2000@yahoo.com قسم الأشعة، كلية الطب البشري، جامعة عمر المختار، البيضاء، ليبيا

Al-Mukhtar Journal of Sciences 34 (4): 316-323, 2019

Study on some hemato-biochemical changes associated with *Babesia* Bovine in cattle of El-Wisata -Libya

Nagia A. S.Abdalsalam*, Safia Hazawy and Hamzah Othman
Department of Clinical Pathology, Faculty of Veterinary Medicine, Omar Al-Mukhtar University, Al-Bayda, Libya

Received: 04 July 2019/ Accepted: 30 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.200

Abstract: *Bovine* Babesiosis is a tick-borne disease of cattle caused by haemoparasite of the genus *Babesia*. This parasite is responsible for considerable losses due to mortality, weight loss, and reduction in milk besides the cost of treatments. This study aimed to study the effect of *Babesia* on some hematological and biochemical parameters on cattle in farms of El-Wisata in the El-Gabal El-Akhdar area. Twenty-three of crossbred cattle of 3-8 years old were examined. Giemsa stained thin blood smears from the ear vain of all 23 cases of crossbred cattle for microscopic examination to diagnose the parasite in the blood and divided the animals into two groups (7 non-infected group (30.5%) and 16 infested group (69.5%)), as well as two blood tubes (with EDTA) from the jugular vein of all cases were collected for hematological analysis and (without EDTA) for biochemical analysis. The results of the haemato-biochemical studies showed a significant reduction in the levels of RBC, PCV, Hb, MCH, MCV, TP, Ca+ and Na+ with a significant increase in WBC and K- levels in the crossbred cattle infected group. The infected cases marked the clinical-pathological symptoms like fever (41 C°), Anorexia, depression, weakness, pale mucous membrane, weight loss, hemoglobin urea, decrease in milk and death within a few days.

Keywords: *Babesia* Bovine, crossbred cattle, Haemato-biochemical Alterations.

INTRODUCTION

Cattle play an essential role in our life as they are the main source of milk and meat. The cattle's health has deteriorated due to parasitic diseases in general and blood parasites in particular(Talkhan et al., 2010) Bovine Babesiosis is a parasitic disease caused by an intraerythrocytic protozoan of the genus *Babesia* (Alvarez et al., 2019). It infects a wide range of domestic and wild animals with a main impact on cattle. This disease has been distributed in the world (Bock et al., 2004; Ristic & Levy, 1981). *Babesia* is the second most commonplace parasite situated within the blood of mammals after trypanosomes (El-Hamed et al., 2016). In addition, some species of *Babesia* are zoonotic and affect human health (Talkhan et al., 2010) It is still representing a serious trouble in tropical and subtropical countries (Hussein et al., 2007), It leads to lowering the productive performance of the affected animals (Zulfiqar et al., 2012).It is an important disease in Middle East countries because it sometimes occurs in acute forms with serious recognized clinical alteration which affects the production of animals (Talkhan et al., 2010). In Libya, the prevalence in Tripoli was 12.9% (El Maghrabi et al., 2008) El-Gabal El-Akhdar was 29.86% (Bulabiad, 2013). 16.74% The most common species that cause infection on cattle are *Babesia bigemina*, *Babesia divergens*, *Babesia bovis* (Adham et al., 2009) *Babesia* species cause acute disease by two principle methods i.e hemolysis and circulatory disturbance (Mohammed & Elshahawy, 2017).

Clinically, this disease has been characterized by high fever (40-41.6°C), anorexia, weight

***Corresponding Author:** Nagia A. S.Abdalsalam *almabrouk20072008@yahoo.com* Department of Clinical Pathology, Faculty of Veterinary Medicine, Omar Al-Mukhtar University, Al-Bayda, Libya

loss, ruminal atony, dyspnea, and hemoglobinuria (MM, 2017). Some studies have reported that the calves up to 9-12 months of age are generally resistant to such diseases due to inverse age resistance, but the clinical symptoms in neonatal calves were inability to suckle. *Babesia* causes red water urine (haemoglobinuria) or dark brown to coffee in urine color accurding to *babesia* stages, various degrees of jaundice from paleness in mild cases to severe yellow discoloration of the conjunctiva (Schalm, 1965) and vaginal mucous membranes in more serious cases and deep shallow respiration in sheep, goats, cattle, horses, dogs, and cats (Bal et al., 2016).

Babesia sporozoites are injected into the host by ticks and invade red blood cells (RBCs) where they transform into trophozoites that grow and divide into two pear-shaped merozoites. *Babesia* enters directly into red blood cells of the host (Lounsbury, 1906), the division process is then repeated. The parasite infects and destroys red blood cells, it can lead to a serious condition called hemolytic anemia (Koger, 1981). The main cause of anemia is due to intravascular hemolysis, and the rate of damage of erythrocytes and capacity of erythropoiesis. Hyperemia occurs in mucous membranes at later stages (MM, 2017). It causes a decline in erythrocyte count, packed cell volume, and hemoglobin level and serum changes may include increased potassium and reduced calcium and sodium levels (Tufani et al., 2015).

The quickly dividing parasites in the red cells create rapid damage to the erythrocytes (Pandey & Misra, 1987) associated with hemoglobinaemia. This may cause death within a few days (Mohammed & Elshahawy, 2017). So, the present study was designed to diagnose the disease and determine the changes in some hematological and biochemical parameters in some infested cattle with bovine *Babesia* in El-Wisata in El-Gabal El-Akhdar area- Libya.

MATERIALS AND METHODS

Study area and period: The present study was conducted between March 2017 and January 2018. The seasons of the study included rainy (September, October, November, December, January, March, and April) and sunny (May, June, July, and August) periods. The study location was on farms of El-Wisata in El-Gabal El-Akhdar area-Libya.

Animals: A total number of twenty-three crossbred cattle, from three to eight years old, were examined and divided into two groups showing clinical signs, ticks and some haemato-biochemical effects of *Babesia bovine* on the two groups, naturally infected group and healthy or non-infected group.

Blood Samples: Three samples were collected from each one of all 23 cases. The first sample was a drop from ear vein to make a blood smear for microscopic examination, however, for each sample, three smears were examined very carefully so that not a single organism might escape. While the second one was serum samples for biochemical analysis of TP, Ca^{+}, Na^{+}, K^{-} and the third was blood samples for CBC Examination.

Clinical Diagnosis: All 23 cases of crossbred cattle were diagnosed by the Giemsa stained thin blood smears technique (Coles, 1986).

Hematological parameters: Approximately, 2 ml sample of blood was collected with EDTA anti-coagulant and was sent to the laboratory directly in an Ice Container and analyzed for hematological parameters which included hemoglobin (Hb g/dL), packed cell volume (PCV %), total erythrocyte count (RBC $\times 10^6/\mu L$), total leukocyte count (WBC $\times 10^3/\mu L$) and differential leukocyte count (Sharma et al., 2016). Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC). These hematological analyses were measured by a Complete Blood Count device CBC in Laboratory Diagnosis.

Biochemical assays: The collected blood samples were kept about 10 minutes at room

ISSN: online 2617-2186 print 2617-2178

temperature. After centrifugation at 3000 rpm for 15 minutes using Thermo Scientific Centrifuge, serum was placed in a 1.5 ml Eppendorf tube and kept at -20°C until it was analyzed. Total serum protein (TP) was estimated by the Biuret method forming a violet-colored copper-protein complex having maximum absorption at 550 nm. Calcium (Ca^{+}), Sodium (Na^{+}) and potassium (K^{-}) levels of serum samples were estimated using commercial kits (Wharton & McCarty, 1972).

Statistical analysis: Data were presented as mean ± standard error (S.E.). Data were analyzed using an independent sample T-test. P values ≤0.05 were considered to be statistically significant (SPSS Version 19) (Snedecor & Cochran, 1994).

RESULTS

Clinical Findings: Cattle infected with B. bovis demonstrated characteristic clinical signs of babesiosis. Briefly, a high rise in body temperature (40-41.6), body condition is thin, pale and empty episcleral blood vessels were anemic. The clinical severity ranged from paleness in mild cases to severe yellow discoloration in more advanced stages of the infected cases, red water urine (haemoglobinuria) or dark brown to coffee in urine color according to *Babesia* stages, severe clinical manifestation and accelerated heart and respiratory rates. Some cases showed nervous manifestations in advanced stages. Different degrees of tick infestations were present inter-mandibular space, around groins, horns and ears .

Hematological Findings: 16 (69.5%) out of 23 cases showed the presence of the parasite *Babesia* from ear vain and seven cases were negative 7 (30.5%).

Hematological parameters: The mean values of Red Blood Cells (RBCs 10^6/µl), hemoglobin concentration Hb (g/dl, Packed cell volume (PCV %), White Blood Cells (WBCs 103/µl), differential leucocytes count DLC %, Mean Corpuscular Volume (MCV fl), and Mean corpuscular hemoglobin (MCH pg) are listed in Table 1.

Table:(1). The results of the hematological parameters of infested/non-infested.

Haematological Parameter	MEAN±SE	
	Infected group	Non infected group
Hb g/dl	5.98±0.23[b]	12.03±0.34[a]
WBC 10^3/µl	7.022±0.42[a]	5.30±0.55[b]
Monocyte %	10.003±0.78[a]	3.50±0.31[b]
Eosinophils %	13.87±0.88[a]	5.13±0.09[b]
Neutrophils %	16.947±0.12[b]	31.32±0.90[a]
Lymphocytes %	59.18±0.21[a]	60.05±0.23[b]
RBC 10^6/µl	4.32±0.18[b]	6.94±0.20[a]
PCV%	19.12±0.63[b]	31.16±0.41[a]
MCV fl	39.01±1.02[b]	44.26±0.11[a]
MCH pg	12.31±0.35[b]	15.67±0.57[a]

*small letters mean there is a significant different between two groups.

Briefly, the important findings can be summarized as follows; there was a significant reduction ($P<0.05$) in the mean values± standard error of RBC, PCV, Hb, MCH, MCV and Lymphocyte with a significant increase ($P<0.05$) in WBC, and DLC. Therefore, it is clear that there are significant differences in the hematological parameters between the *B.* bovine infected group and the control one.

Biochemical parameters: The mean values of Total Protein (TP), Calcium (Ca^{+}), Potassium K^{-} and Sodium (N^{+}) of infected and control groups are listed in Table 2.

Table:(2). The results of the Biochemical parameters of infested/non-infested cattle

Biochemical Parameter	MEA ± SE	
	Infected group	Non Infected group
TP g/dl	5.49±0.23[b]	7.455±0.30[a]
Ca+ mg/dl	7. 22±0.24[b]	9.55±0.55[a]
K- mmol/l	4.62±0.41[a]	4.1±0.16[b]
Na+ mmol/l	119.13±1.52[b]	146.33±2.81[a]

*small letters mean there is a significant different between two groups.

A comparison of serum biochemical examination of parasite positive and negative blood samples from cattle showed a significant increase ($P<0.05$) in potassium level K-. However, a significant decrease ($P<0.05$) was

ISSN: online 2617-2186 print 2617-2178

recorded in total protein TP, calcium, and sodium levels.

DISCUSSION

In the present study, *Babesia* infection was confirmed by light microscopy examination in farms of El-Wisata in El-Gabal El-Akhdar area. The observed clinical findings in cattle with *Babesia* Bovine have shown that animals suffering from a lot of symptoms such as high temperature (40-41.6), pale mucous membranes, thin body, dark brown to coffee urine in color, increased heart and respiratory rates. These findings were in agreement with (Bal et al., 2016; Fujinaga, 1981; Georgi et al., 1990).

The clinical findings Microscopic examination of Giemsa stained blood smear of all 23 cases of crossbred cattle revealed that 16 cases (69.5%) had parasites in the blood and these cases were named as naturally infested group and 7 cases had normal blood (30.5%) and were called as the control group.(Samad et al., 1989) supported this view. (Karim et al., 2012) also recorded *Babesia* organisms through Giemsa's staining of blood smear. However, reports of (Banerjee et al., 1983) were discordant with higher prevalence (14.53%) of subclinical infections.

The clinical findings can be attributed to the multiplication of organisms in peripheral vessels and consequence intravascular hemolysis (Rajendran & Hafeez, 2003). The hemolysis was due to anemia and hemoglobinuria (Rani et al., 2010). Several factors contribute to anemia in babesiosis, such as a decrease in the amount of erythrocytes hemoglobin concentration (Hussein et al., 2007). The Hematological principles were adversely affected in positive cases (Ananda et al., 2009). Table 1 shows a significant reduction ($P<0.05$) in the mean values of RBC, PCV, Hb, MCH, MCV, and neutrophils as a result of an immune response to *Babesia* infection (Mahmoud & Abou-Zeina, 2008), with a significant increase ($P<0.05$) in WBC, monocytes, and Eosinophils in comparison with healthy control. Babesiosis causes normocytic normochromic anemia in cattle which could be attributed to intravascular haemolysis of red blood cells, and this is supported by (Guglielmone et al., 1996; Pandey & Misra, 1987) agrees with significant increases in WBC, Eosinophils and monocytes associated with a significant decrease ($P<0.005$) in neutrophils. This could be explained as the breakdown of RBC by *Babesia* stimulates the phagocytic cells such as lymphocytes and monocytes to clean up the body from the toxic remnants of ruptured red blood cells. *Babesia* infection leads to the stimulation of the body defense mechanism to produce antibodies against the *Babesia* antigen. (Court et al., 2001) mentioned that the significant increase in monocytes in primary *Babesia* infection could be attributed to their role as active mediators in the innate immune response. The serum of Babesiosis infected cattle showed a decrease in calcium levels, increase in potassium levels and reduced sodium levels. This finding agrees with (MM, 2017).

This occurs because *Babesia* can cause degeneration and necrosis in kidney convoluted tubules (Salem et al., 2016) There was a highly significant decrease in total protein in the serum of infected clinical cases. This could have occurred because *Babesia* can cause disruption in liver function that leads to decrease production from the liver due to direct and indirect effect of the parasite, digestive disturbance (diarrhea), loss of appetite and high fever (Atif et al., 2012; Salem et al., 2016) who recorded that with low levels of parasitemia, *Babesia* may not be found on microscopic examination. (Ananda et al., 2009; Chowdhury et al., 2006) documented that more attention in the management of crossbred cattle gives less chance of pre-exposure of vectors and develops no or less immunity, resulting in the frequent occurrence of such diseases.

CONCLUSION

ISSN: online 2617-2186 print 2617-2178

The results obtained from this study could be useful as basic information for a further advanced epidemiological study and formulation of control measures of tick-borne diseases. Further investigation using modern serological and molecular techniques with a large number of samples is recommended especially in another part of the country in order to further establish the effects of tick infestation in cattle of other parts of Libya and management of the disease.

REFERENCES

Adham, F., Abd-El-Samie, E., Gabre, R., & Hussein, H. E. (2009). Detection of tick blood parasites in Egypt using PCR assay I—Babesia bovis and Babesia bigemina. *Parasitology research, 105*(3), 721.

Alvarez, J. A., Rojas, C., & Figueroa, J. V. (2019). Diagnostic Tools for the Identification of Babesia sp. in Persistently Infected Cattle. *Pathogens, 8*(3), 143.

Ananda, K., D'Souza, P. E., & Puttalakshmamma, G. (2009). Prevalence of Haemoprotozoan diseases in crossbred cattle in Banglore north. *Veterinary World, 2*(1), 15.

Atif, F. A., Khan, M. S., Iqbal, H. J., Arshad, G. M., Ashraf, E., & Ullah, S. (2012). Prevalence of Anaplasma marginale, Babesia bigemina and Theileria annulata infections among cattle in Sargodha District, Pakistan. *Afr. J. Agric. Res, 7*(22), 3302.

Bal, M. S., Mahajan, V., Filia, G., Kaur, P., & Singh, A. (2016). Diagnosis and management of bovine babesiosis outbreaks in cattle in Punjab state. *Veterinary World, 9*(12), 1370.

Banerjee, D., Prasad, K., & Samad, M. (1983). Seroprevalence of Babesia bigemina infection in cattle of India and Bangladesh. *Indian journal of animal sciences*.

Bock, R., Jackson, L., De Vos, A., & Jorgensen, W. (2004). Babesiosis of cattle. *Parasitology, 129*(S1), S247-S269.

Bulabiad A. A. (2013) Studies on blood parasites affecting farm animals in Al Jabal Al Akhdar Libya. MS Dissertation Alexandria University, Egypt.99

Chowdhury, S., Hossain, M., Barua, S., & Islam, S. (2006). Occurrence of common blood parasites of cattle in Sirajgonj sadar area of Bangladesh. *Bangladesh Journal of Veterinary Medicine, 4*(2), 143-145.

Coles, E. (1986). Veterinary clinical pathology. WB Saunders co. *Philadelphia. London. Toronto*.

Court, R., Jackson, L., & Lee, R. (2001). Elevated anti-parasitic activity in peripheral blood monocytes and neutrophils of cattle infected with Babesia bovis. *International journal for parasitology, 31*(1), 29-37.

El Maghrabi, A. A., ELsayed, I. H., Hassaneen, A.S., Nisreen. Ezeldin (2008). Incidence of Theileriosis, Babesiosis and Anaplasmosis in cattle in Tripoli - Libya. The *Veterinary Medical Journal-Giza* 56(.2):71-82

El-Hamed, H. A. A., Salem, S. M., & Ibrahim, H. N. (2016). Haemato-biochemical Alterations in Cattle Suffering from Anaemia and Their Effect on Quality of Some Meat.

ISSN: online 2617-2186 print 2617-2178

Fujinaga, T. (1981). Bovine babesiosis in Japan: Clinical and clinico-pathological studies on cattle experimentally infected with Babesia ovata. *(The Japanese Journal of Veterinary Science), 43*(6), 803-813.

Georgi, J., Georgi, M., & Theodorides, V. (1990). Parasitology for Veterinarians. 5 th. *WB Sounders Company*.

Guglielmone, A., Gaido, A., & Mangold, A. (1996). Light microscopy diagnosis of Babesia and Theileria in haemolymph of artificially infected Boophilus microplus engorged female ticks. *Vet. Parasitology, 61*, 15-20.

Hussein, A., Mohammed, N., & Mohammed, H. (2007). Theileriosis and babesiosis in cattle: haemogram and some biochemical parameters. Proceedings of XIII International Congress of International Society of Animal Hygiene,

Karim, M., Rima, U., Hossain, M., Habib, M., Islam, M., Hossain, M., & Khan, M. (2012). Adoption of Polymerase Chain Reaction Techniques for the Detection and Differentiation of Babesiosis, Anaplasmosis and Theileriosis in Clinically Infected and Slaughtered Cattle.

Koger, M. (1981). Characteristics of Types and Breeds of Cattle in the Tropics. In *Diseases of cattle in the tropics* (pp. 3-22). Springer.

Lounsbury, C. P. (1906). *Transmisson of African Coast Fever*.

Mahmoud, M. S., & Abou-Zeina, H. A. (2008). Current state in the serological diagnosis of babesiosis and haematological changes in splenectomised buffaloes. *Global Veterinaria, 2*(5), 271-281.

MM, M. S. (2017). Studies of Naturally Infected Babesiosis and Its Effect on Some Hematological and Biochemical Parameters in Cattle in Qena, Egypt.

Mohammed, E., & Elshahawy, I. (2017). The Current Prevalence of Bovine Babesiosis and Theileriosis Infection in Egypt. *Clin Med Images Int J, 1*(1), 00004.

Pandey, N., & Misra, S. (1987). Hematological And Biochemical Response To Hemolytic-Anemia Of Clinical Babesiosis In Cattle And Therapy. *Indian Veterinary Journal, 64*(10), 882-886.

Rajendran, C., & Hafeez, M. (2003). Haemato-biochemical changes and efficacy of different acaricides in crossbred animals. *Indian Journal of Animal Sciences (India)*.

Rani, N. L., Sreedevi, C., Annapurna, P., & Kumar, K. (2010). Clinical management and haemato-biochemical changes in babesiosis in buffaloes. *Buffalo Bull, 29*(2), 92-94.

Ristic, M., & Levy, M. (1981). A new era of research toward solution of bovine babesiosis [Tick control, vaccines].

Salem, N. Y., Yehia, S. G., Farag, H. S., & Elkhiat, M. A. (2016). Clinical, hemato-biochemical alterations and oxidant–antioxidant biomarkers in Babesia-infected calves. *International journal of veterinary science and medicine, 4*(1), 17-22.

Samad, M., Bashar, S., Shahidullah, M., & Ahmed, M. (1989). Prevalence of haemoprotozoan parasites in cattle of

ISSN: online 2617-2186 print 2617-2178

Bangladesh. *Indian veterinary medical journal*.

Schalm, O. (1965). Veterinary Heamatology, 2nd edt. *Ballere, London*.

Sharma, A., Singla, L. D., Ashuma, B. K. B., & Kaur, P. (2016). Clinicopatho-biochemical alterations associated with subclinical babesiosis in dairy animals. *Journal of arthropod-borne diseases, 10*(2), 258.

Snedecor, G., & Cochran, W. (1994). Statistical Methods'.(The Iowa State University Press: Ames, Iowa, USA).

Talkhan, O., Radwan, M., & Ali, M. (2010). Cattle babesiosis and associated biochemical alteration in Kalubyia Governorate. *Nat Sci, 12*, 24-27.

Tufani, N., Fazili, M., Malik, H., Beigh, S., & Dar, K. H. (2015). Clinico haematological Profile and therapeutic management of acute babesiosis in a Holstein-friesian crossbred cow. *Veterinary Clinical Science, 3*(3), 11-14.

Wharton, D., & McCarty, R. (1972). Enzymes: partial purification and some kinetic properties of an acid phosphatase from wheat germ. *Experiments and Methods in Biochemistry. Wharton, DC, and RE McCarty, ed. The Macmillan Company, New York*, 220-245.

Zulfiqar, S., Shahnawaz, S., Ali, M., Bhutta, A. M., Iqbal, S., Hayat, S., Qadir, S., Latif, M., Kiran, N., & Saeed, A. (2012). Detection of Babesia bovis in blood samples and its effect on the hematological and serum biochemical profile in large ruminants from Southern Punjab. *Asian Pacific journal of tropical biomedicine, 2*(2), 104-108.

ISSN: online 2617-2186 print 2617-2178

دراسة التغيرات في مكونات الدم و بعض مركبات الكيمياء الحيوية المرتبطة ببوفين البابيزيا في الابقار في الوسيطة – ليبيا

ناجية المبروك عبدالسلام*، صفية شعيب الهزاوي وحمزه مفتاح عامر عثمان

[1] قسم الباثولوجيا الاكلينيكية، كلية الطب البيطري، جامعة عمر المختار

تاريخ الاستلام: 04 يوليو 2019 / تاريخ القبول: 30 ديسمبر 2019

Doi:https://doi.org/10.54172/mjsc.v34i4.200

المستخلص: بوفين البابيزيا هو مرض ينقله القراد للماشية يتسبب عن طفيل الدم من جنس البابيزيا. هذا الطفيل مسؤول عن خسائر اقتصادية كبيرة ناجمة عن الوفيات، وفقدان الوزن وانخفاض إنتاج الحليب بالإضافة إلى تكلفة العلاج. هدف هذه الدراسة هو دراسة تأثير التغيرات الدموية والكيمياء الحيوية في الماشية المصابة بالبابيزيا في بعض مزارع الوسيطة في منطقة الجبل الأخضر. فحصت 23 من الماشية الهجين بين عمر 3–8 سنوات. تم عمل مسحات دموية رقيقة من وريد الأذن مصبوغة بصبغة قيمزا من جميع الحالات ثم الفحص مجهرياً للكشف عن الطفيل، ومن خلال هذا الفحص قسمت إلى مجموعتين 16(69.5%) مصابة و7(30.5%) غير مصابة. وكذلك اجري سحب إثنين من أنابيب الدم من الوريد الوداجي في أنابيب تحتوي على مانع تجلط دم. لفحص الدم وجزء اخر بدون مانع تجلط للتحاليل الكيميائية الحيوية. أظهرت نتائج هذه الدراسات أنخفاض في RBC، PCV، Hb، MCH، MCV، البروتين الكلي (+ TP)، الكالسيوم (+ Ca) والصوديوم (+ Na). في المجموعة المصابة مقارنة بالسليمة مع زيادة ملحوظة في مستويات WBC و(-K) البوتاسيوم. تميزت الحالات المصابة بالأعراض المرضية السريرية مثل الحمى (41 درجة مئوية)، وفقدان الشهية، والاكتئاب، والضعف، وشحوب الأغشية المخاطية، والبول الدموي وفقدان الوزن، وأنخفاض الحليب والموت في غضون بضعة أيام.

الكلمات المفتاحية : بوفين البابيزيا، الأبقار الهجينة، تغيرات دموية ومركبات كيمياء حيوية.

* ناجية المبروك عبدالسلام almabrouk20072008@yahoo.comقسم الباثولوجيا الاكلينيكية، كلية الطب البيطري، جامعة عمر المختار

Al-Mukhtar Journal of Sciences 34 (4): 324-331, 2019

Nasal and Hands Carriage Rate of Methicillin-Resistant *Staphylococcus aureus* among Health Care Workers at Alwahda Hospital, Derna

Hussain Y. H. Khnfar[1], Dalal A. Thaood[2], Ilham O. A. Abdraba[3], Intesar N. Omran[2], Guma M. K. Abdeldaim[2,*]

[1]*Karsa polyclinic, Libya*
[2]*Department of medical microbiology, Faculty of Medicine, University of Benghazi, Libya*
[3]*Department Microbiology, Faculty of medicine, Omer-Almuktar University, Al-Bayda, Libya*

Received: 19 August 2019/ Accepted: 30 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.166

Abstract: Increasing incidence of Methicillin-Resistant *Staphylococcus aureus* (MRSA) is a well-documented healthcare and community phenomenon of concern to medical and public health communities all over the world. One of the most important sources of MRSA infection in hospitals is health care workers (HCWs) through nasal or hands carriage. The aim of this study is to determine the rate of methicillin-resistant *Staphylococcus aureus* among HCWs. A cross-sectional study involving 102 HCWs was conducted at Alwahda hospital, Derna. Nasal and hand swabs were collected and cultured on Mannitol Salt Agar. Gram staining was performed on mannitol fermenting colonies. Slide catalase and coagulase were performed to identify *S. aureus*. An oxacillin and cefoxitin susceptibility test was carried out on Muller Hinton agar using the modified Kirby-Bauer disc diffusion method. Results: out of 102 healthcare workers, 46 (45.1%) carried *S. aureus*. The rate of methicillin resistance amongst all *S. aureus* isolates was 47.8 % (22/46) whereas 21.6 % (22/102) of all HCWs were identified as MRSA carriers. Nurses had the highest MRSA carriage with 53%, compared to other HCW. On the other hand, the highest rate of MRSA (75%) was seen in CCU workers followed by workers of pediatric and surgical wards (66%, 62% respectively). The high rate of nasal and hand MRSA carriage among healthcare workers, especially in high-risk wards, indicates the imperfection of infection control measures in our hospitals and the necessity to improve the infection control program.

Keywords: *healthcare workers; nasal carriage; hand carriage; S. aureus, MRSA*

INTRODUCTION

Staphylococcus aureus is a common commensal organism on human skin and mucosa mainly the anterior nares (Khanal et al. 2015; Lewis and Ellis 2007; Vandenesch et al. 2003) with up to 20%–30% of humans persistently colonized and 50%–60% intermittently colonized (Brooks et al. 2013). Moreover, the prevalence of 25% was found among hospital personnel (Haddadin, et al 2002). Also, the increased incidence rate of MRSA isolates that are resistant to all currently available β-lactam antibiotics is a well-documented healthcare and community phenomenon of tremendous concern to medical and public health communities around the world (Lewis and Ellis 2007).

Moreover, MRSA is endemic in many hospitals throughout the world and 50-60% of patients are merely colonized with MRSA (Shopsin et al. 2000). Excessive antibiotic usage, prolonged hospitalization, intravascular catheterization and hospitalization in the

***Corresponding Author:** Guma M. K. Abdeldaim . guma.abdeldaim@uob.edu.ly. Department of medical microbiology, Faculty of Medicine, University of Benghazi, Libya

intensive care unit are factors which contribute to MRSA (Anupurba. et al. 2003).In fact, there are three main reservoirs for MRSA in hospitals; staff, patients and inanimate objects such as beds and linens (Batabyal, et al s 2012; Hujier, And Saleem, 2008), but colonized patients are the main reservoir of MRSA (Lewis and Ellis 2007). They frequently shed MRSA, resulting in contamination of their skin, clothing, bedding, and nearby environmental surfaces (Cadnum et al. 2009; Stiefel et al. 2011).

Besides that, HCWs may carry MRSA in their noses or on their hands (usually transient carriage) following either direct or indirect contact with asymptomatic carriers or patients who have a clinical infection (Evans et al. 2008; Morgan et al. 2012). In addition, they may get infected through contact with the environment. They may then, unknowingly transmit the organism to their patients (Alruaily and Khalil 2011; Shiomori, et al 2001). Furthermore, even if medical staff correctly washes their hands, contact with contaminated environmental surfaces reduces the cleanliness of the fingers. The hands of HCWs were recognized as vectors in staphylococcal transmission as early as the 1960s (Cadnum et al. 2009; Khanal et al. 2015). The imperfect compliance with hand hygiene procedures play an important role in HCWs colonization and contribute to a high incidence of MRSA (Plipat et al. 2013). The HCWs with different kinds of occupations are all at risk to receive or mediate MRSA in the hospital.

In most countries, the percentage of MRSA in hospitals is now higher than 20%. Percentages greater than 50% are even reported in some countries (Blomquist 2006). Therefore, control of infections, screening of HCWs, and eradication of colonization may thus need to be considered (Rahbar, et al 2006). As MRSA is a major cause of healthcare-associated infections, the detection of MRSA carriers within HCWs is vital to decrease the incidence of these infections. Our study aims to screen the MRSA colonization among HCWs in Alwahda hospital, Derna.

MATERIALS AND METHODS

The study was carried out in AlWahda Hospital, Derna, Libya during the period of November – December 2013. A cross-sectional study was conducted on a total of 102 HCWs including; 63 hand swabs and 39 nose swabs.

Nasal and hands swab collection: Between 8 AM to 9 AM, nasal swabs were collected from anterior nares and hands of the HCWs using sterile cotton swabs (moistened with normal saline). The swabs were then immediately transported to the Microbiology laboratory for further processing (Cheesbrough 2006).

Culture and identification: Specimens were inoculated on blood agar and chocolate agar aerobically at 35ºC for 24 hours. Suspected colonies of *S .aureus* were tested by Gram stain, catalase test, and coagulase test. Gram-positive cocci which were catalase and coagulase-positive were inoculated on Mannitol salt agar (MSA) aerobically at 35ºC for 24 hours (Betty, et al 2007).

Antibiotic susceptibility test: Antibiotic susceptibility testing of all isolates against two types of antibiotics oxacillin and cefoxitin by using the disc diffusion method in accordance with the British Society for BSAC (Andrews and Bsac 2008). Oxacillin 1µg (Oxoid Antimicrobial Susceptibility Test Discs, Basingstoke, UK) was used to identify MRSA, in addition, the cefoxitin (second-generation cephalosporins) 30µg (Oxoid Antimicrobial Susceptibility Test Discs, Basingstoke, UK) was used for assisting in the determination of oxacillin resistance in *staphylococci*. *S. aureus*. Strains which grow and form zone diameter ≤10mm around oxacillin, and ≤14 around cefotixin, were classified as methicillin-resistant. The strains which grow

ISSN: online 2617-2186 print 2617-2178

and form zone diameter ≥13mm around oxacillin and ≥18 around cefotixin, were classified as susceptible (CLSI 2015).
Data were analyzed using SPSS 17.0.

RESULTS

Demographic Information of HCWs: The distributional pattern of demographic information of HCWs is shown in Table 1. As can be seen, the highest percentage of MRSA was observed in the age group 40-49 years (60%), and males had a higher carriage rate (53%) of MRSA than females (45.2%).

Table: 1. Demographic Information of Respondents

Demographic characteristics	*S. aureus* (n= 46)	MRSA (n= 22)	
Age group		Frequency	%
20-29	17	8	47.1
30-39	23	11	47.8
40-49	5	3	60
50-59	1	0	0.00
Gender			
Male	15	8	53.3
Female	31	14	45.2
Profession			
Doctors	12	4	33.33
Nurses	28	15	53.6
Others	6	3	50

Nasal and hand Carriage Rate of *S. aureus* and MRSA: Of 102 screening sample, *S .aureus* isolates were 46 (45.1%) which were isolated from (26 hands, 20 noses), of them 22 (47.8%) were MRSA, giving an overall positivity rate of 21.6 % (22/102) as shown in table 2. The distribution of MRSA carriage according to HCW duties is presented in fig 1. MRSA carriage was particularly high amongst nurses (53%), and cleaners (50%).
On the other hand, the highest rate of MRSA carriers (75%) were HCWs in CCU followed by pediatrics and surgery, (66% and 62% respectively) (fig 2).

Table: (2). Distribution of *S. aureus* and MRSA in noses and hands of HCWs

Specimen positive in	Sample frequency	No. of positive HCWs (%)	
		S. aureus	MRSA
Nose	39	20 (19.6)	7 (6.9)
Hands	63	26 (25.5)	15 (14.7)
Total	102	46 (45.1)	22 (21.6)

HCWs= health care workers

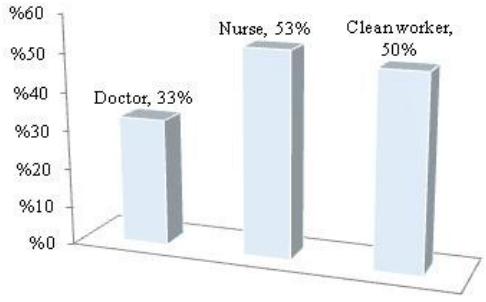


Figure (1). Distribution of MRSA in Alwhda, Derna HCWs according to the duties

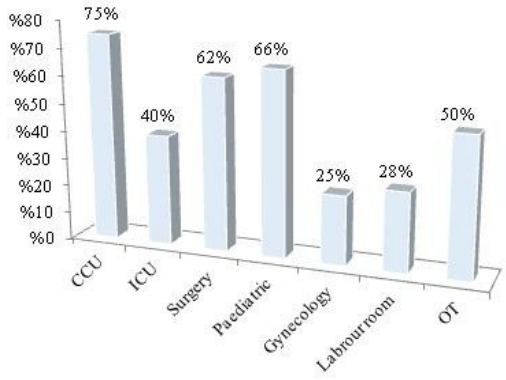


Figure: (2). Distribution of MRSA in hand and nose of HCWs according to hospital wards

DISCUSSION

S. aureus is one of the most common causes of serious infection in the community and hospitals. It is a bacterium that is naturally present with the human and is found as normal flora on the skin and anterior nares. The HCWs carriage percentage of *S. aureus* has been reported to be 45.1% and that of MRSA

ISSN: online 2617-2186 print 2617-2178

has been shown to be 21.6%. In our study, the nasal and hand carriage rate of *S. aureus* was found to be 6.9% and 14.7% respectively. This finding was similar to previous studies from Tripoli, Libya (Ahmed et al. 2012). Lower rates were reported internationally from Nepal (3.4%), Ethiopia (12.7%), and Iran (13.9%,4.6%,) (Jannati et al. 2013; Khanal et al. 2015; Rahbar, et al 2006; Shibabaw, et al 2013).Furthermore, The rate of MRSA among the HCWs carrying *S. aureus*, 47.8 % (22/ 46), is higher than the 39*%* reported by Zorgani AA., *et al* in Libya (Zorgani et al. 2009) but it is lower than that reported from Iran, Nepal and Ethiopia (21.9 %, 35%, and 44.1%) (Khanal et al. 2015; Rahbar, et al 2006; Shibabaw, et al 2013).

The differences in the carriage rate of MRSA between different studies can be attributed to variations in sampling techniques, culturing, and identification methods of MRSA. In addition, local infection control standards and the local prevalence of MRSA are important factors.

The relatively high MRSA rate in this study could be a reflection of weak compliance of HCWs with basic infection control measures; the most important of which is the hand hygiene practices. During the study, we observed that most of the medical staff were ignoring hand washing. In addition, we could not observe perfect cleaning procedures of the patient rooms, although, in some wards, the routine is to disinfect using 70 % alcohol once a week after patient discharge, which is neither perfect nor enough for sterilization of the surfaces.

Unknown carriers between patients may introduce MRSA into the hospital environment and transmit it to other patients, mainly via the transiently colonized hands of hospital staff. in order to prevent the detection of transient, short term MRSA hand carriage that may occur during a work shift Zuschneid *et al.* suggested that screening of HCWs hands should be performed before starting work duties(Zuschneid et al. 2006). This was not done in our study, where the samples were taken after the person had already started their work.

The carriage rate for *S. aureus* and MRSA differed for various professional groups. In our study; nurses were observed to have the highest colonization rate (53%) compared with other HCWs. Nurses were the most commonly colonized HCWs in other studies (Khanal et al. 2015; Rahbar, et al 2006; Shibabaw, et al 2013) although the rates obtained were far lower than our rates (7.8 %, 21.2 %, 12.9% respectively). One study has shown a higher rate of 64% amongst nurses (Askarian et al. 2009). Nurses that had a high colonization with MRSA may be attributed to their frequent contact with patients, weak experience in taking care of patients, and weak attention to the infection control policies, and most importantly, the ignorance of frequent hand washing.

Although MRSA was isolated from HCWs in all hospital wards, the prevalence of MRSA was high among the HCWs in the CCU (75%) followed by pediatric and surgical wards (66, 62 respectively). The CCU department is a site of high healthcare worker–patient contact, potentially substantial crowding, especially with a limited number of hospitals in our region; perhaps that explains the high colonization rate seen in the CCU HCWs. A much less prevalence (24%) has been shown in another study (Al-Talib et al. 2013).

Additionally, HCWs of surgical wards have the second higher rate in our study (66%), and this was higher than other countries 57.1%, 28.6 % in Nepal and Ethiopia respectively (Khanal et al. 2015; Shibabaw, et al 2013). Nevertheless, numerous studies revealed that the rate of MRSA is highest in HCWs of surgical wards (Askarian et al. 2009; Khanal et al. 2015; Shibabaw, et al

ISSN: online 2617-2186 print 2617-2178

2013; Zuschneid et al. 2006). As a consequence of HCWs having a high carriage of MRSA, the chances of transmission of the organism to patients during patient-care are highly suspected.As 62% of the isolates belonged to HCWs from the surgical ward, the vulnerability of surgical wound to infection with MRSA among the patients, following transmission from the HCWs, could explain the high rate of post-surgical wound infections that complicate and delayed postoperative recovery. The high carriage rate in the surgical ward in our study necessitates the implication of highly sophisticated infection control measures in order to prevent transmission to vulnerable operated patients.

In contrast to high rates in CCU and Surgical wards, the gynecology department has the lowest rate of MRSA carriage (25%), the same finding was revealed by.(Shibabaw, et al 2013). Within MRSA carriers, the highest rate was observed in the age group 40-49 (60%), while in a study by Shibabaw A *et al,* the highest rate was recorded in the age group 20 to 29 years (Shibabaw, et al 2013).
The increased rates of MRSA colonization among HCWs have important implications since HCWs may serve as a vector of cross-transmission to patients and may introduce the pathogen into their communities. Thus, the HCWs are not only a source but also a vector or a victim of MRSA infection (Albrich and Harbarth 2008).

Numerous studies proved that screening for nasal carriers of HCWs is very effective in controlling the spread of MRSA within different wards in hospitals since the nares and the anterior nares are important sources of MRSA (Albrich and Harbarth 2008; Cesur and Cokça 2004).

CONCLUSION

The present study indicates a high carriage rate of MRSA (47.8%) among HCWs carrying *S. aureus*. The carriage rate was high in nurses and HCWs in CCU wards. The high MRSA rate in this hospital necessitates the implementation of a protocol to control the risk of nosocomial MRSA, such as routine screening of HCWs for MRSA, susceptibility testing of isolates obtained, and education about basic infection control measures especially hand washing and disinfection. In addition, temporary layoff for colonized staff, isolation of colonized and infected patients should be taken to control the spread of MRSA infection.

REFERENCES

Ahmed, M., Elramalli, A., Amri, S., Abuzweda, A., & Abouzeed, Y. M. (2012). Isolation and screening of methicillin-resistant Staphylococcus aureus from health care workers in Libyan hospitals. *EMHJ-Eastern Mediterranean Health Journal, 18 (1), 37-42, 2012*.

Al-ruaily, Meshref Awad, and Omer Mohamed Khalil. (2011). "Detection of (MecA) Gene in Methicillin Resistant Staphylococcus Aureus (MRSA) at Prince A / Rhman Sidery Hospital , Al-Jouf , Saudi Arabia." *Journal of Medical Genetics*.

Al-Talib, H., Yean, C. Y., Hasan, H., Nik Zuraina, N., & Ravichandran, M. (2013). Methicillin-resistant Staphylococcus aureus nasal carriage among patients and healthcare workers in a hospital in Kelantan, Malaysia. *Polish Journal of Microbiology, 62*(1), 109-112.

Albrich, Werner C., and Stephan Harbarth. (2008). "Health-Care Workers: Source, Vector, or Victim of MRSA?" *The Lancet Infectious Diseases*.

Andrews, J M, and Bsac Working Party on Susceptibility Testing. (2008). "BSAC Standardized Disc Susceptibility Testing Method (Version 7)." *J Antimicrob Chemother*.

ISSN: online 2617-2186 print 2617-2178

Anupurba, S., Sen, M., Nath, G., Sharma, B., Gulati, A., & Mohapatra, T. (2003). Prevalence of methicillin resistant Staphylococcus aureus in a tertiary referral hospital in eastern Uttar Pradesh. *Indian journal of medical microbiology, 21*(1), 49.

Askarian, M., Zeinalzadeh, A., Japoni, A., Alborzi, A., & Memish, Z. A. (2009). Prevalence of nasal carriage of methicillin-resistant Staphylococcus aureus and its antibiotic susceptibility pattern in healthcare workers at Namazi Hospital, Shiraz, Iran. *International Journal of Infectious Diseases, 13*(5), e241-e247.

Batabyal, B, Kundu GKR, and S Biswas. (2012). "Methicillin-Resistant Staphylococcus Aureus: A Brief Review ." *I Res J Biological Sci*.

Betty, A., A. Daniel, and W. Alice. (2007). *Diagnostic Microbiology*. 12th ed. St Louis, United State: Elsevier - Health Sciences Division.

Blomquist, Preston Howard. (2006). "Methicillin-Resistant Staphylococcus Aureus Infections of the Eye and Orbit (an American Ophthalmological Society Thesis)." *Transactions of the American Ophthalmological Society*.

Brooks, G., K. C. Carroll, J. Butel, and S Morse. (2013). *Jawetz, Melnick, & Adelberg's Medical Microbiology*. 26th ed. New York: McGraw Hill Professional.

Chang, S., Sethi, A. K., Eckstein, B. C., Stiefel, U., Cadnum, J. L., & Donskey, C. J. (2009). Skin and environmental contamination with methicillin-resistant Staphylococcus aureus among carriers identified clinically versus through active surveillance. *Clinical infectious diseases, 48*(10), 1423-1428.

Cesur, Salih, and Fügen Cokça. (2004). "Nasal Carriage of Methicillin-Resistant Staphylococcus Aureus among Hospital Staff and Outpatients." *Infection control and hospital epidemiology*.

Cheesbrough, Monica. (2006). *District Laboratory Practice in Tropical Countries*. 2nd ed. New York: Cambridge University Press.

CLSI. (2015). Vol. 35 No. 3 *CLSI Performance Standards for Antimicrobial M100-S23*.

Evans, R. Scott et al. (2008). "Rapid Identification of Hospitalized Patients at High Risk for MRSA Carriage." *Journal of the American Medical Informatics Association*.

Haddadin, A., S. Fappiano, and P. Lipsett. (2002). "Methicillin-Resistant Staphylococcus Aureus (MRSA) in the Intensive Care Unit." *Postgraduate medical journal* 78(921): 385–92.

Hujier, Abu, and Niddal Saleem. (2008). "Detection of Methicillin-Resistant Staphylococcus Aureus in Nosocomial Infections in Gaza Strip." *African Journal of Microbiology Research* 2(9): 235–41.

Jannati, E., Arzanlou, M., Habibzadeh, S., Mohammadi, S., Ahadi, P., Mohammadi-Ghalehbin, B., Dogaheh, H. P., Dibah, S., & Kazemi, E. (2013). Nasal colonization of mecA-positive, oxacillin-susceptible, methicillin-resistant Staphylococcus aureus isolates among nursing staff in an Iranian teaching hospital. *American journal of infection control, 41*(11), 1122-1124.

Lewis, James S., and Michael W. Ellis. (2007). "Approaches to Serious Methicillin-

ISSN: online 2617-2186 print 2617-2178

Resistant Staphylococcus Aureus Infections with Decreased Susceptibility to Vancomycin: Clinical Significance and Options for Management." *Current Opinion in Infectious Diseases*.

Morgan, D. J., Rogawski, E., Thom, K. A., Johnson, J. K., Perencevich, E. N., Shardell, M., Leekha, S., & Harris, A. D. (2012). Transfer of multidrug-resistant bacteria to healthcare workers' gloves and gowns after patient contact increases with environmental contamination. *Critical care medicine, 40*(4), 1045.

Plipat, Nottasorn, Ian H. Spicknall, James S. Koopman, and Joseph N.S. Eisenberg. (2013). "The Dynamics of Methicillin-Resistant Staphylococcus Aureus Exposure in a Hospital Model and the Potential for Environmental Intervention." *BMC Infectious Diseases*.

Rahbar, Mohammed, Mohammed Karamiyar, and Rassol Gra-Agaji. (2006). "Nasal Carriage of Methicillin-Resistant Staphylococcus Aureus Among Healthcare Workers of an Iranian Hospital." *Infection Control & Hospital Epidemiology* 24(04): 236–37.

Shibabaw, Agumas, Tamrat Abebe, and Adane Mihret. (2013). "Nasal Carriage Rate of Methicillin-Resistant Staphylococcus Aureus among Dessie Referral Hospital Health Care Workers; Dessie, Northeast Ethiopia." *Antimicrobial Resistance and Infection Control*.

Shiomori, T., H. Miyamoto, and K. Makishima. (2001). "Significance of Airborne Transmission of Methicillin-Resistant Staphylococcus Aureus in an Otolaryngology-Head and Neck Surgery Unit." *Archives of Otolaryngology - Head and Neck Surgery*.

Shopsin, B., Mathema, B., Martinez, J., Ha, E., Campo, M., Fierman, A., Krasinski, K., Kornblum, J., Alcabes, P., & Waddington, M. (2000). Prevalence of methicillin-resistant and methicillin-susceptible Staphylococcus aureus in the community. *The Journal of infectious diseases, 182*(1), 359-362.

Stiefel, U., Cadnum, J. L., Eckstein, B. C., Guerrero, D. M., Tima, M. A., & Donskey, C. J. (2011). Contamination of hands with methicillin-resistant Staphylococcus aureus after contact with environmental surfaces and after contact with the skin of colonized patients. *infection control and hospital epidemiology, 32*(2), 185-187.

Vandenesch, F., Naimi, T., Enright, M. C., Lina, G., Nimmo, G. R., Heffernan, H., Liassine, N., Bes, M., Greenland, T., & Reverdy, M.-E. (2003). Community-acquired methicillin-resistant Staphylococcus aureus carrying Panton-Valentine leukocidin genes: worldwide emergence. *Emerging infectious diseases, 9*(8), 978.

Vonberg, R.-P., Stamm-Balderjahn, S., Hansen, S., Zuschneid, I., Rüden, H., Behnke, M., & Gastmeier, P. (2006). How often do asymptomatic healthcare workers cause methicillin-resistant Staphylococcus aureus outbreaks? A systematic evaluation. *Infection Control & Hospital Epidemiology, 27*(10), 1123-1127.

Zorgani, A., Elahmer, O., Franka, E., Grera, A., Abudher, A., & Ghenghesh, K. (2009). Detection of meticillin-resistant Staphylococcus aureus among healthcare workers in Libyan hospitals. *Journal of Hospital Infection, 73*(1), 91-92.

ISSN: online 2617-2186 print 2617-2178

معدل حمل الأنف واليدين للمكورات العنقودية الذهبية المقاومة للميثيسيلين بين عمال الرعاية الصحية في مستشفى الوحدة، درنة

حسين خنفر[1]، دلال ذاوود[2]، إلهام عبد ربه [3]، إنتصار عمران[2]، جمعة عبدالدائم[2]*

[1]عيادة كرسة، ليبيا

[2]قسم الأحياء الدقيقة الطبية، كلية الطب البشري جامعة بنغازي، ليبيا

[3] قسم الأحياء الدقيقة الطبية، كلية الطب البشري جامعة عمر المختار، ليبيا

تاريخ الاستلام: 19 أغسطس 2019 / تاريخ القبول: 30 ديسمبر 2019
Doi:https://doi.org/10.54172/mjsc.v34i4.166

المستخلص: تعتبر زيادة حالات المكورات العنقودية الذهبية المقاومة للميثيسيلين (MRSA) من ظواهر الرعاية الصحية والمجتمعية الموثقة جيدًا وتثير اهتمام االمجتمعات الطبية والرعاية الصحية العامة في جميع أنحاء العالم. أحد أهم مصادر عدوى MRSA في المستشفيات هو عمال الرعاية الصحية (HCWs) من خلال حمل هذه البكتيريا عن طريق الأنف أو الأيدي. لذلك كان الهدف من هذه الدراسة هو تحديد معدل المكورات العنقودية الذهبية المقاومة للميثيسيلين بين عاملي الرعاية الصحية. أجريت دراسة مستعرضة شملت 102 من العاملين في مجال الرعاية الصحية في مستشفي الوحدة درنة. حيث تم جمع المسحات من أنوف وأيدي العاملين وزرعها على أجار المانيتول الملحي. وبعد عزل البكتيريا وعمل الاختبارات الكيموحيوية لتعريف المكورات العنقودية الذهبية، تم إجراء اختبار الحساسية للمضادات الحيوية الأوكساسيللين وسيفوكسيتين على أجار المولر هينتون باستخدام طريقة الأقراص المنتشرة. حيث اظهرت النتائج إنه من بين 102 من العاملين في مجال الرعاية الصحية، 46 (45.1%) كانوا حاملين للمكورات العنقودية الذهبية. وكان معدل مقاومة المثيسيللين بين المكورات العنقودية الذهبية 47.8% (22\46) بينما 21.6 % (22/102) من كل العاملين في مجال الرعاية الصحية وبالتالي هم حاملون المكورات العنقودية الذهبية المقاومة للميثيسيلين. نسبة الحاملين للمكورات العنقودية الذهبية المقاومة للميثيسيلين كانت أعلى بين الممرضات بنسبة (53%). وكان أعلي معدل للمكورات العنقودية الذهبية المقاومة للميثيسيلين بين العاملين في عناية القلب المركزة (75%) يتبعها العاملون في أقسام الأطفال والجراحة (66% –62%) على التوالي. ارتفاع معدل حاملي المكورات العنقودية الذهبية المقاومة للميثيسيلين في اليد والأنف للعاملين في مجال الرعاية الصحية خاصة في الاقسام العالية الخطورة يشير إلى النقص في السيطرة علي العدوي في مستشفياتنا، والحاجة لتحسين برامج مكافحة العدوى.

الكلمات المفتاحية : عمال الرعاية الصحية، حمل الأنف، حمل اليدين، المكورات العنقودية الذهبية المقاومة للميثيسيلين

*جمعة عبد الدائمguma.abdeldaim@uob.edu.ly، قسم الأحياء الدقيقة الطبية، كلية الطب البشري جامعة بنغازي، ليبيا

Al-Mukhtar Journal of Sciences 34 (4): 332-349, 2019

Identification and Morphological Description of *Xylocopa* species (Xylocopidae: Hymenoptera) in North East of Libya

Marwa Y. H. Elmabruk and Ali A. Bataw*

Department of Zoology, Faculty of Science, Omar Almukhtar University Al-Bayda, Libya

Received: 25 August 2019/ Accepted: 30 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.165

Abstract: The paper aimed to identify and describe the taxonomic morphological structure of *Xylocopa* species in North Eastern Libya. The samples were collected from different natural sites of Aljabal Alakhder region, identified, and morphological description and measurements of body length (in cm) (From antennal base to apical of pygidium), front wings length, thorax, and abdomen width were conducted, four species of *Xylocopa* were identified and described morphologically, which includes *Xylocopa (Koptortosoma) pubescens* Spinola, 1838, *Xylocopa (Proxylocopa) olivieri* Lepeletier 1841, *Xylocopa (Rhysoxylocopa), amedaei* Lepeletier, *1841, Xylocopa iris* (Christ, 1791). Our conclusion revealed that the investigated area was diverse with *Xylocopa* species and insists on the importance of descriptive study to supply taxonomic information.

Keywords: *Xylocopa*; Xylocopinae; Morphology; Identification; Libya

INTRODUCTION

Large carpenter bees, species of the genus Xylocopa Latreille, 1802, are considered as one of the important floral visitors and bee pollinators of flowering plants in many terrestrial ecosystems, including both agricultural plants and non-agricultural settings (Gerling et al., 1989; Hurd, 1963; Keasar, 2010; Mawdsley et al., 2016).

The genus Xylocopa includes about 450 species (Michener, 2007). The classification of subfamily Xylocopinae (Hymenoptera: Apidae) includes bees that are superficially very varied: in Israel, they are large and robust (13 to 33 mm long) Xylocopini as opposed to the small and slender (3 to 13 mm) Allodapini, Ceratinini and Manueliini (Michener, 2007). Xylocopini (Xylocopa Latreille 1802: subgenera Copoxyla Maa, Ctenoxylocopa Michener, Koptortosoma Gribodo, Proxylocopa Hurd and Moure and Xylocopa Lepeletier), follow the higher classification of (Michener, 2007; Minckley, 1998).
Xylocopa generally, being black, metallic bluish or greenish-black, or purplish-blue. Some males have yellowish areas on the face. Both sexes may have pale or yellowish pubescence on the thorax, legs, or abdomen, but these hairs are not as abundant or as intensely colored as in bumble bees. Large carpenter bees are readily distinguished from bumble bees primarily by the absence of pubescence on the dorsum of the abdomen, which is somewhat shiny (Michener, 2007). As noted by (Eardley, 1983), the taxonomy of species in this subgenus has been based largely on characteristics of body size and coloration, particularly the color of the pale pubescence on the mesosoma and metasoma of the females, which ranges from white to bright yellow. (Cockerell, 1908) used total body length and forewing length as diagnostic characters in a key to separate the different species.

Many of the Libyan endemic wild bee species are predominantly found on restricted mountain habitats Aljabale Alakhder (Zavattari, 1934). The area of Cyrenaica is considered to be one of the most densely populated areas of wild and cultivated flora. The studies of wild bees were limited to ancient studies from the Italian colonial period (Zavattari, 1934).

***Corresponding Author:** Ali A. Bataw ali.bataw@omu.edu.ly , Department of Zoology, Faculty of Science, Omar Almukhtar University, *Al-Bayda, Libya*

The diversity and taxonomic description of Xylocopa species in the North East Libya region are still poorly known. The main objective of this research is to identify and describe the taxonomic morphological characteristics of some bee species in North East Libya to provide taxonomical information that facilitates species identifications.

MATERIALS AND METHODS

Study sites: The samples were collected from different natural sites of Aljabal alakhder region Eastern part of Libya (Cyrenaica): Elbaida, 32°45'40.4"N 21°44'51.4"E (619m) Cyrene 32°48'55.99"N 21°2'05.13"E (634 m), Alwasita 32°51'08.83"N 21°43'43.91"E (336 m) and Sussa 32°53'47.86"N 21°58'15.74"E. (15 m) These locations characterized by coverage with dense wildflowers of *Stachys tourneforti, Anchusa hybridia, Notobasis syriaca*…etc, and flowers of cultivated plants such as almond, apple, and other vegetable.

Collecting Bees

In the Field: A biological survey for wild bees was conducted during different seasons (2014–2018), and collection was on a sunny day between 09:00 and 18:00 throughout the entire flowering period of the wild plants (February - September). Bees were collected with sweep nets and aspirators. The collected bee specimens were kept in glass jars filled with paper tissues to avoid bee damage, and some drops of ethyl acetate to kill the bees. After the killing process, the specimens were stored in paper envelopes. Time and date of visited flowers were documented for each specimen. The coordinates were recorded for each site with a global positioning system (GPS) device.

In the Laboratory: Specimens were pinned and mounted, each specimen was labeled with an independent label containing the collecting time, date, and area of collection. All specimens were kept in wooden insect boxes supplied with foam plates for pinning and naphthalene balls to enable long storage without pest damage.

Identification of specimens: Identification was carried out by using available references (Hurd, 1963; Maa, 1970; Michener, 2007; Terzo & Rasmont, 2014; Warncke, 1982), and all specimens confirmed by International Bees specialists.

3.4. Morphological description

The bee's description includes:

Measurements :Body length (in cm) (From antennal base to apical of pygidium), front wings length, thorax and abdomen width.

Body color

Head: structure of vertex surface, compound eye, ocelli, clypeus, labrum, antenna, mouthparts, mandibles, genal area, facial fovea.

Thorax: thorax structure, tegula, wing, legs structures

Abdomen: tergum, sternum and pygidial plate**.**

Morphological terminology used in the descriptions of bees follows (Michener, 2007). Photographs of different morphological structures were taken by using a stereomicroscope equipped with an Olympus digital camera. All specimens were deposited in collection wood boxes in the entomology laboratory of the Zoology Department, Faculty of Sciences, Omar Almukhtar University.

RESULTS

Xylocopa (Koptortosoma) pubescens Spinola, 1838

= *Xylocopa aestuans* L., 1758

Examined material: ♀1 Albaida 15.7.2014, 4 Sussa 20.6.2018.

19-22 mm body length, body fairly robust, integument black or dark brown (Fig. 1).

ISSN: online 2617-2186 print 2617-2178

Figure (1). Adult of (♀) *Xylocopa pubescens*.

Head: rounded and slightly narrower than the body, dense white setae, densely punctate, vertex curved to the inside with long black setae erected to the outside (Fig. 2).

Figure (2). The head of (♀) *Xylocopa pubescens*.

Compound eye: dark brown with small short scattered setae, dense long black setae between compound eyes, paraocular carina clear, genal area wide.
Ocelli: triangle shape, small, dark brown, the lateral ocelli less than the height level of compound eyes, the median ocellus aligned with frontal line (Fig. 3).

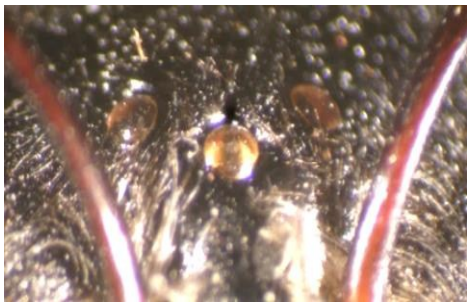


Figure (3). Ocelli of (♀) *Xylocopa pubescens*.

Clypeus: black, the end of apical with two lateral extensions, long dark brown setae erected to down, densely punctate.

Mandibles: rectangular, elongated, black, bidentate at apex, apical tooth slightly longer than preapical tooth, black lope at the connected area with the malar area, outer ridge clear, little punctates (Fig. 4).

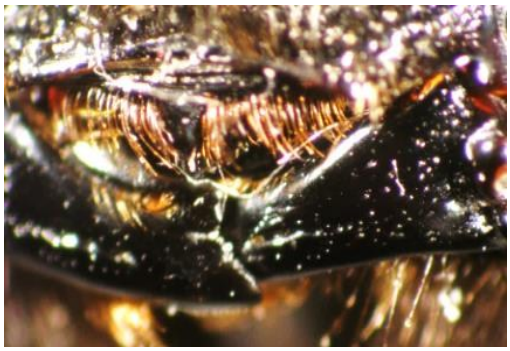


Figure (4). Mandible of (♀) *Xylocopa pubescens*.

Labrum: short projection on a triangular shape, black.
Mouthparts: long, galea black at the base, dark brown at the apical, glossa light brown with dense short light brown setae (Fig.. 5).

Figure (5). Mouthparts of (♀) *Xylocopa pubescens*.

Antennae: twelve segments, antennal socket dark brown, scape long, rectangular, curved at the apical, dark brown to black, pedicel short, rounded, black, apical edge dark brown, flagellum ten segments, the first flagellomere longer than the rest of the other flagellomeres, narrower at the base, wider at the apical, black and apical edge light brown, the other tenth flagellomeres equal in the shape and size, light

ISSN: online 2617-2186 print 2617-2178

brown, the terminal flagellomere of antennae in sharp form (Fig. 6).

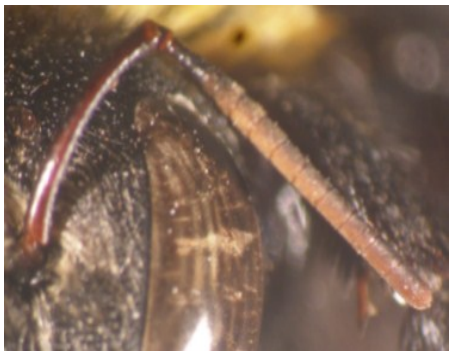


Figure (6). Antenna of (♀) *Xylocopa pubescens*.

Thorax: width across thorax 4 mm, prothorax larger than mesothorax and metathorax, black, dense long yellow setae cover the thorax surface (fig. 7), tegula clear, large, dark brown.

Figure (7). Thorax of (♀) *Xylocopa pubescens*.

Wings: forewings length 6 mm, dark brown, the veins darker brown, marginal cell long and wider at the middle, extended along the edge of the wing, the apical of marginal cell not jointed with costa vein, three submarginal cells, 3smc larger than 1smc and 2smc, 2smc smaller than 1smc and 3smc, vein Rs (2^{nd} abscissa) curved, vein 1rs-m with the same line vein 1m-cu, vein 2rs-m curved outward, vein 2m-cu meets median vein opposite third submarginal cell, basal vein straight, the lower end meeting the longitudinal vein at an acute angle (fig. 8a), the jugal lobe of hindwing is short, less than half the length of vannal lobe, and not nearly reaching the vein closing the cubital cell (Fig. 8b).

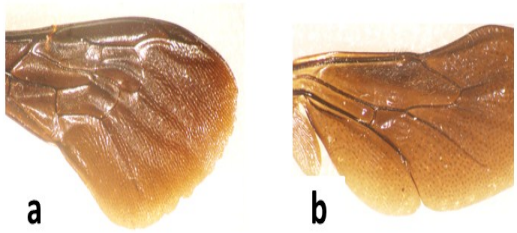


Figure (8). a- forewing, b- hindwing of *(♀) Xylocopa pubescens*.

Legs: coxa elongated, triangular, dark brown with dense short black setae, trochanter rectangular, narrower at the base, wider at the apical, dark brown with long black setae, femur wider at the base, narrower at the apical, dark brown with dense long black setae erected downwards, tibia narrower at the base, wider at the apical, dark brown with dense long black setae, tibial spur ciliated from each side, long, black, forelegs and midlegs with one tibial spur (fig. 9a), hind legs with two tibial spurs, tibial spine one each leg, tarsus five segments in each leg, basitarsus longer than mediotarsus and distitarsus, dark brown with dense long black setae erected downwards, mediotarsus three segments equal in the shape and size, dark brown with little long black robust setae erected downwards at the apical, distitarsus is longer than mediotarsus, narrower at the base, wider at the apical, dark brown with little black setae (Fig. 9b).

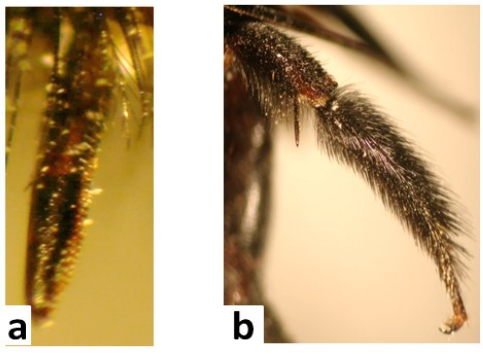


Figure (9). a-Tibial spur, b-Midleg of (♀) *Xylocopa pubescens*.

Pair of elongated tarsal claws, branched at apical, the lateral longer than the internal one,

ISSN: online 2617-2186 print 2617-2178

the base dark brown, apical black, arolium with short yellow setae (Fig. 10).

Figure (10). Tarsal claws of (♀) *Xylocopa pubescens*.

Abdomen: width across abdomen 8 mm, six segments, black with dark brown color bands at apical edges, densely punctate, tergum II wider than the rest of the other terga, tergum VI triangle-shaped, narrower than the rest of the other terga (fig. 11a), the pygidial plate black, relatively narrow and extend across tergum VI with dense long dark brown robust setae erected downwards, dense long black setae at the edges, sternum the base dark brown, apical black, dense black setae at the apical edge of each sternum, sterna I to III has a meeting area in the middle (Fig.11b).

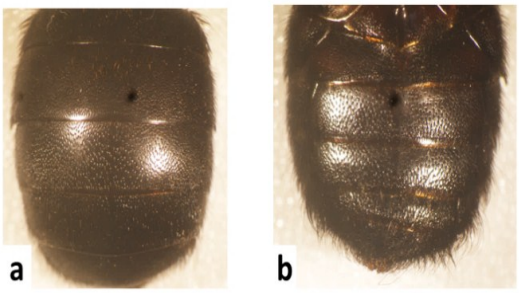


Figure (11). a- Tergum, b- Sternum of (♀) *Xylocopa pubescens*.

Xylocopa (Proxylocopa) olivieri lepeletier 1841

Examined material: ♂1 Albaida 15.7.2014.

16 mm body length (fig. 12).

Figure (12). Adult of (♂) *Xylocopa olivieri*.

Head: triangular, narrower than the body, black, densely punctate, vertex simple, curved to the inside with long light brown setae erected to the outside.

Compound eyes: light brown and occupy most of the head, dense long light brown setae between compound eyes, paraocular carina clear, genal area narrow.

Ocelli: triangle-shaped, dark brown, the median ocellus bigger in the size than the lateral ocelli, the lateral ocelli less than the height level of compound eyes, the median ocellus with frontal line (Fig. 13).

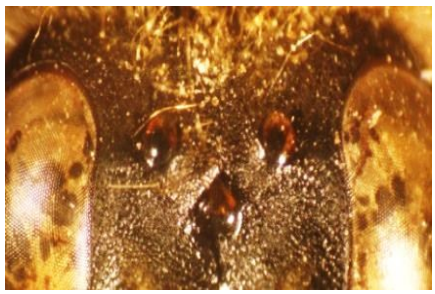


Figure (13). Ocelli of (♂) *Xylocopa olivieri*.

Clypeus: clear, reddish brown, densely punctate (Fig. 14).

paraocular lobe: clear, dark brown.

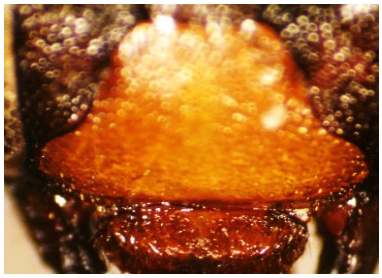


Figure (14). Clumps' of (♂) *Xylocopa olivieri*.

ISSN: online 2617-2186 print 2617-2178

Mandibles: rectangular, dark brown, wider at the base, narrower at the apical, bidentate at apex, apical tooth longer than the preapical tooth, two condylar ridges clear, densely punctate especially at the base (Fig. 15).

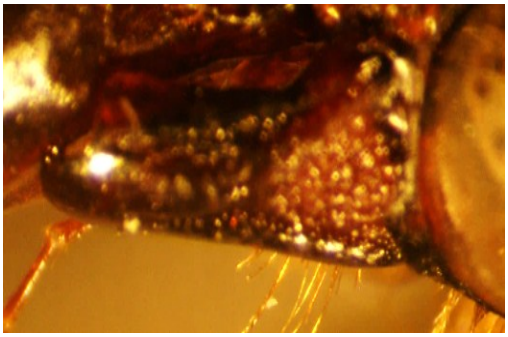


Figure (15). Mandible of (♂) *Xylocopa olivieri*.

Labrum: rectangular, dark brown, densely punctate.

Mouthparts: long, galea dark brown, glossa light brown with dense short light brown setae erected to down (Fig. 16).

Figure (16). Mouthparts of (♂) *Xylocopa olivieri*.

Antennae: thirteen segments, dark brown, scape long, rectangular, curved at the apical, pedicel short, rounded, flagellum eleven segments, the first flagellomere longer than the rest of the other flagellomeres, narrower at the base, wider at the apical, the other tenth flagellomeres equal in the shape and size, the terminal flagellomere of antennae is rounded form (Fig. 17).

Figure (17). Antenna of (♂) *Xylocopa olivieri*.

Thorax: width across thorax 8-9 mm, prothorax larger than mesothorax and metathorax, black, densely punctate, dense long yellow setae (Fig. 18), tegula clear, large, dark brown.

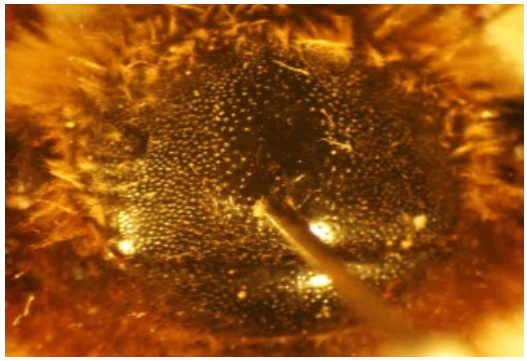


Figure (18). Thorax of (♂) *Xylocopa olivieri*.

Wings: forewings length 14 mm, transparent brown, the veins dark brown, vein Sc+R black, marginal cell long and narrow, marginal cell darker than the rest of the wing, the apical of marginal cell not jointed with costa vein, three submarginal cells, 3smc larger than 1smc and 2smc, 2smc smaller than 1smc and 3smc, vein Rs (2^{nd} abscissa) curved, vein 1rs-m with the same line vein 1m-cu, vein 2rs-m curved outward, vein 2m-cu meets median vein opposite third submarginal cell, basal vein slightly and evenly arched, the lower end meeting the longitudinal vein at an acute angle (fig. 19), the jugal lobe of hindwing is short, less than half the length of the vannal lobe, and not nearly reaching the vein closing the cubital cell.

ISSN: online 2617-2186 print 2617-2178

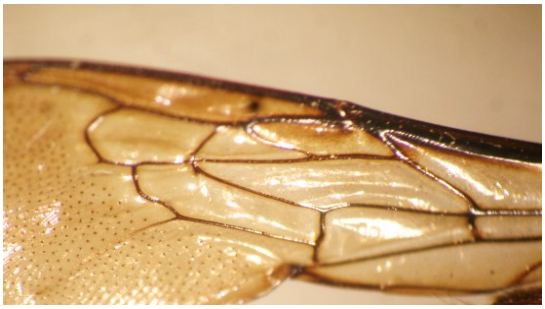


Figure (19). Forewing of (♂) *Xylocopa olivieri*.

Legs: coxa triangle, light brown with little long yellow setae, trochanter narrower at the base, wider at the apical, light brown with little long yellow setae, fumer wider at the base, narrower at the apical, dark brown with long yellow setae erected downwards, tibia long, narrower at the base, wider at the apical, light brown with dense long yellow setae erected downwards, tibial spur one on each leg, ciliated, pointed at the apical, dark brown, tibial spine one on each leg, tarsus five segments on each leg, basitarsus longer than mediotarsus and distitarsus, dark brown with dense long yellow setae, mediotarsus three segments equal in the shape and size with little long yellow robust setae erected downwards at the apical, distitarsus longer than mediotarsus, narrower at the base, wider at the apical, dark brown with little short yellow robust setae erected downwards at the apical (Fig. 20).

Figure (20). Distitarsus of (♂) *Xylocopa olivieri.*

Pair of elongated tarsal claws branched at apical, the lateral longer than the internal one, the base dark brown, apical black, arolium with short yellow setae (Fig. 21). setae (Fig. 21).

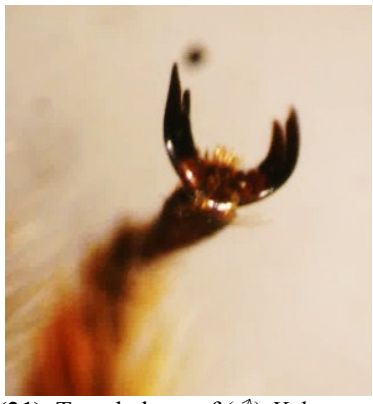


Figure (21). Tarsal claws of (♂) *Xylocopa olivieri*.

Abdomen: width across abdomen 9 mm, seven segments, black with dark brown color bands at apical edges, dense long yellow setae, densely punctate, tergum II is wider than the rest of the other terga, tergum VII is a semi-rounded shape, narrower than the rest of the other terga, edges with bands of dense yellow setae (Fig.. 22a), sternum each sternum has a little curve at the apical with a bond of dense long light brown setae (Fig. 22b).

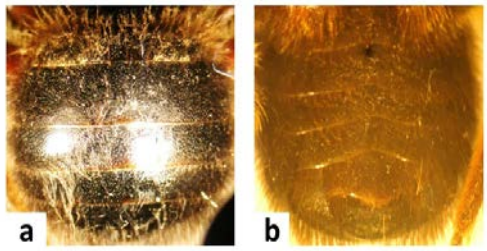


Figure (22). a- Tergum, b- Sternum of (♂) *Xylocopa olivieri*.

Xylocopa (Proxylocopa) olivieri lepeletier **1841**

Examined material: ♀1 Albaida 20.7.2014.

24 mm body length (Fig. 23).

ISSN: online 2617-2186 print 2617-2178

Figure (23). Adult of (♀) *Xylocopa olivieri*.

Head: rounded and slightly narrower than the body, black, densely punctate, vertex simple, curved to the inside with dense long light brown setae erected to the outside (fig. 24).

Figure (24). The head of (♀) *Xylocopa olivieri*.

Compound eyes: light brown, dense long light brown setae between compound eyes, paraocular carina is clear, genal area is wide.

Ocelli: triangle shape, bright brown, the lateral ocelli is less than the height level of compound eyes, median ocellus aligned with frontal line.

Clypeus: dark brown, the end of apical is thick, small long light brown setae, densely punctate.

Paraocular lobe: clear, dark brown.

Mandibles: rectangular, dark brown at the base, black at the apical, bidentate at the apex, apical tooth longer than the preapical tooth, sharp teeth, dark brown lope at the connecting area with the malar area, malar area dark brown, outer ridge and condylar ridge clear with little long light brown setae, acetabular groove clear, outer groove clear, condylar groove clear (Fig. 25).

Figure (25). Mandible of (♀) Xylocopa *olivieri*.

Labrum: short projection on triangular shape, black.

Mouthparts: long, galea dark brown, glossa light brown with little short light brown setae erected downwards (Fig. 26).

Figure (26). Mouthparts of (♀) Xylocopa *olivieri*.

Antennae: twelve segments, dark brown, antennal socket dark brown, scape long, curved at the apical, narrower at the base, wider at the apical, pedicel short, rounded, flagellum ten segments, the first flagellomere longer than the rest of the other flagellomeres, narrower at the base, wider at the apical, the other ninth flagellomeres equal in shape and size, the terminal flagellomere of antennae is in a sharp form (Fig. 27).

Figure (27). Antenna of (♀) *Xylocopa olivieri*.

Thorax: width across thorax 8 mm, prothorax larger than mesothorax and metathorax, black,

ISSN: online 2617-2186 print 2617-2178

densely punctate, dense long light brown setae, tegula clear, large, dark brown (Fig. 28).

Figure (28). Thorax of (♀) *Xylocopa olivieri*.

Wings: forewings length 17 mm, transparent brown, the veins dark brown, vein Sc+R black, marginal cell long and narrow, marginal cell darker than the rest of the wing, the apical of the marginal cell is not jointed with costa vein, three submarginal cells, 3smc larger than 1smc and 2smc, vein 1rs-m with the same line vein 1m-cu, vein 2rs-m curved outward, vein 2m-cu meets median vein opposite the third submarginal cell, basal vein straight and evenly arched, the lower end meeting the longitudinal vein at an acute angle (fig. 29a), the jugal lobe of hindwing is very short, much less than half the length of the vannal lobe, and not reaching anywhere near as far as the vein closing the cubital cell (fig. 29b).

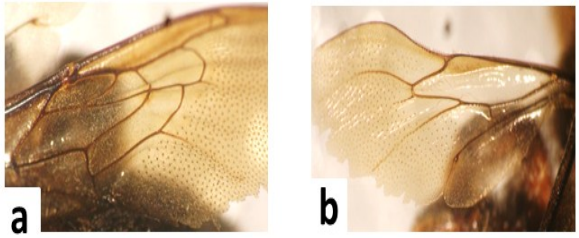


Figure (29). a- Forewing, b- Hindwing of (♀) *Xylocopa olivieri*.

Legs: coxa triangular, dark brown with dense long dark brown setae, trochanter rectangular, narrower at the base, wider at the apical, dark brown with dense dark brown setae at the edges, Fumer wider at the base, narrower at the apical, dark brown with long black setae erected downwards, tibia rectangular, wider at the base, narrower at the apical, dark brown with dense long black setae erected downwards, tibial spur one on each leg, ciliated from each side, dark brown, tibial spur of forelegs short, tibial spur of midlegs and hind legs long, tibial spine one on each leg, tarsus five segments on each leg, basitarsus longer than mediotarsus and distitarsus, dark brown with dense long dark brown setae erected downwards of forelegs, dark brown with dense long reddish brown setae erected downwards of midlegs and hind legs, mediotarsus three segments equal in shape and size, dark brown with little long reddish brown robust setae erected downwards at the apical, distitarsus longer than mediotarsus, narrower at the base, wider at the apical, dark brown with little short reddish brown robust setae erected downwards at the apical (Fig. 30), tarsus of hind legs with dense long reddish brown setae more than the forelegs and midlegs.

Figure (30). Hind leg of (♀) *Xylocopa olivieri*.

Pair of elongated tarsal claws, branched at apical, the lateral longer than the internal one, the base dark brown, apical black, arolium with short yellow setae (Fig. 31).

Figure (31). Tarsal claws of (♀) *Xylocopa olivieri*.

ISSN: online 2617-2186 print 2617-2178

Abdomen: width across abdomen 10 mm, six segments, the base black, apical dark brown, each tergum with dense long light brown setae, terga from I to V equal in the shape and size, tergum VI triangle shape, narrower than the rest of the other terga, dense long dark brown setae at the edges (Fig. 32a), sternum dark brown with dense long reddish-brown setae erected downwards especially at the edge of each sternum (Fig. 32b).

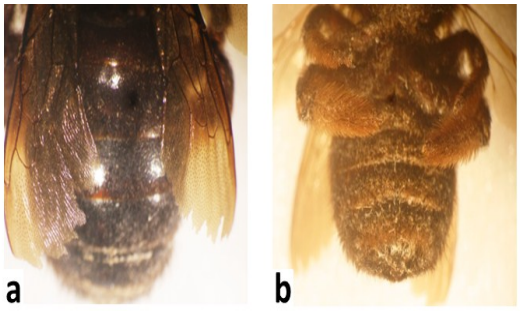


Figure (32). a- Tergum, b- Sternum of (♀) *Xylocopa olivieri*.

Xylocopa (Rhysoxylocopa) amedaei
Lepeletier, 1841

Examined material: ♀1 Albaida 15.6.2012.

20 mm body length (Fig. 33).

Figure (33). Adult of (♀) *Xylocopa amedaei* .

Head: rounded and slightly narrower than the body, black, densely punctate, vertex simple and curved to the inside with dense long black setae erected to the outside.

Compound eyes: bright black, dense short light brown setae between compound eyes, paraocular carina clear, genal area is wide.

Ocelli: triangle shape, dark brown, the lateral ocelli less than the height level of compound eyes, median ocellus aligned with frontal line.

Clypeus: dark brown, the end of apical with two lateral extensions curved to the inside, densely punctate, dense long dark brown setae erected downwards.

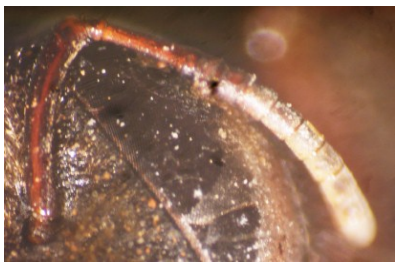
Mandibles: rectangular, wider at the base, narrower at the apical, bidentate at apex, apical tooth longer than preapical tooth, black with black lope at the connecting area with the malar area, outer groove clear, densely punctate especially at the base (fig. 34).

Figure (34). Mandible of (♀) *Xylocopa amedaei*.

Labrum: short projection on triangular shape, black,

Mouthparts: long, galea dark brown, glossa light brown with long light brown setae erected downwards.

Antennae: twelve segments, dark brown, antennal socket dark brown, scape long, curved at the apical, pedicel short, rounded, flagellum ten segments, the first flagellomere longer than the rest of the other flagellomeres, narrower at the base, wider at the apical, the other nine flagellomeres equal in shape and size, the terminal flagellomere of antennae in a sharp form (Fig. 35).



ISSN: online 2617-2186 print 2617-2178

Figure (35). Antennae of (♀) Xylocopa *amedaei*.

Thorax: width across thorax 5 mm, prothorax larger than mesothorax and metathorax, black, dense long light brown setae, densely punctate, tegula clear, large, black (Fig. 36).

Figure (36). Thorax of (♀) Xylocopa *amedaei*.

Wings: forewings length 17 mm, light brown, the veins dark brown, vein Sc+ R black, marginal cell long and narrow, marginal cell darker than the rest of the wing, the apical of marginal cell not jointed with costa vein, three submarginal cells, 3smc longer than 1smc and 2smc, vein 1rs-m with the same line vein 1m-cu, vein 2rs-m curved outward, vein 2m-cu meets median vein opposite third submarginal cell, basal vein straight, the lower end meeting the longitudinal vein at an acute angle (Fig. 37a), jugal lobe of hindwing very short, much less than half the length of the vannal lobe, and not reaching anywhere near as far as vein closing cubital cell (Fig. 37b).

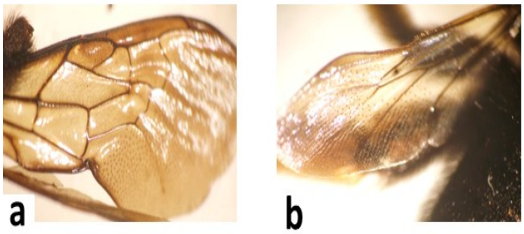


Figure (37). a- Forewing, b- Hindwing of *Xylocopa amedaei*.

Legs: trochanter narrower at the base, wider at the apical, dark brown with dense black setae at the edges, fumer long, rectangular, dark brown with dense long black setae erected downwards, tibia elongated, wide, dark brown with dense long black setae erected downwards of forelegs and midlegs, dark brown with dense long reddish brown setae erected downwards of hind legs, tibial spur ciliated at inner edge, sharp at the outer edge, dark brown, forelegs with one tibial spur, short, midlegs with one tibial spur, long, hind legs with two tibial spurs, long, tibial spine one each leg, tarsus five segments on each leg, basitarsus longer than mediotarsus and distitarsus, dark brown with dense long black robust setae erected downwards of forelegs, dense long reddish brown robust setae erected downwards of midlegs and hind legs, mediotarsus three segments equal in shape and size, dark brown with little reddish-brown robust setae at the apical, distitarsus longer than mediotarsus, narrower at the base, wider at the apical, dark brown with little short reddish-brown robust setae erected downwards at the apical (Fig. 38).

Figure (38). Midleg of (♀) Xylocopa *amedaei*.

Pair of elongated tarsal claws, branched at apical, the lateral longer than the internal one, the base dark brown, apical black, arolium with short yellow setae (Fig. 39)

Figure (39). Tarsal claws of (♀) Xylocopa *amedaei*.

Abdomen: width across abdomen 5 mm, six segments, black, dense black setae, tergum II wider than the rest of the other terga, tergum VI semi-rounded shape, narrower than the rest of the other terga, sternum black with dense

ISSN: online 2617-2186 print 2617-2178

long light brown setae erected downwards (Fig. 40a), sternum I narrower at the apical, dense long black setae at the edges (Fig. 40b).

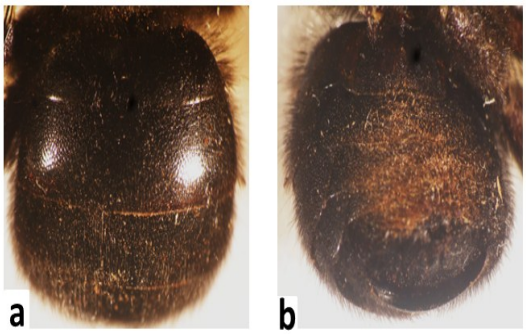


Figure (40). a- Tergum, b- Sternum of (♀) *Xylocopa amedaei*.

Xylocopa (Copoxyla) iris
(Christ,1791) ♀
Examined material: ♀2 Albaida 29.6.2018, 1 Albaida 3.7.2018, 13 Albaida 20.7.2018.
18 mm body length (Fig. 41).

Figure (41). Adult of (♀) Xylocopa *iris*.

Head: rounded and slightly narrower than the body, black, densely punctate, vertex simple curved to the inside with little long black setae erected to outside (Fig. 42).

Figure (42). The head of *Xylocopa iris*.

Compound eyes: dark brown with short scattered light brown setae, dense long black setae between compound eyes, paraocular carina clear, genal area is wide.

Ocelli: triangle shape, dark brown, the median ocellus bigger in size than the lateral ocelli, the lateral ocelli less than the height level of compound eyes, the median ocellus aligned with frontal line (Fig. 43).

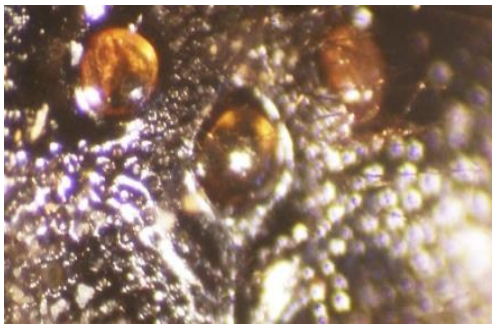


Figure (43). Ocelli of (♀) *Xylocopa iris*.

Clypeus: black, the end of apical thick, dark brown, black projection at the middle of the base, densely punctate, dense long black setae.

Mandibles: rectangular, tridentate at apex, black with black lope at the connecting area with the malar area, acetabular groove clear, outer groove clear, condylar groove clear, densely punctate (Fig. 44).

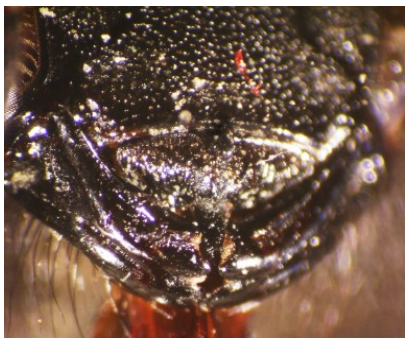


Figure (44). Mandible of (♀) *Xylocopa iris*.

Labrum: semi-rounded shape with triangular extension at the middle, black.

Mouthparts: long, galea dark brown to black, glossa light brown with dense light brown setae.

ISSN: online 2617-2186 print 2617-2178

Antennae: twelve segments, antennal socket dark brown, scape long, rectangular, dark brown, pedicel short, rounded, dark brown, flagellum ten segments, black, the first flagellomere narrower at the base, wider at the apical, longer than the rest of the other flagellomeres, the other nine flagellomeres equal in shape and size, the terminal flagellomere of antennae in a sharp form (Fig. 45).

Figure (45). Antenna of (♀) *Xylocopa iris*.

Thorax: width across thorax 5 mm, prothorax larger than mesothorax and metathorax, black, mesoscutal line clear, dense long black setae, densely punctate, tegula clear, large, black.

Wings: forewings length 14 mm, dark brown, the veins light brown, vein Sc+R black, marginal cell long and narrow, the apical of marginal cell not jointed with costa vein, three submarginal cells, 2smc narrow, triangular, 3smc wider than 1smc and 2smc, vein 1rs-m with the same line vein 1m-cu, vein 2rs-m curved outward, vein 2m-cu meets median vein opposite third submarginal cell, basal vein slightly curved, the lower end meeting the longitudinal vein at an acute angle (Fig. 46a), jugal lobe of hindwing short, less than half the length of the vannal lobe, and not nearly reaching vein closing the cubital cell (Fig.46b).

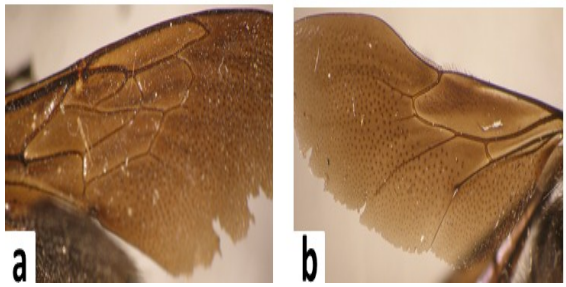


Figure (46). a- Forewing, b- Hindwing of (♀) *Xylocopa iris*.

Legs: coxa triangular, black with little black setae, trochanter rectangular, narrower at the base, wider at the apical, black with little long black setae, femur wider at the base, narrower at the apical, black with dense long black setae erected downwards, tibia long, rectangular, black with dense long black setae erected downwards, tibial spur ciliated at inner edge, sharp at the outer edge, dark brown, forelegs with one tibial spur, short, midlegs with one tibial spur, long (Fig. 47a), hind legs with two tibial spur, long (Fig. 47b), tibial spine one on each leg, tarsus five segments on each leg, basitarsus longer than mediotarsus and distitarsus, black with dense long black robust setae, mediotarsus three segments equal in shape and size, dark brown with little long black setae at the apical, distitarsus longer than mediotarsus, narrower at the base, wider at the apical, dark brown with little black robust setae and dense short yellow setae at the apical.

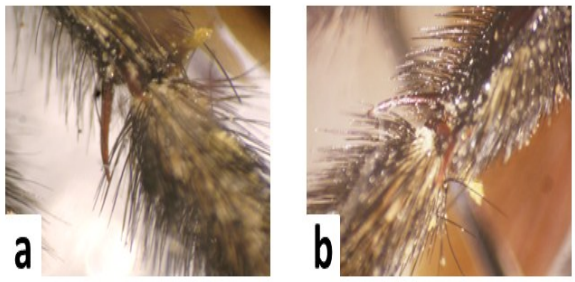


Figure (47). a-Tibial spur of midleg, b- Tibial spur of hind leg of (♀) *Xylocopa iris*.

Pair of elongated tarsal claws, branched at apical, the lateral longer than the internal one, the base dark brown, apical black, arolium with short yellow setae (Fig. 48).

ISSN: online 2617-2186 print 2617-2178

Figure (48). Tarsal claws of (♀) *Xylocopa iris*.

Abdomen: width across abdomen 7 mm, six segments, black, densely punctate, dense long black setae erected downwards, tergum II wider than the rest of the other terga, tergum VI triangle shape, narrower than the rest of the other terga, dense short black setae at the edges (Fig. 49a), sternum black with dark brown color bands at apical edges (Fig. 49b), pygidial plate two connected segments, black, dense long black setae erected downwards (Fig. 49c).

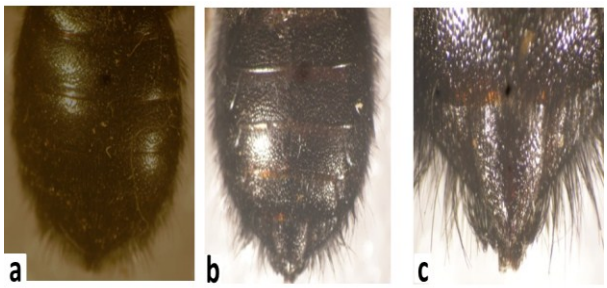


Figure (49). a-Tergum, b-Sternum, c- Pygidial plate of (♀) *Xylocopa iris.*

Xylocopa (Copoxyla) iris
(Christ, 1791) ♂
Examined material: ♂3 Albaida, 3.7.2018.
17 mm body length (Fig. 50).

Figure (50). Adult of (♂) *Xylocopa iris*.

Head: semi-rounded, slightly narrower than the body, black, densely punctate, dense long dark brown setae, vertex simple curved to the inside with dense long light brown setae erected to the outside (Fig. 51).

Figure (51). The head of (♂) *Xylocopa iris*.

Compound eyes: bright black, dense long black setae between compound eyes, paraocular carina clear, genal area wide.

Ocelli: triangle shape, dark brown, the lateral ocelli less than the height level of compound eyes, the median ocellus aligned with frontal line (Fig. 52).

Figure (52). Ocelli of (♂) *Xylocopa iris*.

Clypeus: black, the end of apical thick, dark brown, little long dark brown setae, black projection at the middle of the base, densely punctate, dense long black setae on the surface.

Mandibles: rectangular, tridentate at apex, black with black lope at the connecting area with the malar area, acetabular groove clear, outer groove clear, condylar groove clear, densely punctate (Fig. 53).

ISSN: online 2617-2186 print 2617-2178

Figure (53). Mandible of (♂) *Xylocopa iris*.

Labrum: semi-circular shape with triangular extension at the middle, black.

Mouthparts: long, galea dark brown, glossa light brown with dense light brown setae (Fig. 54).

Figure (54). Mouthparts of (♂) *Xylocopa iris*.

Antennae: thirteen segments, antennal socket dark brown, scape long, rectangular, black, pedicel short, rounded, black, the apical edges of scape and pedicel dark brown, flagellum eleven segments, black, the first flagellomere longer than the rest of the other flagellomeres, narrower at the base, wider at the apical, black and the apical edge dark brown, the other ten flagellomeres equal in shape and size, black, the terminal segment of antennae in sharp form (Fig. 55).

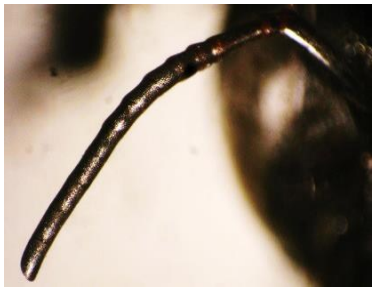


Figure (55). Antennae of (♂) *Xylocopa iris*.

Thorax: width across thorax 5 mm, prothorax larger than mesothorax and metathorax, black, dense long black setae, apical edge of prothorax with dense long light brown setae, densely punctate, tegula clear, large, black (Fig. 56).

Figure (56). Thorax of (♂) *Xylocopa iris*.

Wings: forewings length 14 mm, dark brown, the veins darker brown, vein Sc+R black, marginal cell long and wide, the apical of marginal cell not jointed with costa vein, three submarginal cells, 2smc smaller than 1smc and 3smc, 3smc larger than 1smc and 2smc, vein 1rs-m with the same line vein 1m-cu, vein 2rs-m curved outward, vein 2m-cu meets median vein opposite third submarginal cell, basal vein slightly curved, the lower end meeting the longitudinal vein at an acute angle (Fig. 57a), jugal lobe of hindwing very short, much less than half the length of the vannal lobe and not reaching anywhere near as far as vein closing cubital cell (Fig. 57b).

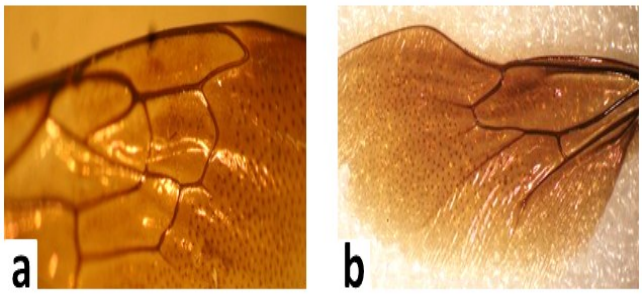


Figure (57). a- Forewings, b- Hindwings of (♂) *Xylocopa iris*.

Legs: coxa cylindrical has an extension, black with dense long black setae, trochanter

ISSN: online 2617-2186 print 2617-2178

narrower at the base, wider at the apical, black with dense long black setae, femur wider at the base, narrower at the apical, black with dense long black setae erected downwards, tibial rectangular, long, black with dense long black setae erected downwards, tibial spur one on each leg, ciliated, forelegs light brown, thicker than tibial spur of midlegs and hind legs, tibial spur of midlegs and hind legs dark brown, thick and longer than tibial spur of forelegs, tarsus five segments on each leg, basitarsus longer than mediotarsus and distitarsus, black with dense long black setae erected downwards, mediotarsus three segments equal in shape and size, dark brown with dense long black setae erected downwards, distitarsus longer than mediotarsus, narrower at the base, wider at the apical, dark brown with little dark brown setae (Fig. 58)

Figure (58). Hindleg of (♂) *Xylocopa iris*.

Pair of elongated tarsal claws, branched at apical, the lateral longer than the internal one, the base dark brown, apical black, arolium with short yellow setae (Fig. 59).

Figure (59). Tarsal claws of *Xylocopa iris*.

Abdomen: width across abdomen 6 mm, seven segments, black with dark brown color bands at apical edges, tergum I with dense long light brown setae, terga from II to VII with dense long black setae, tergum II wider than the rest of the other terga, tergum VII semi-rounded shape, narrower than the rest of the other terga, densely punctate (Fig. 60a), sternum black with dense long black setae erected downwards (Fig. 60b).

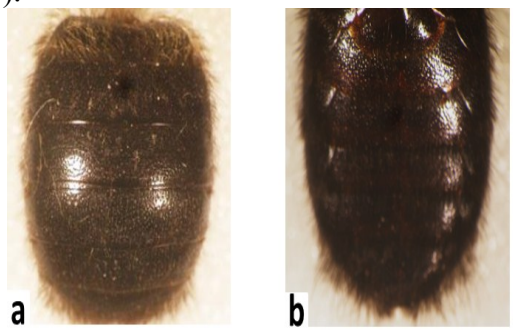


Figure (60). a- Tergum, b- Sternum of (♂) *Xylocopa iris*

ACKNOWLEDGEMENT

We thank Georg Els, Stuart Robert NHM for their assistance in confirming identification of specimens. And special thanks to Michaël Terzo for identified *Xylocopa amedaei***.**

REFERENCES

Cockerell, T. D. A. (1908). *Some Bees Collected by Dr. FC Wellman, in West Africa*.

Eardley, C. D. (1983). A taxonomic revision of the genus Xylocopa Latreille (Hymenoptera: Anthophoridae) in southern Africa.

Gerling, D., Velthuis, H., & Hefetz, A. (1989). Bionomics of the large carpenter bees of the genus Xylocopa. *Annual review of Entomology, 34*(1), 163-190.

Hurd, P. D. (1963). A classification of the large carpenter bees (Xylocopini)(Hymenoptera: Apoidae).

ISSN: online 2617-2186 print 2617-2178

University of California Publications in Entomology, 29, 1-365.

Keasar, T. (2010). Large carpenter bees as agricultural pollinators. *Psyche: A Journal of Entomology, 2010*.

Maa, T. (1970). revision of the subgenus Ctenoxylocopa (Hymenoptera: Anthophoridae). *Pacific Insects*.

Mawdsley, J., Harrison, J., & Sithole, H. (2016). Natural history of a South African insect pollinator assemblage (Insecta: Coleoptera, Diptera, Hymenoptera, Lepidoptera): diagnostic notes, food web analysis and conservation recommendations. *Journal of Natural History, 50*(45-46), 2849-2879.

Michener, C. D. (2007). *The bees of the world*.

Minckley, R. L. (1998). A cladistic analysis and classification of the subgenera and genera of the large carpenter bees, tribe Xylocopini (Hymenoptera: Apidae).

Terzo M. & Rasmont P. (2014). Atlas of the European Bees: genus *Xylocop*a. STEP Project, Atlas Hymenoptera, Mons, Gembloux.http://www.zoologie.umh.ac.be/hymenoptera/page.asp?ID=214

Warncke, K. (1982). Die holzbienen des vorderen orients (Hym., Apidae).

Zavattari, E. (1934). *Prodromo della fauna della Libia: pubblicato sotto gli auspici del Ministero delle colonie e della R. Universitá di Pavia*. Tipografia già cooperativa.

ISSN: online 2617-2186 print 2617-2178

التعريف والوصف المورفولوجي لانواع النحل جنس *Xylocopa* (Xylocopidae: Hymenoptera) في شمال شرق ليبيا

مروة يونس المبروك، علي عبد القادر بطاو*

قسم علم الحيوان، كلية العلوم؛ جامعة عمر المختار، البيضاء–ليبيا

تاريخ الاستلام: 25 أغسطس2019 / تاريخ القبول: 30 ديسمبر 2019

Doi:https://doi.org/10.54172/mjsc.v34i4.165

المستخلص : تستهدف هذه الدراسة تعريف ووصف الصفات المورفولوجية التصنيفية لانواع النحل جنس Xylocopa في شمال شرق ليبيا. تم جمع العينات من مواقع طبيعية مختلفة في منطقة الجبل الأخضر، وتم التعرف على الشكل المورفولوجي وقياسات طول الجسم (بالسنتمتر) (من قاعدة قرن الاستشعار إلى قمة البيغيدوم)، وتم قياس طول الأجنحة الأمامية، والصدر، وعرض البطن. أربعة أنواع من نحل *Xylocopa* تم تحديدها ووصفها مورفولوجيا والتي شملت *Xylocopa (Koptorosoma) pubescens* Spinola, 1838, *Xylocopa (Proxylocopa) olivieri* Lepeletir 1841, *Xylocopa (Rhysoxylocopa), amedaei* Lepeletir, 1841, *Xylocopa iris* (Christ, 1791). ويدل استنتاجنا أن منطقة الدراسة بها تنوع حيوي من أنواع Xylocop وكذلك على أهمية الدراسة المورفولوجية لتزويدنا بالمعلومات التصنيفية المهمة.

الكلمات المفتاحية: *Xylocopa*؛ Xylocopidae؛ الشكل الظاهري؛ تعريف؛ ليبيا.

*علي عبد القادر بطاو *ali.bataw@omu.edu.ly* قسم علم الحيوان، كلية العلوم؛ جامعة عمر المختار، البيضاء-ليبيا

Al-Mukhtar Journal of Sciences 34 (4): 350-358, 2019

A Comparative Analysis of the Outcomes of Carotid Stenting and Carotid Endarterectomy in the Management of Carotid Stenosis

Hasan I. Fadel Saad[1*], Mustafa Noom [2], Khalid Shnab[3] and Abdel Magid El Osta[4]

[1]Department of surgery, Faculty of Medicine Omer-Al-Mukhtar University, Al-Bayda, Libya*
[2]Department of Vascular Surgery, BMC, Tripoli, Libya
[3]Department of Surgery, Faculty of Medicine, Musrata University, Libya
[4]Department of Surgery, Faculty of Medicine, Tripoli University, Libya

Received: 24 September 2019/ Accepted: 30 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.134

Abstract: Carotid Stenosis is an important cause of stroke (20%) which is associated with high morbidity and mortality rates. The management is mainly by surgery or carotid stenting. This study reviews 3 years of experience and the outcomes in the treatment of carotid stenosis by the two methods. The study aimed to evaluate and compare the outcomes of both procedures during a 3yr period at a vascular Surgery department of the Cisanello Hospital. 302 pts were retrospectively analyzed; 151 pts assigned for each procedure. The average intervention time was significantly higher for the CEA group O.R: 0.556; 95% C.I; 0.349- 0.886, P: 0.014 but technical successes were achieved in 100% of CEA pts, whereas were achieved in 91.39% of the CAS group. The periprocedural stroke was nonsignificant between the two procedures. The Periprocedural TIA were show significant difference with more incidences in CAS pts [O.R: 7.292, 95% C.I; 1.150- 45.856, P: 0.032] but almost all pts improved. The cranial nerve injuries were a specific complication of CEA [11.9%]. The recurrent stenosis was seen only in CAS pts [2.9%] with O.R: 0.493, 95% C.I; 0.104-2.345, P: 0.410. Both procedures are effective and comparable in outcomes in the management of carotid Stenosis.

Keywords: Stroke; carotid stenosis; Carotid endarterectomy (CEA); carotid artery stenting (CAS)

INTRODUCTION

Carotid artery stenosis due to atherosclerosis is a common cause of strokes, which is responsible for around 20% of strokes in the adult population (Linfante et al., 2009). Surgical intervention to relieve atherosclerotic stenosis of the carotid arteries was first successfully performed by Dr. Michael DeBakey in 1953 at the Methodist Hospital in Houston, TX [Debakey Bio].The first case to be recorded in the medical literature was in The Lancet in 1954 (Eastcott et al., 1954). The role of carotid endarterectomy (CEA) for the treatment of atherosclerotic carotid bifurcation disease is now well established (Hobson et al., 1993). (CEA) is one of the most common vascular surgical procedures, and more (CEA)s are now being performed than at any time in the history of the operation (Ouriel et al., 2004; Tu et al., 1998). In the last few years, carotid artery stenting (CAS) has emerged as a possible alternative to (CEA) for the management of carotid artery stenosis (Narins & Illig, 2006; Ricotta & Malgor, 2008). The supporters of CAS underline the less invasive nature of the procedure, which enables its application in high-risk patients, the shorter in-hospital stay, and the reduction in wound complications and cranial nerve injury (Narins & Illig, 2006; Ricotta & Malgor, 2008). The results of three major European studies into the treatment of symptomatic stenosis- Endarterectomy versus Angio-

***Corresponding Author:** Hasan I. Fadel Saad *Hasanfadeel70@gmail.com* , Department of surgery, Faculty of Medicine Omer-Al-Mukhtar University, Al-Bayda, Libya.

plasty in Patients with Symptomatic Severe Carotid Stenosis (EVA-3S); Stent-Protected Angioplasty versus Carotid Endarterectomy (SPACE); International Carotid Stenting Study (ICSS) - showed that stenting was more hazardous than endarterectomy for the outcomes of stroke and death during the periprocedural period (30 days), and on longer-term follow-up (Eckstein et al., 2008; Ederle et al., 2010; Mas et al., 2008). In contrast, the North American Carotid Revascularization Endarterectomy vs Stenting Trial (CREST) demonstrated equivalent (non-significant) rates of stroke, myocardial infarction, and death in its stenting and endarterectomy groups in the periprocedural period, and at 4 years (Brott et al., 2010). The aim of this study is to evaluate and compare the outcomes of CEA with CAS in Cisanello Hospital in the period 2005 to 2008.

MATERIALS AND METHODS

Records and a database were reviewed at the U.O of Vascular Surgery of the Cisanello Hospitals [Pisa/ Italy] during a 3 year period from June 2005 to December 2008. A total of 986 patients underwent carotid Stenosis management, invasively by an open surgical technique called carotid endarterectomy (CEA) which included most of the cases [835 (84.68%)] pts, and by a less invasive method called carotid stenting (CAS) which included 151 pts (15.31%). In the view to compare the outcomes of both procedures; we prefer to select a representative random sample from a surgical group, equal to the CAS group which was done with the help of the vascular surgery team in the unit for easy comparison and calculation. 302 cases treated with the two techniques, [151] for each, were collected and retrospectively analyzed. Information obtained included the demographic, clinical presentations of patients undergoing the two procedures, and the characteristics for the two types of intervention; in terms of duration, hospital stay, and successful technical and postoperative outcomes for the two procedures (Table 1).

Statistical analysis: The percentages of cases in each group were calculated and the effectiveness of the intervention was expressed as odds ratios and all data are presented with 95% confidence intervals with P values, accepting a significance level equal to $\alpha = 0.05$.

RESULTS

Of 986 patients who were managed for carotid Stenosis by both CEA and CAS performed between June 2005 and December 2008, the medical records of 302 patients were assessed, in whom 151 underwent surgery and 151 an endovascular procedure. This selection was random for CEA pts and all cases who underwent CAS were included in the review. The 68.9% of the 302 patients examined were male (208 patients), and 31.1% were female (94 patients), forming a male to female ratio nearly 2:1 (Table 1). The distribution of sex along each procedure (CAS and CEA groups) are homogeneous for age and sex. The average age of all cases is 72.2 (± 7.4) yrs. Apart from smoking which shows Significant differences between the two types of management [(CEA: 86 (57.0%) vs. CAS: 51 (33.8%), O.R: 0.385, 95%C.I: 0.242- 0.614; $p < 0.05$)]. All previous data with other risk factors and associated cardiac and peripheral arterial diseases[PAD] were comparable, and no significant differences in both groups selected for study (Table 1) 245 (81.12%) of them were asymptomatic, and the remainder 57 (18.87%) of cases were symptomatic. The symptomatic group of pts form (29.2%) and (8.7%) for CEA and CAS respectively with O.R: 0.229; 95% C.I: 0.119-0.443, $p < 0.05$) which reveal significant difference between the two management options. Among the 14 symptomatic patients in the CEA group, (9.2%) had a previous stroke, 28 (18.5%) had had a TIA, amaurosis 2 (1.4%). Among the 13 symptomatic (8.7%) pts in the CAS group two pts gave a history of previous stroke (1.4%), and 11 pts (7.3%) had had TIA. The main cerebral symptom is TIA, The average incidence of TIA in this collection 39

ISSN: online 2617-2186 print 2617-2178

(12.9%); most of these cases were in surgical the group (18.5%) and 1.3% for CAS pts with an odds ratio 0.059 and 95%C.I: 0.015 to 0.229; with a highly significant difference between the two treatments in the study. The history of previous stroke forming about (5.3%) of all cases in the study which were seen much more in CEA pts than CAS pts [14 (9.2%)] and [2 (1.3%)] respectively O.R: 0.131; 95% C.I 0.033- 0.529, p.value: 0.002 significantly high in the group that underwent surgical treatment. The main indications for CAS procedure were as follows: restenosis in 16 cases (10.6%), (irradiated, previous surgery, high Stenosis) in 7 (4.6%) cases, and high surgical risk in 128 (84%).

The operative and postoperative outcomes are summarized in (Table 2). The average duration of the intervention is 70 min (± 21) and 49 (± 15) for CEA and CAS respectively with O.R: 0.556; 95% C.I; 0.349- 0.886, P: 0.014 significantly high for the group that underwent surgical treatment. But the technical success was 100% for CEA, and 91.4% for CAS with P= 0.001, which is also significantly high with the surgical treatment. Whereas in 13 (8.6%) cases; the procedure failed because of anatomical problems causing impossible cannulation of the common carotid artery (String type III in 6 cases, excessive angulations of the aortic arch in 7 cases). The average postoperative hospital stay was significantly greater in the CAS group as compared to CEA [2.3 days (range 2-5) [2.3 (± 0.6)] for CEA and 1.7 days (range 1-24) [1.7 (± 2.6), p <0.05).] for CAS. Postoperatively, the periprocedural central neurological complications occurred more with CAS pts [10 (6.7%)]. The incidences of periprocedural stroke were 0[0%] and 3 (1.9%) for CEA and CAS respectively, with nonsignificant P: 0.082. The stroke occurred before placing the stent in one case and at the end of the procedure in 2 cases. The periprocedural TIAs were 1(0.7%) for CEA and 7 (4.6%) for CAS with significant difference [O.R: 7.292, 95% C.I; 1.150- 45.856, P: 0.032].

The TIAs occurred within 3hrs of the procedure in 4 cases and within 12hrs in 3 cases. 18 cases (11.9%) of the cranial nerve injuries were recorded only in the CEA group: 9 patients reported dysphonia (50.0%), dysphagia 6 (33.3%), 3 had difficulty moving the shoulder ipsilateral to the intervention (16.7%). Of this group, 16 patient's symptoms were transient with spontaneous regression; in 2 cases, rehabilitation therapy was necessary, with complete recovery in 12 months. 40 patients (28.8%) reported sensory disturbances on the surgical wound which resolved spontaneously. The procedural MI was only seen in CEA group, forming an incidence of 0.7% in this study sample. The incidence of hematomas of the surgical neck wound or at the groins [as a part of CAS technique] was more in the surgical group pts (2.6%) and (1.4%) respectively, with O.R: 0.493; 95% C.I; 0.104- 2.345, P: 0.410, was not significantly different between the two treatments groups. The 4 cases have required re-exploration for the hematoma on neck incisions, and one of the two femoral access complications required surgery (0.7%).

Recurrent stenosis was seen only in the CAS group in this collection; from about 2.9% with O.R: 0.493, 95% C.I; 0.104- 2.345, P: 0.410. The four cases of restenosis were high-grade and required new endovascular treatment. There was no perioperative mortality related to the procedure in both groups. But on long-term follow-up [the mean follow-up after discharge was 22 months (range 1-43 months)] there were deaths in both groups 12 (8.6%) [From139 who attended or contacted by telephone] and 10 (7.1%) of 141 for CEA and CAS respectively with O.R: 0.822, 95% C.I; 0.351-1.923, P: 0.658 with no significant difference between the treatment groups and the deaths were unrelated to the procedures.

ISSN: online 2617-2186 print 2617-2178

Table:(1). Demographic and clinical characteristics of patients subjected to a CAS and CEA in Cisanello Hospital, Pisa, 2005-2008.

characteristics		total N=302 (100 %)	CEA N=151 (100%)	CAS N=151 (100%)	Odds ratio	C.I	P value
sex	male	208 (68.9%)	108 (71.5%)	100 (66.2%)	4.9248	3.021-8.026	0.000
	female	94 (31.1%)	43 (28.5%)	51 (33.8%)	1.281	0.787-2.084	0.321
Average age in years		72.2 (± 7.4)	72.9 (± 7.9)	72.1 (± 6.8)	---	---	0.346
Risk factors	Dyslipidemia	144 (47.7%)	75 (49.7%)	69 (45.7%)	0.853	0.543-1.339	0.490
	hypertension	233 (77.1%)	116 (76.8%)	117 (77.5%)	1.038	0.609-1.771	0.891
	Diabetes m	82 (27.1%)	42 (27.8%)	40 (26.5%)	0.935	0.564-1.550	0.796
	Cigarette smoking	137 (45.4%)	86 (57.0%)	51 (33.8%)	0.385	0.242-0.614	0.000*
Associated pathology	Renal insufficiency	17 (5.6%)	10 (6.6%)	7 (4.6%)	0.685	0.262-1.793	0.455
	PAD	42 (13.9%)	22 (14.6%)	20 (13.3)	0.895	0.470-1.707	0.740
	Previous cardiovascular surgery	65 (21.5%)	29 (19.2%)	36 (23.8%)	1.317	0.761-2.278	0.328
Cerebro Vascular symptoms	Asymptomatic	245 (81.1%)	107 (70.8%)	138 (91.3%)	4.365	2.255-8.438	0.000*
	symptomatic	57 (18.9%)	44 (29.2%)	13 (8.7%)	0.229	0.119-0.443	0.000
	stroke	16 (5.3%)	14 (9.2%)	2 (1.3%)	0.131	0.033-0.529	0.002
	TIA	39 (12.9%)	28 (18.5%)	2 (1.3%)	0.059	0.015-0.229	0.000
	Amaurosis	2 (0.6%)	2 (1.3%)	0 (0.0%)	0.000	0.000-1.917	0.157

C.I: confidence interval; PAD: Peripheral arterial disease; TIA: transient ischemic attack; O.R: odds ratio; C.I: confidence interval.

Table (2). Overall operative and post-operative results

characteristics		CEA [151 pts]	CAS [151 pts]	O.R	95% C.I	p- value
the average duration of the intervention [min]		70 (± 21)	49 (± 15)	0.556	0.349- 0.886	0.014 (p <0.05)
technical success		151 [100%]	138(91.4%)	0.000	0.000- 0.273	0.001 (p <0.05)
neurological complications	Periprocedural stroke	0[0%]	3 (1.9%)			0.082
	Periprocedural TIA	1(0.7%)	7 (4.6%)	7.292	1.150-45.856	0.032
	cranial nerve palsy	18 cases (11.9%)	0 [0%]	0.000	0.000- 0.190	0.000
procedural MI		1 (0.7%)	0[0%]			0.317
Haematomas		4 (2.6%)	2 (1.4%)	0.493	0.104- 2.345	0.410
recurrent stenosis		0[0%]	4 (2.9%)	0.493	0.104- 2.345	0.410
mortality	Perioperative death	0[0%]	0[0%]			1.000
	Long-term non perioperative death	12 (8.6%)/139	10 (7.1%)/141	0.822	0.351-1.923	p = 0.658

ISSN: online 2617-2186 print 2617-2178

DISCUSSION

Carotid stenosis is one of the most common causes of stroke all over the world. And The treatment of carotid stenosis, therefore, lies in decreasing the risk of stroke or stroke-related deaths (van der Vaart et al., 2008). The CEA has been shown to reduce the overall risk for stroke and death compared with medical treatment in patients with relevant carotid artery stenosis, both with symptoms (Cina et al., 2000), and without symptoms (Chambers et al., 2000). CEA also carries a risk of stroke, sometimes disabling or fatal, and of myocardial infarction since many patients with carotid artery stenosis also have coronary artery disease (Endovascular versus surgical treatment (CAVATAS), 2001). Carotid stenting is a recent innovation started a decade ago where it is now competing for the surgical treatment of carotid Stenosis. Although it's less invasive than operative management, it may carry a higher risk of complications. In general; the asymptomatic cases have a lower procedural and periprocedural stroke or death rate with better results in both the short and long term. The selection criteria for selecting asymptomatic carotid artery Stenosis pts for surgery or stenting in this analysis was the stenosis equal to or greater than 70% and for symptomatic carotid artery stenosis, equal to or greater than 60%. In the largest trial of asymptomatic subjects [asymptomatic carotid surgery trial (ACST)], the perioperative risk of stroke or death was 3.1%, and after 5years, stroke risk was 3.8 vs. 11% for best medical therapy, i.e. 16 CE's were needed to prevent one stroke in 5 years (Halliday et al., 2004).

In our study; most of the cases where asymptomatic forming 81.1% of all cases, whereas the symptomatic cases forming 18.87%. A recent meta-analysis of randomised controlled trials reported an increased risk of stroke or death within 30 days of carotid artery stenting compared with carotid endarterectomy (Ederle et al., 2009). This was similar to our result where the periprocedural central neurological complications such as stroke and TIA were more significant within the CAS group than the CEA group. In addition, a newer large observational study (A. Sidawy et al., 2009) and a multicenter randomized controlled trial (Committee, 2009) found a higher periprocedural (< 30 days) incidence of stroke with carotid artery stenting compared with carotid endarterectomy. Based on these trials (Barnett et al., 1998); an acceptable upper limit of perioperative rate for stroke or death has been determined to be around 3% for asymptomatic patients and 6% for patients with symptoms. And as compared to our analysis, the average incidence of periprocedural stroke 1.9% happened only in CAS pts, not in CEA pts. And the incidence of perioperative death was 0% for both groups. And in several clinical trials, the 30-day incidence of heart attack, stroke, or death was significantly higher with stenting than with endarterectomy (9.6% vs. 3.9%) (A. N. Sidawy et al., 2009). The procedural incidence of MI in our study was 0.7% only in CEA pts. The reported incidence of postoperative cranial nerve palsies after carotid endarterectomy varies from 1 to 30% (Organ et al., 2008).

The usual injuries occur in the vagus nerve and its branches, for example, the superior laryngeal, and recurrent laryngeal nerves, also, the hypoglossal nerve, spinal accessory nerve, marginal mandibular and transverse cutaneous nerve of the neck. The injuries varied from neuropraxia, axontemesis, and neurotemesis. Most of these injuries due to traction type injuries. Even though most of the cranial nerve neuropathies are transient, about 4% persist over several months and about 0.5% are permanent (Cunningham et al., 2004). In comparison to our research; the incidence of cranial nerve injuries was 11.9% of all cases from CEA group pts. All pts improved over a period of time. The incidence of recurrent restenosis following CEA was found to be 6-14%, which equates to an average annual restenosis or occlusion rate of 1.5-4.5% (Horrocks, 2000). And

ISSN: online 2617-2186 print 2617-2178

compared to our results; the incidence of the restenosis was (2.9%) and was only with CAS pts. The comorbidities are the major risk factors with carotid endarterectomy. Carotid artery stenting outcomes are mainly influenced by the anatomy of local vessels and both factors have to be considered in treatment decision making (Bates et al., 2007). From this review; we noted that the CAS procedure is a less invasive procedure compared to CEA procedures with shorter duration of intervention and less post-operative hospital stay with no cranial nerve injuries which are recorded only in surgical group pts apart from TIA which occurred more with this procedure where pts mostly recover spontaneously over a period of time.

CONCLUSION

From this review, we conclude that both procedures are effective and comparable in outcomes in the management of carotid Stenosis. The CAS results are favorable especially if it used in selected cases as shown in Carotid Stenting Guidelines Committee: recommended indications and contraindications for carotid artery stenting (CAS) (Carotid Stenting Guidelines Committee, 2009).

ETHICS

All data was given by the head of the vascular department of the Cisanello Hospitals during the training period for conducting research regarding the Topic. The authors declare that they have no competing interests.

REFERENCES

Barnett, H. J., Taylor, D. W., Eliasziw, M., Fox, A. J., Ferguson, G. G., Haynes, R. B., Rankin, R. N., Clagett, G. P., Hachinski, V. C., & Sackett, D. L. (1998). Benefit of carotid endarterectomy in patients with symptomatic moderate or severe stenosis .*New England journal of medicine, 339*(20), 1415-1425 .

Bates, E. R., Babb, J. D., Casey, D. E., Cates, C. U., Duckwiler, G. R., Feldman, T. E., Gray, W. A., Ouriel, K., Peterson, E. D., & Rosenfield, K. (2007). ACCF/SCAI/SVMB/SIR/ASITN 2007 clinical expert consensus document on carotid stenting: a report of the American College of Cardiology foundation task force on clinical expert consensus documents (ACCF/SCAI/SVMB/SIR/ASITN clinical expert consensus document committee on carotid stenting). *Journal of the American College of Cardiology, 49*(1), 126-170 .

Brott, T. G., Hobson, R. W., Howard, G., Roubin, G. S., Clark, W. M., Brooks, W., Mackey, A., Hill, M. D., Leimgruber, P. P., & Sheffet, A. J. (2010). Stenting versus endarterectomy for treatment of carotid-artery stenosis. *New England journal of medicine, 363*(1), 11-23 .

Chambers, B., You, R., & Donnan, G. (2000). Carotid endarterectomy for asymptomatic carotid stenosis (Cochrane review). la: Cochrane Library, Issue 4, 2002. *Update Software* .

Cina, C ،.Clase, C., & Haynes, R. (2000). Carotid endarterectomy for symptomatic carotid stenosis (Cochrane Review). *The Cochrane Library, 4* .

Committee, C. S. G. (2009). Guidelines for patient selection and performance of carotid artery stenting. *Journal of Medical Imaging and Radiation Oncology, 53*(6), 538-545 .

Cunningham, E. J., Bond, R., Mayberg, M. R., Warlow, C. P., & Rothwell, P. M. (2004). Risk of persistent cranial nerve injury after carotid endarterectomy.

ISSN: online 2617-2186 print 2617-2178

Journal of neurosurgery, 101(3), 445-448 .

Eastcott, H. H. G., Pickering, G. W., & Rob, C. G. (1954). Reconstruction of internal carotid artery in a patient with intermittent attacks of hemiplegia. *The Lancet, 264*(6846), 994-996 .

Eckstein, H.-H., Ringleb, P., Allenberg, J.-R., Berger, J., Fraedrich, G., Hacke, W., Hennerici, M., Stingele, R., Fiehler, J., & Zeumer, H. (2008). Results of the Stent-Protected Angioplasty versus Carotid Endarterectomy (SPACE) study to treat symptomatic stenoses at 2 years: a multinational, prospective, randomised trial. *The Lancet Neurology, 7*(10), 893-902 .

Ederle, J., Dobson, J., Featherstone, R., Bonati, L., van der Worp, H., de Borst, G., Lo, T., Gaines, P., Dorman, P., & Macdonald, S. (2010). International Carotid Stenting Study investigators: Carotid artery stenting compared with endarterectomy in patients with symptomatic carotid stenosis (International Carotid Stenting Study): an interim analysis of a randomised controlled trial. *Lancet, 375*(9719), 985-997 .

Ederle, J. r., Featherstone, R. L., & Brown, M . M. (2009). Randomized controlled trials comparing endarterectomy and endovascular treatment for carotid artery stenosis: a Cochrane systematic review. *Stroke, 40*(4), 1373-1380 .

Halliday, A., Mansfield, A., & MARRO, J. (2004). PETO C, PETO R, POTTER], THOMAS D; MRC Asymptomatic Carotid Surgery Trial (ACST) Collaborative Group. Prevention of disabling and fatal strokes by successful carotid endarterectomy in patients without recent neurological symptoms: randomised controlled trial. *Lancet, 363*, 1491-150 .2

Hobson, R. W., Weiss, D. G., Fields, W. S., Goldstone, J., Moore, W. S., Towne, J. B., Wright, C. B., & Group, V. A. C. S. (1993). Efficacy of carotid endarterectomy for asymptomatic carotid stenosis. *New England journal of medicine, 328*(4), 221-227 .

Horrocks, M. (2000). When should I reoperate for recurrent stenosis. In *Carotid artery surgery: a problem-based approach* (pp. 371-374). Harcourt Publishers Ltd, London, UK .

Linfante, I., Andreone, V., Akkawi, N., & Wakhloo, A. K. (2009). Internal carotid artery stenting in patients over 80 years of age: Single‐center experience and review of the literature. *Journal of Neuroimaging, 19*(2), 158-163 .

Mas, J.-L., Trinquart, L., Leys, D., Albucher, J.-F., Rousseau, H., Viguier, A., Bossavy, J.-P., Denis ،B., Piquet, P., & Garnier, P. (2008). Endarterectomy Versus Angioplasty in Patients with Symptomatic Severe Carotid Stenosis (EVA-3S) trial: results up to 4 years from a randomised, multicentre trial. *The Lancet Neurology, 7*(10), 885-892 .

Narins, C. R & ،.Illig, K. A. (2006). Patient selection for carotid stenting versus endarterectomy: a systematic review. *Journal of vascular surgery, 44*(3), 661-672 .

Organ, N., Walker, P., Jenkins, J., & Foster, W. (2008). 15 year experience of carotid endarterectomy at the Royal Brisbane and Women's Hospital: outcomes and changing trends in management.

ISSN: online 2617-2186 print 2617-2178

European Journal of Vascular and Endovascular Surgery, 35(3), 273-279 .

Ouriel, K., Yadav, J., & Green, R. M. (2004). Standards of practice: carotid angioplasty and stenting. *Journal of vascular surgery, 39*(4), 916-917 .

Ricotta, J. J., & Malgor, R. D. (2008). A review of the trials comparing carotid endarterectomy and carotid angioplasty and stenting. *Perspectives in vascular surgery and endovascular therapy, 20* .308-299 ،(3)

Sidawy, A., Zwolak, R., White, R., Siami, F., Schermerhorn, M., & Sicard, G. (2009). Outcomes Committee for the Society for Vascular Surgery. Risk-adjusted 30-day outcomes of carotid stenting and endarterectomy: results from the SVS Vascular Registry. *J Vasc Surg, 49*(1), 71-79 .

Sidawy, A. N., Zwolak, R. M., White, R. A., Siami, F. S., Schermerhorn, M. L., Sicard, G. A., & Surgery, O. C. f. t. S. f. V. (2009). Risk-adjusted 30-day outcomes of carotid stenting and endarterectomy: results from the SVS Vascular Registry. *Journal of vascular surgery, 49*(1), 71-79 .

Tu, J. V., Hannan, E. L., Anderson, G. M., Iron, K., Wu, K., Vranizan, K., Popp, A. J., & Grumbach, K. (1998). The fall and rise of carotid endarterectomy in the United States and Canada. *New England journal of medicine, 339*(20), 1441-1447 .

van der Vaart, M. G., Meerwaldt, R., Reijnen, M. M., Tio, R. A., & Zeebregts, C. J. (2008). Endarterectomy or carotid artery stenting: the quest continues. *The American journal of surgery, 195* ،(2) .269-259

ISSN: online 2617-2186 print 2617-2178

مقارنة تحليلية لنتائج استئصال باطنة الشريان السباتي وتركيب الدعامات في علاج الضيق السباتي الشرياني

حسن فضيل[1]*، مصطفى نوم[2]، خالد شنب[3] وعبد المجيد الأسطى[4]

[1]* قسم الجراحة، كلية الطب البشري، جامعة عمر المختار، البيضاء، ليبيا

[2] قسم جراحة الاوعية الدموية، مركز طرابلس الطبي

[3] قسم الجراحة، كلية الطب البشري، جامعة مصراته، ليبيا

[4] قسم الجراحة، مركز طرابلس الطبي

تاريخ الاستلام: 24 سبتمبر 2019 / تاريخ القبول:30 ديسمبر 2019

Doi:https://doi.org/10.54172/mjsc.v34i4.134

المستخلص: ضيق الشرايين السباتية هو سبب رئيس للجلطات المخية (20%) والتي تكون دائما مصحوبة بمعدل تمرض عالٍ ووفيات مرتفعة. العلاج الرئيس هو بواسطة إجراء الجراحة للضيق الشرياني أو بالأشعة التداخلية ووضع دعامات للشريان السباتي. في هذه الدراسة تم مراجعة خبرة ونتائج 3 سنوات من علاج الضيق السباتي بواسطة الطريقتين. تهدف الدراسة إلى معايرة ومقارنة نتائج الطريقتين العلاجيتين خلال 3 سنوات في قسم جراحة الأوعية الدموية في مستشفى تشيزانلو–إيطاليا. أجريت دراسة استقصائية لعدد 302 مريض (151 مريضاً لكل طريقة علاج). وأجريت مقارنات إحصائية لتوضيح فاعلية كل تدخل علاجي. حيث كان المعدل الزمني للتدخل العلاجي أعلى بوضوح في مجموعة التدخل الجراحي (O.R: 0.556; 95% C.I; 0.349- 0.886, P: 0.014) ولكن النجاح حقق في جميع الحالات والذي حقق في 91.3% من حالات العلاج بالأشعة التداخلية والدعامات. الجلطات المخية التي حدثت حول العملية كانت غير مهمة للطريقتين. أما الجلطات العابرة المؤقتة كانت أكثر أهمية في حالات التدخل الإشعاعي والدعامات (O.R: 7.292, 95% C.I; 1.150- 45.856, P: 0.032) إلا إن معظم الحالات تحسنت. إصابة الأعصاب الجمجمية كانت من المضاعفات المحددة للتدخل الجراحي (11.9%). أما رجوع الضيق السباتي فكان فقط في مجموعة التدخل الإشعاعي والدعامات (2.9%) مع (O.R: 0.493, 95% C.I; 0.104- 2.345, P: 0.410.). كلا الطريقتين فعال ومتوازٍ في نتائج علاج الضيق السباتي الشرياني.

الكلمات المفتاحية: الجلطة الدماغية، ضيق الشريان السباتي، التدخل الجراحة للشريان السباتي (CEA)، تركيب دعامة للشريان السباتي (CAS).

*حسن فضيل Hasanfadeel70@gmail.com قسم الجراحة، كلية الطب البشري، جامعة عمر المختار، البيضاء، ليبيا

مجلة المختار للعلوم 34 (4): 359-371، 2019

استخدام طريقة مقلوب المسافة الموزونة IDW لإنتاج خرائط لبعض خواص التربة في محطة الابحاث الزراعية جامعة طرابلس

ماجدة بشير البشتي* أبوعبدالله سعد الشريف وإيهاب محمد الصقر

قسم التربة والمياه، كلية الزراعة، جامعة طرابلس، طرابلس-ليبيا

تاريخ الاستلام: 04 مايو 2019 / تاريخ القبول: 30 ديسمبر 2019

Doi:https://doi.org/10.54172/mjsc.v34i4.207

المستخلص: هدفت الدراسة لتحديد الاختلافات المكانية لبعض الخواص الفيزيائية والكيميائية لعينات تربة محطات أبحاث كلية الزراعة/ جامعة طرابلس في شهر أبريل 2013، واستخدمت النتائج لإنتاج خرائط مكانية لمعرفة التوزيع المكاني لكل من الخواص الآتية: الكثافة الظاهرية Bulk density (BD)، محتوى الرطوبة الوزني (GWC)، ملوحة التربة (EC)، ودرجة حموضة التربة (pH) باستخدام طريقة مقلوب المسافة الموزونة Inverse Distance Weighting (IDW). أجريت هذه الدراسة على أرض مساحتها 13200 م^2 تقريبا قُسمت إلى شبكة بأبعاد 12 م X 11م لتنتج 100 وحدة مساحية وأختيرت 36 وحدة حددت إحداثياتها بواسطة جهاز GPS المحمول لتجميع العينات منها. أجريت تحاليل لكل من BD و GWC من الأعماق 0-10 سم، 10-20 سم و20-30 سم، بينما تحاليل EC و pHأجريت للعينات بعمق 30 سم. أنتجت خرائط مكانية ذات أسطح مستمرة وذات جودة اختلفت من خاصية لأخرى حسب قيم الجذر التربيعي لمتوسط الخطأ Root Mean Square Error(RMSE). من النتائج تراوحت قيم (RMSE) (0.71، 0.82، 0.86) لخاصية GWC و (0.06، 0.13، 0.08) لخاصية BD للأعماق الثلاثة على التوالي. بينما كانت قيم RMSE (0.15، 0.84) لخاصيتي pH و EC على التوالي. أظهرت قيم RMSE المنخفضة لخرائط BD عند العمق الأول والثالث وكذلك خريطة pH مؤشر جودة أعلى للخرائط. بينما بينت قيم (RMSE) المرتفعة نوعا ما بأن الخرائط المنتجة لكل من خاصيتي EC و GWC كانت أقل جودة. خلصت هذه الدراسة إلى إمكانية إنتاج خرائط مكانية متفاوتة الجودة لبعض خواص التربة داخل الحقل باستخدام IDW. وبالتالي يمكن استخدام هذه الخرائط للتنبؤ بخاصيتي BD و pH في الحقل، بينما يصعب استخدامها للتنبؤ بخاصيتي EC و GWC، ولهذا ينصح باستمرار البحث في إمكانية إنتاج خرائط ذات جودة عالية بطرق أخرى لهاتين الخاصيتين مع مراعاة زيادة عدد العينات.

الكلمات المفتاحية: مقلوب المسافة الوزنية، الكثافة الظاهرية، المحتوى الرطوبي الحجمي، ملوحة التربة، درجة حموضة التربة.

المقدمة

تعد التربة أحد أهم مصادر الثروات الطبيعية في العالم، وتتباين الترب في خصائصها الفيزيائية والكيميائية مثل القوام والكثافة الظاهرية والحقيقية والمسامية بالإضافة لدرجة تفاعل التربة وملوحتها من مكان إلى آخر داخل الحقل الواحد؛ حيث يصعب التعرف على هذه الخواص في جميع أنحاء الحقل من خلال تحليل عينات التربة وذلك لارتفاع التكاليف والوقت، من هنا كان من الضروري استعمال طرق تحديد هذه الخواص بأقل تكاليف وفي فترة زمنية قصيرة (الجبوري وآخرون، 2015).

في السنوات الأخيرة ألقت علوم التربة الضوء على استخدام الإحصاء المكاني الذي يعطينا الدقة المكانية لصفات التربة سواء في الحقل أو المختبر ويستعمل لوصف نماذج الاختلاف المكاني لصفات التربة (Krasilinkov; Carre;

* ماجدة بشير البشتي. melbeshti@yahoo.com، قسم التربة والمياه، كلية الزراعة، جامعة طرابلس، طرابلس، ليبيا.

(Montanarella, 2008). إن دراسة التباين المكاني لخواص التربة مهمة في فهم صفات التربة ودليل مهم لأخذ العينات الخاصة بالتحاليل المختلفة، كذلك معرفة الاختلاف الموجود في التربة يمكن الاستفادة منه في تطوير النموذج المستخدم لدراسة صفات التربة ووصفها بصورة دقيقة Hudnall and Bekele, 2006). (

إن الهدف الأساسي من دراسة التغاير أو الاختلاف المكاني لخصائص التربة المختلفة هو الحصول على تفسير منطقي لهذه التغايرات، وكذلك التنبؤ بقيم خواص التربة المختلفة عند المواقع التي لم يتسنّ تجميع عينات حقلية منها De la) Rosa, 1979; Burrough, 1989; White وآخرون , . Talkkari ;1989وآخرون.2002) .وقد وفرت تقنية نظم المعلومات الجغرافية طرائق عدة في دراسة التغايرات المكانية الموجودة في التربة، التي أثبتت بأنها مفيدة في فهم وتفسير التنبؤ المكاني لخصائص التربة المختلفة، حيث استخدمت من قبل العديد من الباحثين في مجال علم التربة لدراسة التغايرات المكانية والزمانية لخصائص التربة الكيميائية والفيزيائية (Burrough, 1993; Fahad وآخرون., 1993; Usowicz, , 2004, Corwin and Lesch, 2005; Santra وآخرون ., 2008, Camachu وآخرون Hosseini ;2009 ,.وآخرون (2009

تعتبر طرق الإحصاء المكاني (Geostatistic) المختلفة من الطرق المستخدمة في تحليل، تمثيل وعرض البيانات المكانية (معلومات تحتوي على إحداثيات جغرافية). وتستخدم هذه الطرق على نطاق واسع في الدراسات البيئية بصفة عامة وفي دراسات بيئة التربة و المياه بصفة خاصة، حيث إنه يصعب وصف وعرض الخواص المختلفة بدقة عالية نتيجة إلى التباين الكبير في الخواص داخل مساحة الحقل الواحد (Webster, Oliver & 2001). إن التطور الكبير الذي حدث في برمجيات نظم المعلومات الجغرافية (GIS) في العقود الأخيرة ساهم في الانتشار الواسع لاستخدم طرق التنبؤ المكاني (Burrough, 1986; McDonnell & Burrough, 1998; Chang, 2002)، بالإضافة إلى تطور برمجيات التحليل الإحصائي للبيانات المكانية و تطور تقنيات الاستشعار عن بعد(Remote Sensing) (Mulla, 1997)، وأنظمة تحديد المواقع العالمية و على رأسها نظام (GPS) Hand Held Global Positioning System كمصدر للبيانات الحقلية ساهم مساهمة كبيرة في انتشار استخدام طرق التنبؤ المكاني في الدراسات البيئية و ذلك لما يوفره من جهد وسرعة، ودقة في عمليات تحليل وعرض البيانات المكانية(Burrough, 1986).

هناك العديد من طرق التنبؤ المكاني المتوفرة مثل طريقة مقلوب المسافة الموزونة (IDW)وطريقة الكريكنج (Kriging) اللتين أساسهما عملية التوليد المكاني (Spatial Interpolation) والتي تعتبر هي العملية الأساسية في طرق الإحصاء المكاني (Geostatistical Methods)، كما أن هذه الطرق تستعمل افتراضية أن هناك علاقات مكانية (Spatial Correlation) للعينات المقيسة لأي خاصية داخل الحقل (Cay and Uyan, 2010). وتعرف عملية (Interpolation)على أنها عمليات إنشاء أو إنتاج بيانات في مواقع جغرافية غير مقيسة مستخدماً بيانات جغرافية مقاسه داخل نفس منطقة الدراسة جغرافيا مع التأكيد على فرضية وجود علاقة مكانية للخاصية المقيسة داخل الحقل، حيث تتم هذه العملية بواسطة معادلات وحسابات رياضية وإحصائية، بعد ذلك يتم تمثيل وعرض هذه البيانات في سطوح مستمرة (Continues Surfaces)علي هيئة خرائط رقمية، وبما انه يجب أن تكون مصحوبة بقياسات أو حسابات لتقييم دقة عمليات الإنشاء (Interpolation)، فتستعمل المقاييس مثل: متوسط الخطأ Mean Error (ME) ، متوسط الخطأ التربيعي Mean Square Error (MSE)، والجذر التربيعي لمتوسط مربع الخطأ Root Mean Square Error (RMSE)، ومعامل التحديد (R^2) بين القيم المقيسة والقيم المستنبطة كمؤشر لدقة هذه العمليات (Mardia and Jupp, 2000; Chile`s and Delfiner, 1999).

ISSN: online 2617-2186 print 2617-2178

وتعرف طريقة مقلوب المسافة الموزونة (IDW) بأنها هي طريقة توليف موضعي، تعتمد على توليف المسافات بين النقاط حيث تربط بين كل أقرب نقطتين من نقط التحكم، ثم تقدر قيمة النقط بين كل نقطتين على طريقة مقلوب المسافة بينهما، التي تكون موزونة بقيمة المدى بين الحد الأدنى والحد الأعلى لقيمتي المسافة وتكون النقط المؤلفة بين هذا المدى (شرف، 2017) .

وقد أظهرت هذه الطريقة دقتها وجودتها العالية في التنبؤ المكاني للمواقع التي لم تؤخذ منها عينات، حيث أشار Weber and England (1992) أن IDW أكثر دقة وتعطي نتائج تنبؤ أفضل مقارنة بالطرق الأخرى للتنبؤ المكاني. كما وجد Wollenhaupt وآخرون(1994) أن طريقة IDW كانت نتائجها أكثر دقة نسبياً لإنتاج خرائط تربة مكانية لمستويات الفسفور (P) والبوتاسيوم (K). ولاحظ Gotway وآخرون،(1996) أفضل النتائج في إنتاج خرائط مكانية لمحتويات المادة العضوية ومستويات النترات في ترب عدة حقول عند استخدام طريقة IDW. وقد استخدمت معظم الدراسات (MSE) كمقياس للمقارنة وجودة الخرائط (England and Weber, 1992; Gotway وآخرون(1996)ودرس Mabit and Bernard (2010) التوزيع المكاني للمادة العضوية لتربة حقل زراعي في كندا باستخدام طريقة IDW حيث أعطت الطريقة نتائج جيدة. كما قارن صادق وآخرون (2014) أداء طريقة IDW بطرق أخرى لرسم خرائط بعض صفات التربة الفيزيائية لتربة من حقل بور في مدينة الحلة بالعراق. وأظهرت النتائج أن طريقة IDW كانت الأفضل في تقدير ورسم خرائط كل من التوصيل الهيدروليكي التشبعي والمحتوى الرطوبي الحجمي للتربة، بينما كانت طريقة IDWأقل دقة في رسم خريطة الكثافة الظاهرية للتربة حسب قيم (MSE). وأشارت جبير (2013) إلى أن طريقة IDW أعطت نتائج جيدة لحساب التنبؤ المكاني داخل قطاع التربة لكل من القوام، الكثافة الظاهرية، ملوحة التربة، المادة العضوية، والسعة التبادلية الكاتيونية لبعض ترب محافظة صلاح الدين بالعراق وذلك حسب قيم (RMSE).

وقام Tunçayوآخرون.،(2016) بتقييم طريقة IDW لرسم خرائط التوزيع المكاني لبعض خصائص التربة لعينات جُمعت من حوض نهر سيحان السفلي في تركيا، وبتطبيق تقنية IDW على نتائج تحاليل كل من:كربونات الكالسيوم، المادة العضوية، السعة التبادلية الكاتيونية، ومحتوى الطين، ووجد أن الخصائص المتنبَّئ بها والمتحصل عليها باستخدام IDW تتفق مع نتائج تحاليل التربة؛ إلا أن قيم المادة العضوية أظهرت خطأ متوسط عالي على خلاف الخصائص المدروسة الأخرى. وأجرى(Nikpeyوآخرون 2017) تقييم أداء تقديرات طريقة IDW لإنتاج خرائط لبعض خصائص نوعية التربة والتنبؤ بالاختلافات المكانية لهذه الخصائص في مقاطعة جولستان الواقعة في الجزء الشمالي من إيران، حيث قام بقياس نسبة الطين والطمي والرمل وكربونات الكالسيوم والكربون العضوي والجير وتركيزات المغذيات الصغرى والكبرى وEc وpH كمتغيرات رئيسة تؤثر على جودة التربة.

ومن النتائج تبين أن طريقة IDW أنتجت أفضل الخرائط للتنبؤ بالاختلافات المكانية لكل من:(نسبة الرمل، الكربون العضوي، pH والجير). إن الاختلافات المكانية والزمانية في المحتوى الرطوبي للتربة (GWC) أصبحت تستخدم بكثرة في النماذج الهيدرولوجية والمناخية. كذلك استخدام النماذج الرياضية لتقدير حركة الماء والأملاح في تربة الحقل أدى إلى زيادة الحاجة إلى فهم الاختلافات في خصائص التربة مثل المحتوى الرطوبي (GWC) والكثافة الظاهرية(BD) وغيرها من الخصائص التي تؤثر على اختلافات مخرجات نماذج التنبؤ. وبما أن الخصائص الهيدروليكية للتربة تتغاير رأسياً وجانبياً نتيجة للبخر –النتح والهطول المتأثرين بالطبوغرافية وقوام التربة والغطاء النباتي، لهذا فإن إيجاد طريقة جيدة للتنبؤ وتخريط هذه الخصائص في المواقع التي لم يتسنَّ أخذ العينات منها سوف يساعد في تأسيس نظام ري وصرف ناجح. وتعد ملوحة التربة (EC) من السمات البارزة والملاصقة لأراضي المناطق الجافة وشبه الجافة ، وتكون التربة ملحية أو قلوية إذا ارتفعت فيها نسبة تركيز الأملاح القابلة للذوبان في الماء،

ISSN: online 2617-2186 print 2617-2178

ويعتمد توزيع الأملاح المختلفة في التربة على الاختلافات في درجة ذوبانها من جهة وشدة عملية الغسيل النهائي وعملية التبخر من جهة آخرى، ولهذا فإن معرفة تركيز الأملاح الموجودة في تربة أي منطقة ومدى تباينها وتغايرها وذلك من خلال معرفة نتائج التحاليل المعملية للتربة التي سوف تستخدم في التنبؤ وإنتاج خرائط ملوحة التربة للمناطق التي لم يتحصل منها على عينات تربة. وبيَّن المحيمد (1999) أن من بين الصفات الكيميائية الأكثر تغايراً هي الملوحة ثم نسبة المادة العضوية ثم السعة التبادلية الكاتيونية ثم كربونات الكالسيوم وأخيراً درجة تفاعل التربة pH. وأوضحTalkkari وآخرون (2002) أن محددات ومتطلبات pH مرتبطة بمحتوى الطين، وبيَّن أنه بانخفاض محتوى الطين تنخفض مساحة السطح النوعي وتنخفض كل من السعة التبادلية الكاتيونية والكربون العضوي مما يؤدي لانخفاض pH وبالتالي تكون تربة حامضية.

أوضح Usowicz وآخرون(2004) أن التغايرات في خواص التربة السطحية أكثر من الترب تحت السطحية ومن هذه الخواص pH والسعة التبادلية الكاتيونية والكربون العضوي. أما على المستوى المحلي فمازال استخدام التنبؤ المكاني في دراسة الاختلافات المكانية في خواص التربة المختلفة محدوداً، حيث استخدم امحمد (2015) طريقة IDW في إنتاج خرائط وتقييم الملوحة لبعض المحاصيل الزراعية في منطقة سواوة بسرت، وأستنتج أن هذه الطريقة أعطت نتائج يمكن الوثوق بها في تتبع التغاير المكاني لبعض خواص التربة الكيميائية. كذلك قام العالم (2017) بدراسة التغايرات المكانية لبعض خواص التربة الكيميائية لمنطقة سهل الجفارة لمعرفة التوزيع المكاني لكل من نسبة الصوديوم المتبادل (ESP) والسعة التبادلية الكاتيونية (CEC) ونسبة كربونات الكالسيوم ($CaCO_3$) باستخدام طريقتي IDW و Kriging، واستنتج أن النتائج المتحصل عليها باستخدام طريقة IDW يمكن الوثوق بها اعتماداً على قيم الجذر التربيعي لمتوسط الخطأ (RMSE) ومعامل التحديد (R^2) لكل الخصائص المدروسة.

وبناء عليه فإن تطبيق التنبؤ المكاني في المجالات البيئية والموارد الطبيعية مازال محدوداً، كذلك تتباين الترب في خصائصها وخواصها من مكان إلى أخر داخل الحقل الواحد حيث يصعب التعرف على هذه الخواص في جميع أنحاء الحقل من خلال تحليل عينات التربة وذلك لارتفاع التكاليف والوقت، من هنا كان من الضروري استعمال طرق تحديد هذه الخواص بأقل تكاليف وفي فترة زمنية قصيرة. ولهذا كان الهدف من هذه الدراسة تطبيق التنبؤ المكاني بطريقة مقلوب المسافة الموزونة (IDW) في تخريط بعض خواص التربة (درجة حموضة التربة pH ، درجة التوصيل الكهربائي EC ، الكثافة الظاهرية BD، و محتوي الرطوبة الوزني GWC لأعماق مختلفة في التربة) على مستوي الحقل (حقل داخل محطة أبحاث كلية الزراعة بجامعة طرابلس/ ليبيا)، مع تقييم دقة وجودة الاستنباط بالخرائط المنتجة .

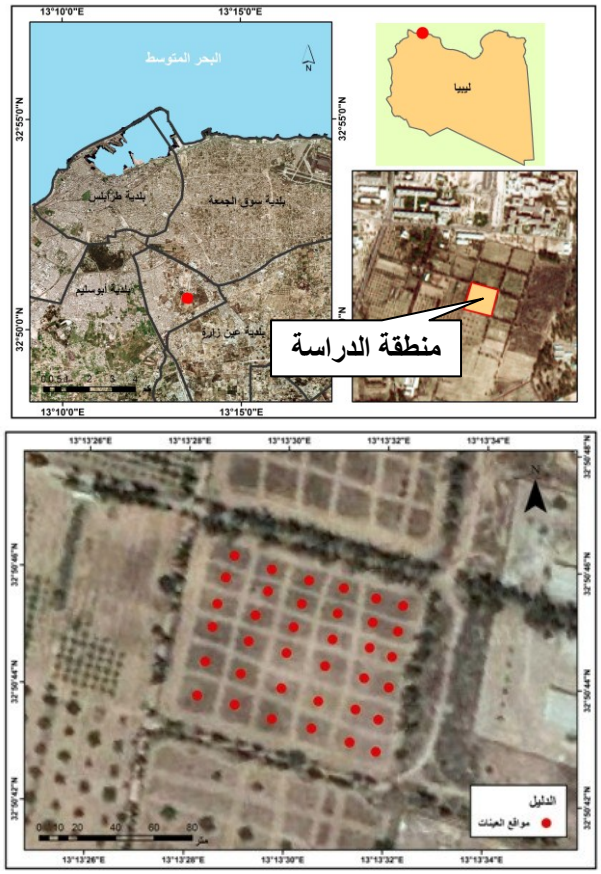
المواد وطرق البحث

منطقة الدراسة:

أجريت هذه الدراسة بمحطة أبحاث كلية الزراعة في جامعة طرابلس والتي يمر بها دائرة عرض '50 º32 شمالاً وخط طول '13 º13 شرقاً خلال شهر أبريل 2013 الذي يتميز باعتدال في درجات الحرارة وندرة الأمطار. بدأت الدراسة بتحديد قطعة أرض مسطحة مساحتها 13200 م^2 تقريبا منتشرة بها بعض النباتات والأعشاب البرية ومحاطة بأشجار مصدات الرياح من كل الجهات كما هو موضح بالشكل (1). تم تقسيمها إلى شبكة بأبعاد 12 م X 11 م لتنتج 100 وحدة مساحية حيث اختيرت منها 36 وحدة حُددت إحداثياتها باستخدام جهاز GPS، واستخدمت الطريقة المنتظمة Regular لتحديد نقاط تجميع عينات التربة. تم تجميع عينات تربة غير مثارة باستخدام أسطوانة الكثافة مفتوحة الطرفين القياسية من الأعماق (0–10، 10–20، 20–30 سم) بواقع ثلاثة مكررات لكل عمق وذلك لتحديد كثافة التربة الظاهرية (BD)، وعينات أخرى مثارة من نفس الأعماق لتحديد المحتوى الرطوبي الوزني (GWC)، بينما أُخذت عينات مثارة

ISSN: online 2617-2186 print 2617-2178

بعمق 30 سم لتقدير ملوحة التربة (EC) ودرجة حموضتها (pH).



شكل (1): يوضح موقع الدراسة

المصدر: إنتاج الباحثة باستخدام ArcMap

التحاليل المعملية:

قياس الكثافة الظاهرية: تم تقدير الكثافة الظاهرية بطريقة الاسطوانة، حيث تم تجفيف عينات التربة غير المثارة المجمعة من الأعماق المحددة في الفرن عند درجة حرارة 105 م° لمدة 48 ساعة، وتم تحديد الأوزان الجافة للعينات وقسمت هذه الأوزان على حجم أسطوانة الكثافة القياسية المستخدمة (Carter & Ball, 1993).

قياس المحتوى الرطوبي: تم تقدير المحتوى الرطوبي بالطريقة الوزنية عن طريق تجميع عينات من الأعماق (0–10)، (10–20) و (20–30) سم وتحديد أوزانها الرطبة. ثم تم تجفيفها في الفرن عند درجة حرارة 105 م° لمدة 48 ساعة، وتم تحديد أوزانها الجافة لتقدير المحتوى الرطوبي الوزني للتربة (Arshad وآخرون 1996)

قياس درجة حموضة التربة وتوصيلها الكهربائي: تم تجهيز مستخلص تربة 1:2.5 باستعمال تربة خليط من الأعماق الثلاثة المحددة سابقاً لكل وحدة مساحية، وتم استعمال هذا المستخلص لقياس pH و EC للتربة بواسطة جهازي pH و EC ميتر (Hendershort وآخرون 1993).

خطوات التوليد المكاني (Spatial Interpolation) بطريقة مقلوب المسافة الموزونة (IDW): تم استخدام أحد برامج نظم المعلومات الجغرافية برنامج Arcmap 10.5 و ملحقاته من البرامج المختلفة و من بينها ملحق برنامج المحلل الإحصائي (Geostatistical Analyst) وذلك لاستخدامها في عمليات التحليل الإحصائي الوصفي والمكاني للبيانات ومن ثَمَّ إنتاج خرائط الاستنباط (Interpolated Maps) المختلفة بالإضافة إلى عمليات تقييم عمليات التوليد Interpolation (لخرائط كل من الكثافة الظاهرية، المحتوى الرطوبي الوزني، درجة التفاعل، ودرجة التوصيل الكهربي) (Rosenbaum and Söderström.1996) (ESRI,2012).

ويتم في هذه الطريقة تقدير قيم للنقاط غير المقيسة مستخدما القيم المقيسة للنقاط المجاورة لها كما هو موضح بالشكل (2)، بحيث وزن كل نقطة مقاسه تساهم في التنبؤ بالنقطة غير المقيسة وهو عبارة عن مقلوب المسافة بين النقطة المقيسة والنقطة المطلوب تنبؤها، حيث يقل وزن النقاط المقيسة كلما كانت بعيدة عن النقطة الغير مقاسه والمطلوب توليدها. وتتأثر القيم المتنبأ بها بكل من: طول المسافة (كلما قصرت المسافة كان التأثير أكبر على القيمة المتنبأ بها)، قيمة الأسّ على المسافة، وعدد العينات المستخدمة في استنباط القيمة المستنبطة. و حسب Peterson (2017) فالمعادلة التالية تستخدم في حساب القيم المستنبطة في طريقة IDW :

$$z(\mathbf{x}) = \sum_i w_i z_i \Big/ \sum_i w_i \qquad (1)$$

ISSN: online 2617-2186 print 2617-2178

$$w_i = 1/d_i^2 \quad (2)$$

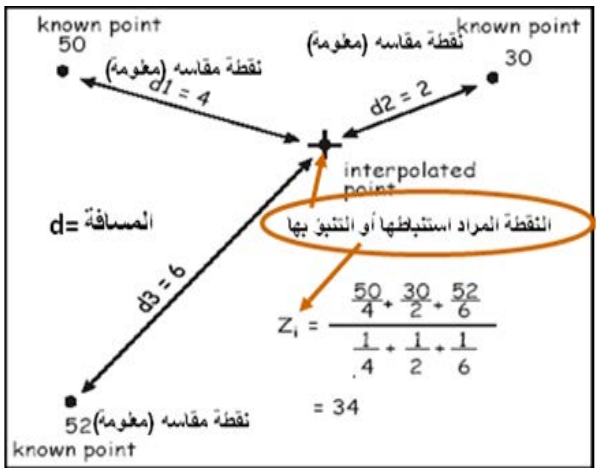
حيث:-

$Z(x)$:النقطة المراد استنباطها أو التنبؤ بها

Zi : النقطة التي تم قياسها (معلومة)

d^2i : المسافة بين النقطة المقيسة والنقطة المراد استنباطها أو التنبؤ بها

wi : الوزن



شكل (2) يوضح طريقة حساب قيم غير معلومة مستخدماً قيم معلومة داخل منطقة الدراسة – طريقة مقلوب المسافة IDW .

المصدر: Vineeth *et al.*, (n.d)

وبعد إنتاج الخرائط لكل الخصائص المدروسة من النتائج المستنبطة، يتم تقييمها إحصائياً من خلال حساب الجذر التربيعي لمتوسط مربع الخطأ RMSE الذي يتأثر بقيمة أُسّ المسافة لتحديد الوزن المشار إليها في المعادلة 2، وكلما كانت قيم RMSE صغيرة واقتربت من الصفر دلت على درجة عالية من الثقة في عملية الاستنباط، والدقة في خرائط التنبؤ المكاني المنتجة. كذلك تشير قيم معامل التحديد (R^2) ومعامل الارتباط (R) المتحصل عليها من عملية (Cross-Validation) لمدى دقة وثقة عمليات الاستنباط والخرائط المستنبطة المتحصل عليها، حيث تم في هذه العملية استخدام تقنية تحليل الانحدار لتقدير دقة القيم (المقدرة أو المستنبطة Y) المتحصل عليها من IDW والقيم (المقيسة X) للخاصية المدروسة.

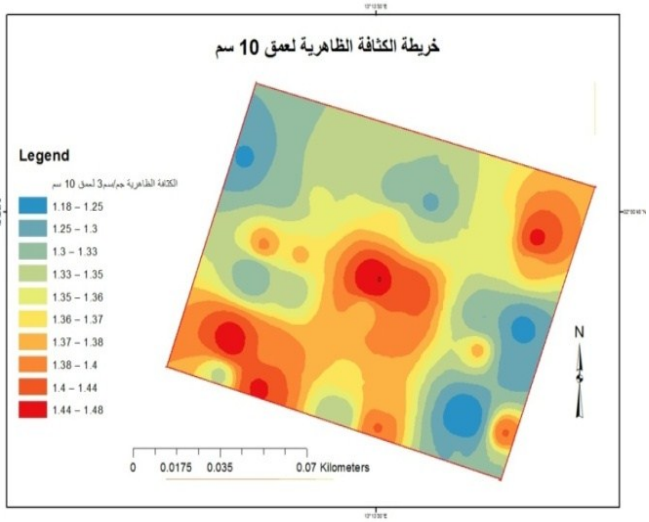
النتائج والمناقشة

أظهرت نتائج قياسات التربة والتحاليل الإحصائية الموضحة بالجدول (1) بأن هناك تبايناً بسيطاً في الكثافة الظاهرية للتربة رأسياً وأفقياً، حيث تراوحت رأسياً بين (1.18–1.48 جم/سم^3)، (1.18– 1.96 جم/سم^3)، (1.14–1.56 جم/سم^3) في العمق الأول والثاني والثالث على التوالي، ولكن التباين كان أكثر وضوحاً في العمق الثاني، كذلك تشير قيمة معامل الاختلاف (CV= %9) في العمق الثاني إلى ان هناك تبايناً أو تغايراً في BD في هذا العمق أكثر وضوحاً من التغاير في العمق الأول والثالث حيث كانت (CV= 5%، 6% على التوالي) وهذا ربما يعزى إلى أن BD في العمق الأول أقل تغايراً أو تبايناً مقارنة بالعمق الثاني الذي يتعرض لعمليات الرص والضغط مما يؤثر على قيم BD، وتتفق هذه النتائج مع ماوجده (2005 وآخرون Corwin)عند دراستهم لترب Sanjoaquin في كاليفورنيا حيث وجدوا أن BD أقل تغايراً في الآفاق السطحية مقارنة بالآفاق تحت السطحية، وهذا ما تؤكده نوعية الخرائط المستنبطة باستخدام IDW الموضحة بالأشكال (a3، b3، c3)، حيث تشير قيم RMSE المنخفضة في العمق الأول والثالث إلى أن الخرائط المنتجة لها ذات نوعية جيدة وأفضل نوعاً ما من تلك الخرائط المستنبطة للعمق الثاني. كذلك يتبين من خلال معامل التحديد R^2 ومعامل الارتباط R بين القيم المقيسة والقيم المستنبطة أن هناك ارتباطاً طردياً جيداً لهذه الخاصية خاصة في العمق الأول، وبالتالي صلاحية خرائط التنبؤ المكاني لخاصية BD المتحصل عليها باستخدام IDW في منطقة الدراسة. وتتفق هذه النتائج مع ما وجده Bogunović وآخرون (2016) ، حيث استنتج بأنه لاتوجد فروق معنوية في BD مع العمق، كذلك أشار لقيم CV المنخفضة والأقل من 10% كمؤشر لتغاير أو تباين أقل في دراسته. بينما توصل صادق وآخرون (2014) إلى ان الخرائط المنتجة لخاصية BD أقل دقة باستخدام طريقة IDW نتيجة لارتفاع قيمة (CV > 100) وانخفاض قيم R^2 (0.062 R^2=).

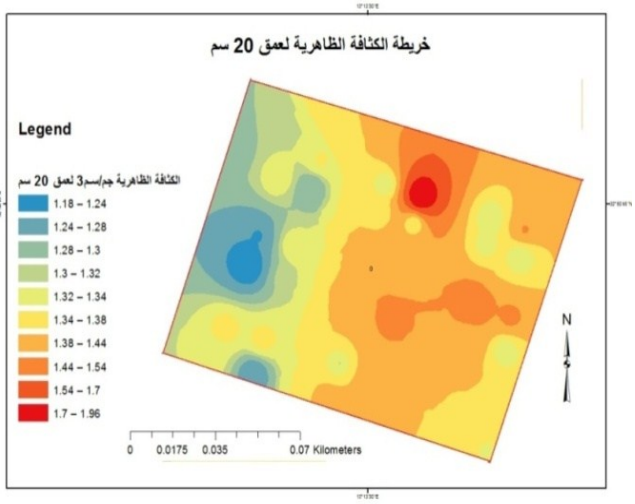
ISSN: online 2617-2186 print 2617-2178

جدول: (1) التحليل الإحصائي لبيانات الخرائط المكانية المنتجة لخواص التربة المدروسة

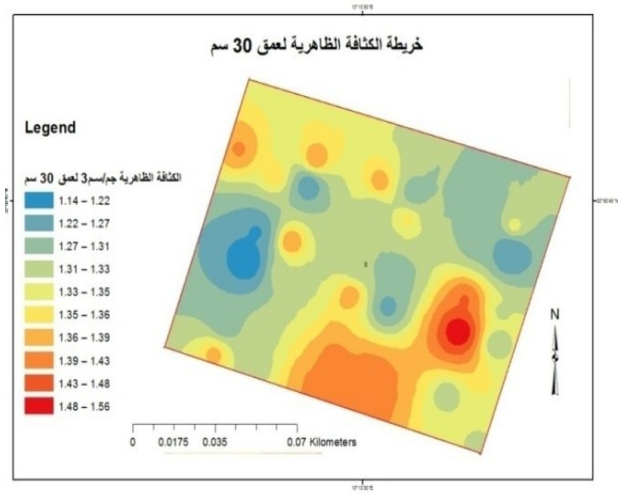
% CV	R	R^2	RMSE	Max	Min	الأعماق (سم)	الخواص
5	0.55	0.30	0.06	1.48	1.18	10 −0	
9	0.47	0.22	0.13	1.96	1.18	20 −10	BD (جم/سم^3)
6	0.46	0.21	0.07	1.56	1.14	30 −20	
29	0.56	0.31	0.71	3.98	1.03	10 −0	(%) GWC
30	0.45	0.20	0.82	4.25	1.19	20 −10	
39	0.45	0.20	0.86	4.60	1.20	30 −20	
35	0.81	0.65	0.84	0.64	0.16	30 −0	EC (ملیموز/سم))
3	0.66	0.44	0.15	8.1	7.4	30 −0	pH



شكل (3a): الخريطة المستنبطة للكثافة الظاهرية للعمق الأول



شكل (3b): الخريطة المستنبطة للكثافة الظاهرية للعمق الثاني

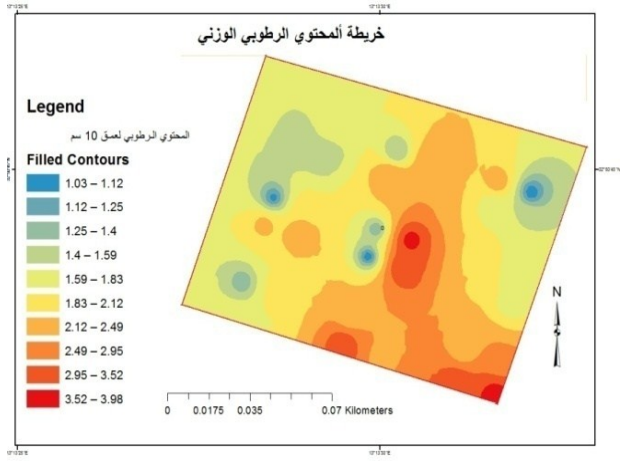


شكل (3c): الخريطة المستنبطة للكثافة الظاهرية للعمق الثالث

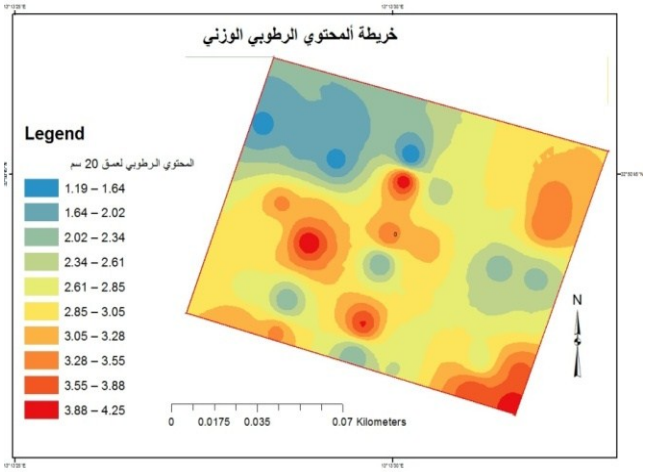
أما بالنسبة للتغاير في المحتوى الرطوبي الوزني GWC كما هو موضح بالأشكال (a4، b4، c4) يبدو واضحاً من النتائج المبينة في الجدول (1) بأن هناك اختلافات مكانية حسب قيم RMSE و CV ولكن الاختلافات أكثر وضوحاً في العمق الثاني والثالث، حيث يُلاحظ تزايد في GWC مع العمق مقارنة بالعمق الأول الذي تنخفض فيه GWC نتيجة للبخر أو الفقد في الرطوبة الذي يحدث في الطبقة السطحية للتربة خاصة وإن العينات جمعت خلال شهر أبريل الذي لم تسقط فيه الأمطار، وتتفق هذه النتائج مع نتائج Bogunović وآخرون(2016) الذي وجد فروق معنوية في GWC مع العمق كذلك وجد انخفاض معنوي في GWC في العمق 0− 10 ، كما وجد(Moradi وآخرون 2012) اختلافات مكانية

ISSN: online 2617-2186 print 2617-2178

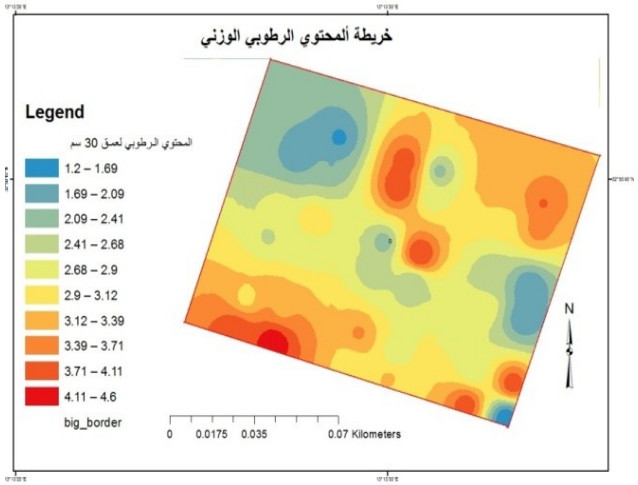
واضحة في GWC عند الأعماق المختلفة قبل الري وبعده، وبشكل عام تعتبر الخرائط المستنبطة لخاصية GWC أقل جودة من تلك المستنبطة لخاصية BD حسب قيم RMSE و CV ولكن كانت أفضل من نتائج Bogunović وآخرون (2016) حيث وجد قيم RMSE (1.7741 −2.1206) للأعماق (0−10 ، 10−20) على التوالي عند دراسة الاختلافات المكانية لخاصية GWC، كذلك ارتفاع قيم معامل التحديد R^2 ومعامل الارتباط R بين القيم المقيسة والقيم المستنبطة في العمق الأول تشير إلى أن هناك ارتباطاً جيداً لهذه الخاصية في هذا العمق على خلاف العمق الثاني والثالث بالرغم من أن قيم CV تشير إلى إن التغاير أو الاختلافات متوسطة حسب ما أشار له صادق وآخرون (2014) عندما (CV= 15%-50%).



شكل (4a): الخريطة المستنبطة للمحتوى الرطوبي الوزني للعمق الاول



شكل (4b): الخريطة المستنبطة للمحتوى الرطوبي الوزني للعمق الثاني

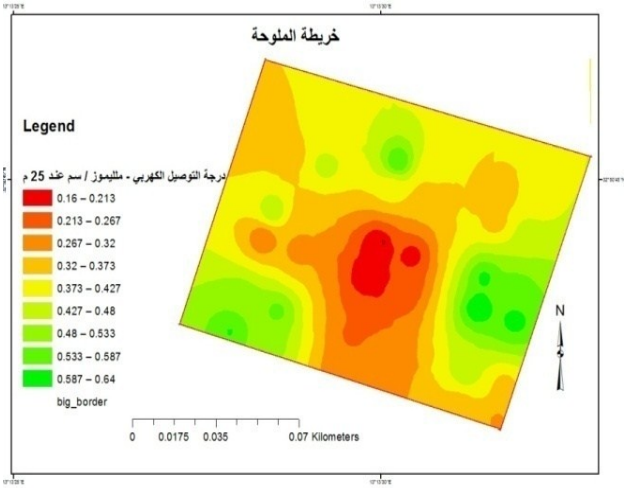


شكل (4c): الخريطة المستنبطة للمحتوى الرطوبي الوزني للعمق الثالث

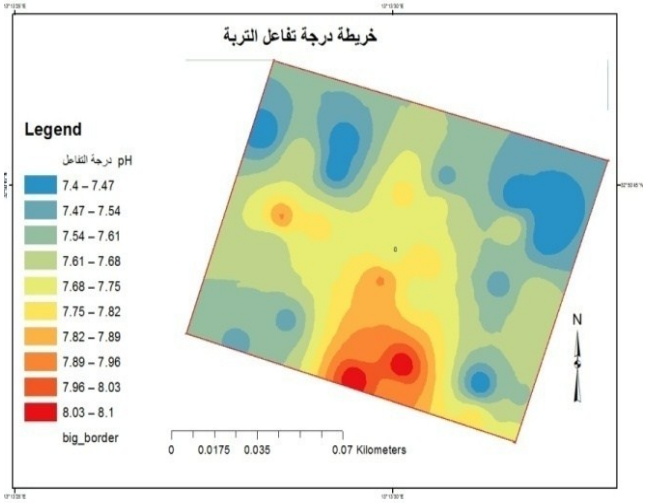
يوضح شكل (5) الخريطة المستنبطة لملوحة التربة والتي يعبر عنها بالتوصيل الكهربائي EC، وتصف هذه الخريطة التغاير المكاني العالي نسبياً وبالتالي تصنف من ضمن الخرائط الأقل جودة في هذه الدراسة، حيث تشير قيم RMSE و CV في الجدول (1) أن هناك اختلافات مكانية واضحة وذلك ربما نتيجة لأن EC صفة متغايرة بفعل عمليات الإذابة والغسيل والإضافة والترسيب والتبخر كما أشار لها سليمان وجبير (2014). وتتفق هذه النتائج مع ما وجده المحيميد (1999) إذ وجد أن من بين الصفات الكيميائية الأعلى تغايراً هي الملوحة عند دراسته لتغاير قيم EC لترب رسوبية عراقية، كذلك أشارت النتائج المتحصل عليها Lascano وآخرون (2001) عند دراسته لترب في أمريكا أن تغاير الملوحة كان عالياً مقارنة بالخواص الأخرى. على خلاف ذلك تعتبر درجة تفاعل التربة pH أقل الخواص تغايراً حسب النتائج الموضحة بالجدول (1)، حيث توضح قيمة CV المنخفضة مقارنة بتلك الخواص الأخرى أن الاختلافات المكانية ضئيلة، كذلك تشير القيمة المنخفضة RMSE إلى أن الخرائط المستنبطة لهذه الخاصية الموضحة بالشكل (6) ذات جودة عالية، بالإضافة لارتفاع قيم معامل التحديد R^2 ومعامل الارتباط R بين القيم المقيسة والقيم المستنبطة تشير إلى أن هناك ارتباطاً طردياً جيداً لهذه الخاصية، أي إن القيم المستنبطة لا تنحرف كثيراً عن القيم المقيسة، وبالتالي صلاحية خرائط التنبؤ المكاني

ISSN: online 2617-2186 print 2617-2178

لخاصية pH المتحصل عليها باستخدام IDW في منطقة الدراسة. وهذا يتفق مع نتائج جبير(2013) إذ أشارت إلى أن pH قليل التغاير في الترب العراقية نتيجة لاحتوائها على كميات عالية من كربونات الكالسيوم. كما أكدت قيم CV المنخفضة لخاصية pH في التربة بأنها أقل الخواص تغايراً، وتتفق مع نتائج Aishah *et al.*،(2010) إذ وجدوا (CV= 4%) في ترب سيريلانكا، كذلك (CV=7–9 %) متحصل عليها من قبل Usowicz & Lipiec (2017) في الترب البولندية.



شكل (5): الخريطة المستنبطة لملوحة التربة للعمق 0–30 سم



شكل(6): الخريطة المستنبطة لدرجة تفاعل التربة للعمق 0–30 سم

الخلاصة

إن تقدير التباين أو الاختلاف المكاني لخواص التربة الفيزيائية والكيميائية شرط أساسي لإدارة التربة والمحاصيل وبناء بيئة إيكولوجية محددة. ويُعَدُّ استخدام الأرض وإدارتها من العوامل الرئيسية للإنتاج المحصولي المستدام، بالاضافة لخواص التربة المرغوبة والمنتجة والتي تدمج مجموعة متنوعة من العمليات البيئية والممارسات البشرية في الوسط الطبيعي. من المهم للغاية وجود مجموعة من المؤشرات لإدارة موقع محدد، بحيث يجب أن تركز هذه المؤشرات على الخصائص الفيزيائية والكيميائية والبيولوجية للتربة في منطقة الأبحاث وأن تكون مستهدفة. ركزت هذه الورقة على استخدام الإحصاء المكاني في إنتاج خرائط لبعض خواص التربة تم دمجها ضمن نظام المعلومات الجغرافية. بالإضافة إلى ذلك، تم تخطيط نمط توزيع خصائص التربة في منطقة الدراسة باستخدام الأساليب الإحصائية. تم استخدام طريقة مقلوب المسافة الموزونة (IDW) وتقييمها لتحليل بعض خصائص التربة، ومتغيراتها مثل الحد الأدنى(Min) والحد الأقصى (Max) ومعامل الاختلاف (CV) للعينات. كذلك تم حساب الجذر التربيعي لمتوسط مربع الخطأ (RMSE)، ومعامل التحديد (R^2) بين القيم المقيسة والقيم المستنبطة كمؤشر لدقة عمليات التوليد أو التنبؤ هذه. وبما انه كلما انخفضت قيم RMSE كانت هذه الطريقة أفضل في إنتاج خرائط التنبؤ، عليه نستنتج ان طريقة IDW في هذه الدراسة أعطت نتائج جيدة لخرائط كل من الكثافة الظاهرية (BD) ودرجة حموضة التربة (pH)، وبالتالي يمكن ان تستخدم هذه القيم التي تم الحصول عليها للتنبؤ بهذه الخواص في أي منطقة مماثلة لم تؤخذ منها عينات. ويمكن الاستفادة من البيانات التي تم الحصول عليها في إدارة المواقع المحددة بما في ذلك اختبار أداء أنظمة الري والصرف الحالية والعمليات الزراعية مثل الحراثة والتسميد وكذلك تقييم ممارسات استخدام الأراضي. بينما خرائط المحتوى الرطوبي الوزني (GWC) وملوحة التربة (EC) أعطت نتائج أقل دقة، ولهذا فإن طريقة IDW ربما غير مناسبة بالدرجة الكافية في استنباط كل خواص التربة في هذه الدراسة وعليه يجب استخدام طرق أخرى مثل Kriging للحصول على نتائج أفضل بشرط زيادة عدد العينات ومقارنتها بالنتائج المتحصل عليها بطريقة IDW. كما أظهرت هذه

ISSN: online 2617-2186 print 2617-2178

الدراسة أهمية تأسيس قاعدة بيانات مكانية لخصائص تربة محطة أبحاث كلية الزراعة بجامعة طرابلس، وذلك لتتبعها مكانياً وزمانياً في الدراسات المستقبلية.

المراجع

امحمد، مفتاح علي محمد. (2015). تقييم وتخريط ملوحة التربة للمحاصيل المروية باستخدام طرق الإحصاء المكاني (Geostatistics) والدراسات الحقلية بمنطقة سواوة. رسالة ماجستير، جامعة طرابلس، طرابلس– ليبيا.

الجبوري، ثاير حبيب؛ منعم نصيف جاسم المزروعي ومنذر صائل الجبوري. (2015). التحليل المكاني لخصائص ترب ناحية المنصورية. مجلة ديالي. (65): 58–84.

العالم، مختار محمود. (2017). التغايرات المكانية لبعض خواص التربة الكيميائية لمنطقة سهل الجفارة (حالة دراسية: طرابلس، وادي المجينين، بن غشير). المجلة الليبية للعلوم الزراعية. 22 (1): 19–34.

المحميد، عبد الحليم علي سليمان. (1999). التغايرات المكانية والزمنية لبعض صفات الترب في وسط السهل الرسوبي العراقي – اطروحة دكتوراه–كلية الزراعة/ جامعة بغداد.

جبير، أمل راضي. (2013). دراسة التغايرات المكانية واستحصال العينات لبعض صفات التربة في شمال تكريت باستخدام مفاهيم الإحصاء الجيولوجي عن طريق المعلومات الجغرافية (GIS). مجلة الفرات الزراعية. 5 (3): 268–279.

سليمان. عبد الحليم علي وأمل راضي جبير. (2014). دراسة التغايرات المكانية لبعض الصفات الفيزيائية والكيميائية للتربة في وسط السهل الرسوبي باستخدام مفاهيم الإحصاء البيدولوجي. مجلة جامعة تكريت للعلوم الزراعية. 14 (1): 236–245.

شرف. محمد ابراهيم محمد. (2017). المرجع في نظم المعلومات الجغرافية. دار المعرفة الجامعية. جامعة الاسكندرية، مصر. ص 328.

صادق، منير هاشم؛ هادي عبد الأمير العجيلي وسعد شاكر العزاوي. (2014). دراسة مقارنة تقنيات التقدير لرسم خرائط بعض الصفات الفيزياوية للتربة. مجلة جامعة كربلاء. 12 (2): 221–232.

Aishah, A.W.; Zauyah. S; Anuar. A.R; and Fauziah.C.I . (2010). Spatial variability of selected chemical characteristics of padoly Soils in Sawah Sempadan , Selangor ,Malaysia. Malaysian J of soil Sci, vol.14:27 -39

Arshad, M.A.; B. Lowery and B. Grossman (1996). Physical tests for monitoring soil quality. In: Doran, J.W. and A.J. Jones (Eds). Methods for assessing soil quality. SSSA Spec. Publ. 49. Soil Science Society of America, Inc., Madison, Wisconsin, USA, p.123-142.

Bogunović, I., Dekemati, I., Magdić, I., Vrbanić, M., Matošić, S., Mesić, M. (2016). Spatial modeling for describing spatial variability of soil physical properties in eastern Croatia. Poljoprivreda,22: 2016 (1) 46-52.

Burrough, P. A. (1989). Fuzzy Mathematical Methods for Soil Survey and Land Evaluation. Journal of Soil Science, 40: 447-492.

Burrough, P. A. (1993). Problems of Superim Posed Effects in The Statistical Study of The Spatial Variation of Soil Agricultural .Water Management, Netherlands, 6: 123 - 143.

ISSN: online 2617-2186 print 2617-2178

Fahad, A. A.; Shib, R. M.; Al-Siaykaly, A. A. and Razaq, I. B. (1993). Spatial Variability of Field Soil Salinity Using Geostatistical Techniques. Basra, Journal Agricultural Science, 6 (1).

Gotway, C. A; Ferguson, R. B; Hergert, G. W; and Peterson, T.A .(1996). Comparison of kriging and inverse-distance methods for mapping soil parameters. Soil Science Society of America Journal ,60: 1237-1247.

Hendershort, W.H.; H. Lalande and M. Duquette (1993). Soil reaction and exchangeable acidity. In: Carter. M.R. (Eds). Soil Sampling and methods of soil analysis (pp. 141-145). Canadian Soc. Soil Sci., Lewis Publishers London.

Hosseini, E.; Gallich, J. and Marcot, D. (2009). Theoretical and Experimental Performance of Spatial Interpolation Methods for Soil salinity analysis. Transactions of the American Society of Agricultural and Biological Engineers, 37:1799 - 1907.

Hudnall W.; A.Bekele. (2006). Spatial Variability of soil chemical properties of a prairieforest transition in Louisiana. Plant Soil, v. 280, p. 7-21.

Krasilinkov,P.; F.Carre; L. Montanarella. (2008). Soil geography and geostatistics.

Lascano ,R.J. and Hatfield. J.L.(2001). Spatial variability of evaporation long two transects of a bare soil .Soil Sci.Soc Am.J. 56:341 -346.

Mabit, L. and Bernard C .(2010). Spatial distribution and content of soil organic matter in an agricultural field in eastern Canada, as estimated from geostatistical tools. Earth Surface Process and Landforms, 35: 278- 283

Burrough, P. A., and McDonnell. R. A. (1998). Principles of Geographic Information Systems. Oxford, Oxford University Press.

Burrough, P.A. (1986). Principles of Geographic Information Systems for Land Resources Assessment. Oxford, Oxford University Press.

Camachu, T.; Jesus, H.; Luengas C. A. and Fabio R. L. (2009). Effect of Agricultural Intervention on the Spatial Variability of Some Soils Chemical Properties in the Eastern Plains of Colombia. Chilean Journal of Agricultural Research 68(1): 42 -55.

Carter, M.R. and B.C. Ball (1993). Soil porosity. In: Carter, M. R (Eds). Soil sampling and methods of analysis. Canadian Society of soil science. Lewis Publishers. ISBN 0-87371-861-5.

Chang, K. (2002). Introduction to Geographic Information Systems McGraw-Hill, New York.

Chile`s, J. P. and Delfiner, P. (1999). Geostatistics: Modeling Spatial Uncertainty. John Wiley & Sons, Inc., New York.

Corwin, D.L. and Lesch, S. M. (2005). Characterizing Soil Spatial Variability with Apparent Soil Electrical Conductivity Part 11. Case Study .Computers and Electronics in Agriculture, 46:135 -152.

De la Rosa, D. (1979). Relation of Several Pedological Characteristics to Engineering Qualities of Soil. Journal of Soil Science, 30: 793 –799.

ESRI. (2012). Environmental Systems Research Institute, Using ArcGIS geostatistical analyst USA.

ISSN: online 2617-2186 print 2617-2178

Variability of Selected Soil Properties in the Cukurova Plain. Journal of Agricultural Sciences. 22: 377-384.

Usowicz, B.; Hajnos, M.; Sokololwska, Z.; J.zefaciuk, G.; Bowanko, G. and Kossowski, J. (2004). Spatial Variability of Physical and Chemical Soil Properties in a Field and Commune Scale. Acta Agrophys, 3:5 – 90.

Usowicz,B. and Lipiec, J. (2017). Spatial variability of soil properties and cereal yield in a cultivated field on sandy soil. Soil & Tillage Research 174 :241–250.

Uyan, M. and Cay, T. (2010). Geostatistical methods for mapping groundwater nitrate concentrations. Paper presented at the 3rd international conference on cartography and GIS. Nessebar, Bulgaria.

Vineeth, P.; Teja. K. and Raghuveer.D. (n.d) https://www.slideshare.net/penchalavineeth/inverse-distance-weighting

Weber,D., and E.J. England, (1992). Evaluation and comparison of spatial interpolations.Math. Geol., 26: 381-391

Webster, R., and Oliver. M. (2001). Geostatistics for Environmental Scientists John Wiley & Sons, Chichester.

White, J. G.; Welch, R. M. and Norvell, W. A. (1997). Soil Zinc Map of USA Using Geostatististics and Geographic Information System. Soil Science Society of America Journal, 61:185 -194.

Wollenhaupt, N.C., Wolkowski. R.P, and Clayton, M.K. (1994). Mapping soil test phosphorous and potassium for variable-rate fertilizer application. J. Prod. Agric, 7: 441- 448

Mardia, K. V. and Jupp, P. F. 2000. Directional Statistics. John Wiley & Sons, Ltd, Chichester.

Moradi, M., D. Ghonchehpour, A. Majidi, and V.M. Nejad.(2012). Geostatistic approaches for investigating of soil hydraulic conductivity in Shahrekord Plain, Iran. Amer. J. Math. And statistics 2(6): 164-168.

Mulla, D. J. (1997). Geostatistics, remote sensing and precision farming. In: Precision Agriculture: Spatial and Temporal Variability of Environmental Quality. John Wiley & Sons, Ltd, Chichester.

Nikpey M, Sedighkia M, and Nateghi M B (2017). Comparison of Spatial Interpolation Methods for Mapping the Qualitative Properties of Soil. Advances in Agricultural Science, 5: 1-15.

Peterson, M. (2017). Advances in Cartography and GIScience. Selection from the International Cartographic Conference 2017. Washington.

Rosenbaum, M.; and Söderstoröm, M. (1996).Geostatistices as an aid to mapping. In 1996 ESRI European User Conference. London, UK.

Santra, P.; Chopra, U. K. and Chkraborty, D. (2008). Spatial Variability of Soil Properties and its Application in Predicting Surface Map of Hydraulic Parameters in an Agricultural Farm. Current Science, 95: 937-945.

Talkkari, A.; Lauri, J. and Markku Y. H. (2002). Geostatistical Prediction of Clay Percentage Based on Soil Survey Data Agricultural Journal, 11: 381- 390.

Tunçay, T; Bayramin, I; Atalay, F; and Unver, I. (2016). Assessment of Inverse Distance Weighting (IDW) Interpolation on Spatial

ISSN: online 2617-2186 print 2617-2178

Al-Mukhtar Journal of Sciences 34 (4): 359-371, 2019

Using The Inverted Distance Weighting Method (IDW) to Produce Maps of Some Soil Properties at the Agricultural Research Station, University of Tripoli

Magda Bashir El-beshti*, Abuabdalla Saad Sherif and Ehab Mohamed Sagar
Department of Soil and Water, Faculty of Agriculture, University of Tripoli, Tripoli, Libya

Received: 04 May 2019/ Accepted: 30 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.207

Abstract: The objective of the study was to determine the spatial differences of some physical and chemical properties of the soil samples of the research stations of the Faculty of Agriculture/University of Tripoli in April 2013. The results were used to produce spatial maps in order to find out the spacial distribution for the following properties: Bulk density (BD), Gravimetric water content (GWC), soil salinity (EC) and soil pH using the inverse distance weighting (IDW) method. The study was conducted on an area of approximately 13000 m^2 and was divided into a 12 m x11 m grid to produce 100 survey units and 36 units were chosen and coordinated by a portable GPS device to collect the samples. Tests were performed for both BD and GWC from depths 0-10 cm, 10-20 cm and 20- 30cm, while EC and pH analysis where done for samples from a depth of 30 cm. Spatial maps were produced of continuous surfaces and quality that differed from one property to another according to the Root Mean Square Error (RMSE) values. Based on the results, the values of RMSE varied (0.71, 0.82, and 0.86) for the GWC and (0.06, 0.13, 0.08) for the BD properties of the three depths, respectively. Where as the RMSE values were (0.15, 0.84) for the pH and EC properties respectively. The low RMSE values for BD maps at the first and third depths and the pH map showed a higher quality index for the maps. While the relatively high RMSE values showed that the maps produced for both EC and GWC properties were lower quality. This study concluded that it is possible to produce spatial maps of different quality for some soil properties within the field using IDW. These maps can therefore be used to predict BD and pH properties in the field, while they are difficult to predict for EC and GWC. Therefore, it is recommended to continue to explore the possibility of producing high-quality maps in other ways for these two properties, taking into account the increase in the number of the samples.

Keywords: Inverted Distance Weighting, Bulk Density, Volumetric Water Content, Soil Salinity, Soil pH.

*Correspondence Author: Magda Bashir El-Beshti, e-mail: melbeshti@yahoo.com, Department of Soil and Water, Faculty of Agriculture, University of Tripoli, Tripoli, Libya.

مجلة المختار للعلوم 34 (4): 372-381، 2019

حصر بعض الأمراض الفطرية على أوراق الورد بمدينة البيضاء، ليبيا

نوارة علي محمد* نوال جمعة عبدالله وعمر موسي السنوسي

قسم وقاية النبات، كلية الزراعة، جامعة عمر المختار، البيضاء، ليبيا

تاريخ الاستلام: 13 يونيو 2019 / تاريخ القبول: 30 ديسمبر 2019
Doi:https://doi.org/10.54172/mjsc.v34i4.235

المستخلص : أجريت هذه الدراسة على نباتات الورد النامية في مدينة البيضاء عام 2016 بهدف حصر الأمراض الفطرية على أوراق نبات الورد النامي بمدينة البيضاء، أوضحت نتائج الدراسة أن شجيرات الورد المزروعة في الحدائق العامة كانت الأعلى اصابة معنوياً مقارنة بالحدائق المنزلية والمشاتل، ويظهر من هذه النتائج أن كمية المرض على أوراق الورد المزروع بالبيضاء كانت عالية خلال فترة الدراسة، كانت الحدائق المنزلية والمشاتل أقلها اصابة (45.5% و 48.3%) على التوالي. مقارنة بالحدائق العامة (73%)،الأمراض التي سجلت في هذه الدراسة كانت: البياض الدقيقي،الصدأ، البقعة السوداء، والبقعة الفضية، احتراق الحواف، واللطخة؛ أكثر الأمراض تواجداً هو مرض البياض الدقيقي حيث بلغ (46.9% و 30.4%) لكل من نسبة الإصابة وشدتها على أوراق الورد المزروعة بمدينة البيضاء على التوالي، بينما مرض الصدأ كان أقل الأمراض المسجلة بالمنطقة خلال سنة 2016 بنسبة اصابة لم يتجاوز متوسطها 4.1%. مع عدم وجود فروق معنوية بين الاتجاهات النبات وإن نسبة الإصابة تتراوح بين 37.5-40%، وكان شهر يوليو هو أعلى الشهور إصابة، وأن أوراق الورد المسنَّة هي الأعلى نسبة أصابة في جميع شهور الدراسة.

الكلمات المفتاحية: حصر، أمراض فطرية، أوراق الورد، البيضاء، ليبيا

المقدمة

الورد Rose الاسم اللاتيني (*Rosa* sp.) هو نبات زينة للحدائق المنزلية، والمسطحات ويُنَمَّى لأسباب تجارية ، فهو نبات معمر، على شكل شجيرة مستديمة الخضرة أو نصف متساقطة، تتبع العائلة الوردية Rosaceae. يعتبر من محاصيل التصدير لعدد من دول العالم و يقدر الإنتاج العالمي سنويا بمئة مليون شتلة سنوياً وتعتبر الدنمارك أكبر منتج له حيث تنتج منها حوالى 50% (Pemberton وآخرون،2003). يمتاز هذا النبات بأنه متعدد الاستعمالات؛ منها ما يزرع في الحدائق المنزلية والعامة بهدف تجميلها، صناعة العطور من خلال استخلاص الزيوت العطرية منها ، ويدخل في الصناعة العلاجية.

نبات الورد يصاب بالعديد من الممرضات النباتية التي ينجم عنها أمراض لها تأثير عالٍ على صحته، جماله وقيمته التجارية، هذه الأمراض تسبب خسائر للنبات بالكامل أو أجزاء كبيرة منه، لذا يتطلب التعرف على مسببات هذه الأمراض، وعزلها وتحديد الظروف الملائمة لانتشارها ووبائيتها.يصاب نبات الورد بالعديد من الفطريات التي تهاجم الأوراق منها مرض البقعة السوداء، البياض الدقيقي والصدأ (Schwer 2006)، ويعد مرض البياض الدقيقى المتسبب عن الفطري الاسكي *Sphaerotheca pannosa* var.*rosae*، *Podosphaera rosae*، من بين أهم تلك الأمراض، يليه مرض الصدأ الناتج عن فطر *Phragmidium* الذي يظهر على الأوراق لينتشر على المجموع الخضري على شكل بقع برتقالية وتساعد نسبة الرطوبة العالية على انتشار هذا المرض يرجع خطورة هذا المرض إلى ظهور بثرات على الأوراق والأفرع مؤدية إلى زيادة فقد الماء وجفاف النبات وموته عند الإصابة الشديدة، أما مرض البقع السوداء الذي تظهر أعراضه

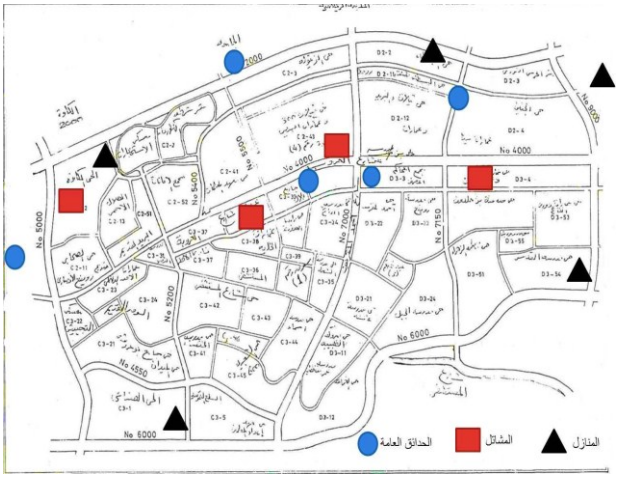
*نوارة علي محمد nwboshakoa@gmail.com ، قسم وقاية النبات، كلية الزراعة، جامعة عمر المختار، البيضاء، ليبيا

بوضوح على شكل بقع سوداء على السطح العلوي للورقة والسوق الصغيرة قد يتسبب عنه تساقط الأوراق، أما مرض العفن الرمادي فهذا المرض ناتج عن فطر *Botrytis cinerea* حيث يهاجم الأزهار والسوق ويظهر في شكل كتل رمادية اللون على الأزهار والسوق كما يتسبب في موتها، بالإضافة إلى مرض البياض الزغبي تظهر بقع أرجوانية اللون داكنة على الأوراق تسبب سقوط الأوراق نتيجة الإصابة بفطر *Pernospora sparsa* ، كذلك تبقعات ناتجة عن الفطريات *Alternaria* sp، *Cercospora puderi*، *Coryneum microstictum*، *Mycosphaerlla rosicola*، *Septoria rosae*، ذكر(Salamone وآخرون،2009) أن البياض الدقيقي(*Podosphaera pannosa* (Wallr. Fr de Bary) ، والعفن الرمادي *Botrytis cinerea* Pers.

من أشهر أمراض الورد في ليبيا، سجل خلال السنوات 1959 إلى 1964 في طرابلس العديد من الاصابات على شجيرات الورد المزروعة منها: الصدأ (Schr.)Wint. *Phragmidium subcorticium*)، البياض الدقيقي (*Sphaerotheca pannosa* (Waltas) Lev.)، البقعة السوداء (*Diplocarpon rosae* Wolf IMI 105311)، والعفن الرمادي (*Botrytis cinerea* Pers. Ex Fr. IMI 105312) ، كما درس Kranz (1965) أهم الأمراض الفطرية بمنطقة الجبل الأخضر الذى يصل ارتفاعه عن مستوى سطح البحر 800م، ومتوسط امطاره 200–600 مم^3 سنويا، وأقصى درجة حرارة 30–33م يوليو–أغسطس سنة 1959، وعزل فطر *Gliocladium roseum* من شجيرات الورد المزروعة بهذه المنطقة. تهدف هذه الدراسة إلى حصر أمراض الورد بمدينة البيضاء، الجبل الأخضر–ليبيا.

المواد وطرق البحث

جمع العينات: جمعت العينات من 15 موقعاً داخل مدينة البيضاء الواقعة في الشمال الشرقي من ليبيا، بالمنطقة الوسطى من الجبل الأخضر، خط عرض °21 33-44’ وخط طول °32 45’-59’ ، بمساحة 11.429 كم^2 وارتفاع 624 متراً عن سطح البحر، تمتاز بمناخ البحر الأبيض المتوسط حار جاف صيفاً وممطر شتاء (Abdullrahman، 2014)، وشملت الأماكن المستهدفة خمسة مواقع لكل من: مشاتل، حدائق عامة وحدائق منزلية، خلال فترة نشاط النبات متضمنة المواسم الأربعة (الخريف، الشتاء، الربيع والصيف)، بمعدل خمس أشجار من كل موقع، ليصل عدد الشجيرات المختبرة 75 شجرة /شهر، جلبت العينات إلى معمل أمراض النبات، الكائن بقسم وقاية النبات، التابع لكلية الزراعة، جامعة عمر المختار، البيضاء، ليبيا بعد حفظها في صناديق بلاستيك الحاوية أوراق ورقية للحفاظ على حيوية العينات، ركزت هذه الدراسة على مواقع تختلف في طبيعة الزراعة بها والعناية بنبات الورد وشملت حدائق عامة، حدائق منزلية ومشاتل، موزعة في مدينة البيضاء باتجاهات مختلفة(كما هو مبين بالخريطة)، وجمعت العينات من ثلاثة مستويات متضمنة الأوراق المسنة، الأوراق المتوسطة والأوراق الحديثة، وأربعة اتجاهات (الشمالي، الجنوبي، الشرقي والغربي) لكل شجرة. تم الجمع بمعدل شهري في فترة نشاط مارس– ديسمبر لسنة 2016، حيث تباينت خلال هذه الفترة ظروف بيئية مختلفة نتيجة تعاقب الفصول الأربعة (الخريف، الشتاء، الربيع والصيف).



شكل (1) خريطة تبين موقع الدراسة

ISSN: online 2617-2186 print 2617-2178

جدول:**(1)**. المتوسطات الشهرية لعناصر المناخ بمحطة البيضاء لسنة 2016

الأشهر	العناصر المناخية*						
	الحرارة الكبرى	الحرارة الصغرى	كمية الأمطار	عدد الأيام الممطرة	سرعة الرياح	كمية السحب الكلية	نسبة الرطوبة
3	14.9	06.2	04.0	06.0	11.0	05.0	72
4	16.4	08.9	01.5	03.0	08.8	03.2	65
5	17.5	10.5	0.2	02.0	09.0	01.0	61
6	19.5	12.8	0	0	10.5	01.0	55
7	22.0	14.6	0	0	10.5	0. 5	50
8	24.8	17.5	0	0	09.0	0.5	45
9	28.0	20.0	0.9	02.0	09.0	01.0	46

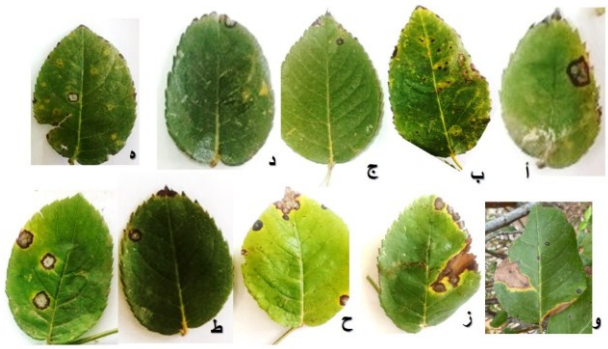
مركز الأرصاد الجوية بجامعه عمر المختار

تقدير كمية الإصابة في المواقع : قيمت كمية الإصابة على أوراق نباتات الورد المجموعة من كل موقع وكانت تفصل إلى مجاميع باستخدام طريقة Carlson-Nilsson & Davidson (2002). حيث قسمت النباتات إلى مجاميع حسب المرض.

تقدير كمية الإصابة بالأمراض : قدرت أعراض الإصابة على أمراض الورد حسب الأعراض الظاهرة من نموات دقيقية، بثرات أو شكل التبقعات، لونها، حجمها، وجود جراثيم من عدمها، وزعت العينات إلى مجاميع، كل عرض تم توزيعه حسب درجة الإصابة لكل عرض وفق المقاييس المعتمدة في المراجع العلمية،ليتم تقدير كمية الإصابة وحساب نسبة وشدة الإصابة لكل مرض على حدة.

النتائج

أمراض الورد المسجلة بالدراسة: من أهم النتائج المسجلة في هذه الدراسة هو ظهور العديد من الأعراض على الورقة الواحدة، ووجود أكثر من بقعة مختلفة في اللون والحجم، كما هو مبين في الشكل (2) نجد أن (2–أ) عليها تبقع غير منتظم بني ووجود موت للحواف مع موت قمة الورقة، (2–ب): يظهر عدد من التبقعات بنية –سوداء صغيرة الحجم غير منتظمة الشكل مع ظهور أعراض موت الحواف،(2–ج): بقع سوداء اللون مع موت الحواف، (2–د): البقع الفضية وموت الحواف، (2–هـ): بقع صفراء، بثرات، موت الحواف، (2–و): لطخة وبقع سوداء، (2–ز): لطخة، بقع سوداء وموت الحواف، (2–ح): لطخة، بقعة فضية، بقع سوداء وبقع محاطة بهالة صفراء، (2–ط): موت القمة وبقع فضية، (–ي): بقع فضية وبقع سوداء.



شكل:**(2)**. أهم الأعراض الظاهرة على أوراق الورد خلال موسم نموها لسنة 2016م.

حصر أمراض الورد المسجلة بالدراسة: يظهر من الجدول (2) أن شجيرات الورد المزروعة في الحدائق العامة كانت الأعلى إصابة معنوياً مقارنة بالحدائق المنزلية والمشاتل حيث بلغ متوسط نسبة الإصابة (73% ، 45.3%، 48.3%) على التوالي، وكانت نسب الإصابة بشكل عام عالية طيلة فترة الدراسة حيث وصلت أقل نسبة إصابة سجلت بسنة 2016 م 49.2%، في حين أعلى نسبة إصابة على الورد سجلت في شهر 7 (يوليو) بلغت 69%، عند حساب شدة الإصابة ظهرت الحدائق المنزلية هي الأقل إصابة مقارنة بالعامة والمشاتل، وبينت النتائج أن الشهور الأعلى حرارة تراوحت شدة الإصابة بها 30–38%، في حين كانت شهور الربيع لم تتجاوز 27%، ويظهر من هذه النتائج أن كمية المرض على أوراق الورد المزروع بالبيضاء كانت عالية خلال فترة الدراسة،

ISSN: online 2617-2186 print 2617-2178

كانت الحدائق المنزلية والمشاتل أقلها أصابة مقارنة بالحدائق العامة.

جدول (2) نسبة إصابة أوراق الورد المزروعة بحدائق البيضاء العامة والمنزلية ومشاتلها في الفترة الممتدة (03-09 لسنة 2016م).

الأشهر	تقدير كمية الإصابة بمواقع الدراسة لسنة 2016			
	نسبة الإصابة			متوسط الأشهر
	حدائق	منازل	مشاتل	
3	68.0	47.2	64.8	60.0
4	80.5	46.7	36.0	54.4
5	94.7	29.2	34.2	52.7
6	75.6	15.8	56.3	49.2
7	64.4	57.5	72.0	69.0
8	68.0	49.2	45.4	54.2
9	60.2	58.6	29.4	49.4
متوسط المواقع	73.1	45.3	48.3	
LSD 0.05	الأشهر	21.721		
	المواقع	18.358		
	الأشهر * المواقع	48.570		
	شدة الإصابة			
3	14.3	20.8	48.6	27.9
4	36.5	19.6	25.6	27.2
5	43.1	13.1	24.3	26.8
6	42.6	8.5	40.4	30.5
7	32.3	38.7	43.7	38.2
8	38.4	31.7	29.2	33.1
9	39.6	39.2	26.3	35.0
متوسط المواقع	35.2	24.5	34.0	
LSD 0.05	الأشهر	15.547		
	المواقع	13.140		
	الأشهر * المواقع	34.764		

حصر أمراض الورد في منطقة البيضاء: أظهرت النتائج أن أهم الأمراض المسجلة على أوراق الورد كانت البياض الدقيقي، الصدأ، البقعة السوداء، والبقعة الفضية، احتراق الحواف، واللطخة، بالإضافة إلى تبقعات أخرى كان أكثر الأمراض تواجداً هو مرض البياض الدقيقي حيث بلغ (46.9% و 30.4%) لكل من نسبة الإصابة وشدتها على أوراق الورد المزروع بمدينة البيضاء على التوالي، بينما مرض الصدأ كان أقل الأمراض المسجلة بالمنطقة خلال سنة 2016 بنسبة إصابة لم يتجاوز متوسطها 4.1%. وكان كل من مرض اللطخة ، البقعة الفضية، والبقعة السوداء عالية الإصابة مقارنة بمرض احتراق حواف الأوراق. من جهة أخرى سجلت النتائج عدم وجود فروق معنوية بين أشهر الدراسة لجميع نسب الإصابة للأمراض المختبرة، بينما نتائج شدة الإصابة أظهرت أن شهر 3 (مارس) هو أقل الأشهر إصابة حيث كان متوسطه 11.1%، في حين ارتفعت شدة الإصابة خلال الأشهر 8 و 9 لتبلغ 25%.

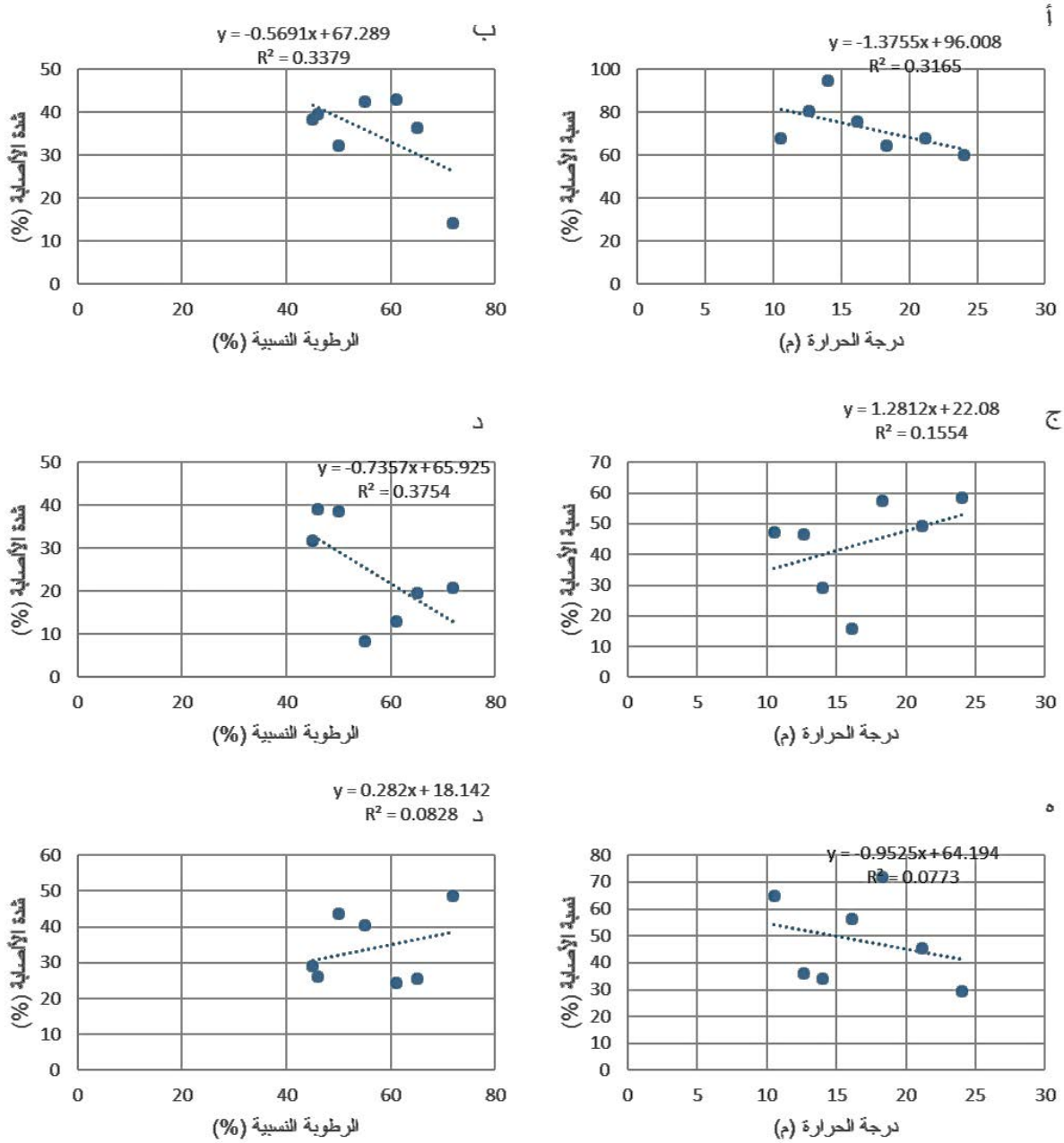
ISSN: online 2617-2186 print 2617-2178

جدول (3) : نسبة الإصابة بأهم الأمراض الفطرية على أوراق الورد وشدتها خلال أشهر الدراسة لسنة 2016

الأشهر	كمية الأمراض على أوراق الورد خلال الفترة (03-2016/09)						
	نسبة الإصابة						
	البياض الدقيقي	اللطخة	البقعة الفضية	البقعة السوداء	احتراق الحواف	الصدأ	المتوسط
3	33.0	18.0	64.0	0.0	5.9	0.0	20.2
4	35.5	28.9	60.5	70.2	20.7	6.2	37.0
5	39.0	39.9	33.7	31.0	25.2	15.9	30.8
6	45.3	43.8	21.5	22.9	30.0	0.0	27.3
7	61.8	58.0	16.4	26.2	33.5	0.0	32.7
8	56.1	63.4	40.4	32.8	19.9	0.0	35.4
9	57.7	55.6	37.6	38.6	10.4	6.9	34.5
المتوسط	46.9	43.9	39.2	31.7	20.8	4.1	
LSD 0.05		الأمراض	12.497				
		الأشهر	11.570				
		الأمراض* الأشهر	30.612				
	شدة الإصابة						
3	21.6	10.0	29.0	0.0	5.9	0.0	11.1
4	25.1	18.4	37.4	30.8	16.5	6.2	22.4
5	28.5	22.6	29.7	24.7	19.0	12.1	22.8
6	32.5	29.9	19.8	22.9	20.4	0.0	20.9
7	33.6	30.3	17.7	15.6	26.2	0.0	20.6
8	36.4	33.0	39.1	27.3	18.7	0.0	25.8
9	35.3	32.5	37.5	34.8	7.9	6.1	25.7
المتوسط	30.4	25.2	30.0	22.3	16.4	3.5	
LSD 0.05		الأمراض	7.84				
		الأشهر	7.26				
		الأمراض* الأشهر	n.s				

أظهرت نتائج الدراسة المبينة بالشكل (3) أن العلاقة بين الظروف البيئية لمدينة البيضاء والمواقع المستهدفة في الدراسة كانت هذه العلاقة ضعيفة ، ولم تسجل أى علاقة بين العوامل المختبرة من درجة حرارة ورطوبة نسبية مع نسبة الإصابة وشدتها في المواقع الثلاثة المختبرة مما يعزى إلى أن الإصابة تعود لاسباب أخرى وليست العوامل البيئية فقط.

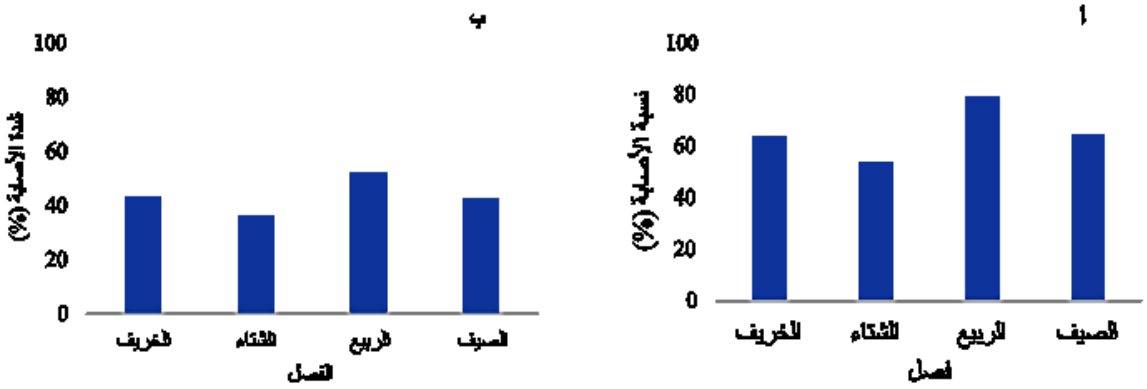
ISSN: online 2617-2186 print 2617-2178



شكل (3) :العلاقة بين الظروف البيئية (درجة حرارة ورطوبة نسبية مع كمية الأمراض الفطرية في المواقع الثلاثة: (أ ، ب) نسبة الإصابة وشدتها في الحدائق العامة، (ج ،د) في الحدائق المنزلية (هـ ، و) في المشاتل

أظهرت نتائج الدراسة المبينة بالشكل (4) تسجيل أمراض فطرية على أوراق الورد المزروع بمدينة البيضاء، في جميع فصول سنة 2016 المتعاقبة، وبخاصة فصل الربيع الذي كان أعلى الفصول أصابة، بينما كانت هناك فروق غير معنوية بين فصلي الصيف والخريف في حين سجل انخفاض في كمية الإصابة بالأمراض الفطرية في فصل الشتاء.

ISSN: online 2617-2186 print 2617-2178



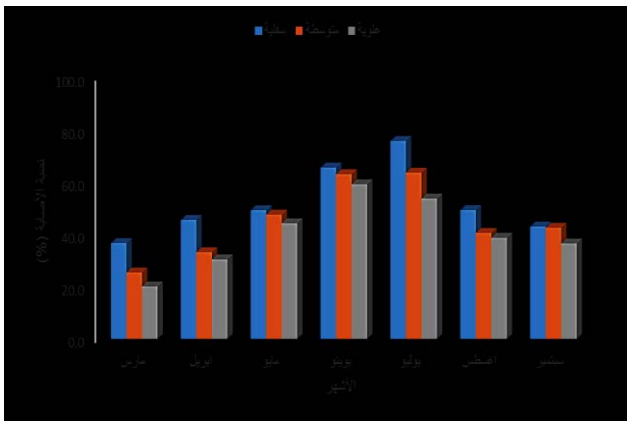
شكل (4): نسبة الإصابة بأمراض الورد في منطقة البيضاء وشدتها خلال المواسم الأربعة (أ:نسبة الإصابة، ب: شدة الإصابة)

وعند حساب نسبة الإصابة بالأمراض الفطرية في الاتجاهات الأربعة كما هو مبين بالجدول (4) أوضحت نتائج التحليل الإحصائي عدم وجود فروق معنوية بين الاتجاهات وأن نسبة الإصابة تتراوح بين 37.5–40%، وكان شهر يوليو هو أعلى الشهور اصابة في حين كانت أقل إصابة في شهر مارس، ويلاحظ أن أشهر الصيف تجاوزت بها نسبة الإصابة 50%.

جدول (4) تأثير الاتجاهات على نسبة الإصابة بالأمراض الفطرية على أوراق الورد في منطقة البيضاء خلال أشهر الدراسة

الأشهر	نسبة الإصابة (%) بالأمراض الفطرية على أوراق الورد حسب أتجاه الشجرة				
	شرق	غرب	شمال	جنوب	المتوسط
مارس	23.3	25.9	18.8	25.0	23.3
ابريل	40.8	31.3	41.6	32.0	36.4
مايو	41.6	40.4	33.9	43.6	39.9
يونو	47.8	58.7	45.9	52.5	51.2
يوليو	55.7	53.3	58.2	53.4	55.1
اغسطس	37.7	28.9	34.8	36.5	34.5
سبتمبر	27.2	30.4	29.2	37.2	31.0
المتوسط	39.2	38.4	37.5	40.0	

أظهرت نتائج الدراسة المبينة بالشكل (4) أن الأوراق المسنة الواقعة في الجزء السفلي من الفرع هى الأعلى نسبة أصابة في جميع شهور الدراسة، بالإضافة إلى ظهور اختلاف معنوي بين أشهر الدراسة حيث تزداد الإصابة في أشهر الصيف وتصل أعلى أصابة في شهري يونيو ويوليو (65 و 75%) على التوالي للأوراق السفلية، في حين كانت أشهر الربيع والخريف هي الأقل أصابة.



شكل (5) تأثير المستويات على أمراض الورد في منطقة البيضاء خلال أشهر الدراسة

المناقشة

تم في هذه الدراسة التعرف على الأمراض التى تهاجم أوراق الورد كان في صدارتها البياض الدقيقي يليها أمراض أخرى هي: الصدأ والبقعة السوداء ومرض البقعة الفضية ومرض موت الحواف واللطخة، وقد سجلت هذه الدراسة تواجد مرض الصدأ ولكنه الأقل أصابة خلال هذه الدراسة، يعود ارتفاع الإصابة البياض الدقيقي إلى عدة عوامل متداخلة كالظروف البيئية والأصناف كما أشار Garlson-Nilsson و Uggla

ISSN: online 2617-2186 print 2617-2178

، 2005) كما يعزى الاختلاف بين الأصناف إلى وجود حواجز ميكانيكية وكيميائية تمثلت في تراكم المواد الفينولية عند مواقع الإصابة ومناطق دخول المسبب (Schwer2006) أظهرت النتائج أن الإصابة بالأمراض الفطرية على أوراق الورد سجلت أرتفاعا تجاوزت نسبتها 50%، وكانت أعلاها إصابة الشجيرات المزروعة في الحدائق العامة، وبخاصة في شهر 7 (يوليو) حيث بلغت نسبة الإصابة(69%)، في حين كانت الحدائق المنزلية والمشاتل أقل أصابة. كما يتضح من النتائج المبينة بالجدول (2) أن أعلى شدة أصابة سجلت في المشاتل بلغت 48.6% في شهر مارس إلا أن هذه النسبة تناقصت في الأشهر اللاحقة ويعزى سبب هذا الانخفاض إلى أن المشاتل تزداد بها العناية والاهتمام وتطبيق برامج المكافحة للحصول على المردود المادي الأعلى، وهذه النتائج تتشابه مع ما أشار إليه (عبدالله، 2019) من أن عدداً من المشاتل كانت الإصابة الفطرية بها ضعيفة جدا تقارب من 0%، في حين بينت نتائج الدراسة أن الحدائق العامة كانت شدة الإصابة بها 14.3% في شهر مارس إلا أن الإهمال أدى إلى ارتفاع كمية الأمراض إلى 43.1% في شهر مايو. ويعزى التباين في النتائج إلى العناية والرعاية بالنباتات تختلف باختلاف مواقع زراعتها، حيث كانت الحدائق العامة هي الأعلى إصابة، بينما تناقصت الإصابة في المشاتل والحدائق المنزلية، وسجلت الدراسة عدم وجود اختلاف بين الجهات الأربعة للشجرة، في حين كانت الأوراق السفلى هي الأعلى إصابة وقد يعزى السبب إلى ضعف مقاومة الورقة المسنة.

من هذه الدراسة نستنتج أنه لم يسجل مرض منفرد على أوراق الورد، معظم أمراض الورد مركبة، أهم الأمراض المسجلة على أوراق الورد هي: البياض الدقيقي، الصدأ، البقعة السوداء، البقعة الفضية، بالإضافة للتبقعات واحتراق الحواف، وموت قمة الورقة واللطخة، سجل تباين بين مواقع الإصابة ، وكان أعلى إصابة سجلت في الحدائق العامة، بينما المشاتل كانت الأقل إصابة ، وأن جميع اتجاهات الشجرة سجل بها إصابة بالأمراض الفطرية، وقد أوضحت نتائج الدراسة على وجود علاقة بين عمر الورقة وكمية الإصابة، لذا يوصي البحاث بالاهتمام بأشجار الورد لأهميته الأقتصادية والعناية به، ووضع قاعدة بيانات للفطريات الممرضة للورد.

المراجع

.عبدالله، نوال جمعة (2019). دراسة الأمراض الفطرية على أوراق الورد النامي بمدينة البيضاء. رسالة ماجستير، غير منشورة، قسم وقاية النبات، كلية الزراعة، جامعة عمر المختار، البيضاء، ليبيا.

Carlson-Nilsson, B. U. (2002). *Variation in Rosa with emphasis on the improvement of winter hardiness and resistance to Marssonina rosae (Black-spot)*. Swedish University of Agricultural Sciences.

El-Gali, Z., & Abdullrahman, E. (2014). Distribution of some molds in the atmospheric air of El-Beida city, Libya. *International Journal of Innovative and Applied Research, 6*, 1-7.

Kranz, J. (1965). A list of plant pathogenic and other fungi of Cyrenaica (Libya). *Phytopathological Papers*(6).

Pemberton, H., Kelly, J., & Ferare, J. (2003). Pot rose production. Pp: 587-593. *Encyclopedia of rose science. Academic press. Oxford, USA. 1450p. http://dx. doi. org/10.1016/B0-12-227620-5/00074-4*.

Salamone, A., Scarito, G., Scovazzo, G. C., & Fascella, G. (2009). Control of Powdery Mildew in Cut Roses using Natural Products in the Greenhouse. *Floriculture and Ornamental Biotechnology, 3*, 121-125.

ISSN: online 2617-2186 print 2617-2178

Schwer, C. S. (2006). *Impact of foliar fungi on dogroses*. SLU, Dept. of Crop Science.

Uggla, M., & Carlson-Nilsson, B. (2005). Screening of fungal diseases in off-spring from crosses between Rosa sections Caninae and Cinnamomeae. *Scientia Horticulturae, 104*(4), 493-504.

ISSN: online 2617-2186 print 2617-2178

Al-Mukhtar Journal of Sciences 34 (4): 372-381, 2019

Survey of Some Fungal Diseases on Leaves of Rose Plants in Al-Bayda City, Libya

Nwara A. Mohamed*, Nawal G. Abdullah and Omar M. El-Sanousi
Plant protection Department, Agriculture Faculty, Omar Al-Mukhtar University, Al-Bayda, Libya

Received: 13 June 2019/ Accepted: 30 December 2019
Doi: https://doi.org/10.54172/mjsc.v34i4.235

Abstract: This study was conducted on rose plants growing in Al-Bayda City's in 2016 to survey the fungal diseases on leaves of this plant. The results of this study indicated that the infection on roses planted in public gardens (parks) was more significant than that of home or nursery planted roses, and these results showed that the amount of disease on leaves of roses grown in El-Beida were high during the period of this study, Home gardens and nurseries were the least infected (45.5% and 48.3%) respectively, compared to parks (73%). The reported diseases in this study were powdery mildew, rust, black spot, silver spot, burning margins and blotches, the most disease occurring was powdery mildew disease at (46.9% and 30.4%) for both incidence rate and severity respectively on cultivated roses in El-Bieda City, While rust was the least registered disease during the year 2016 with an infection rate that did not exceed an average of 4.1%. There are no significant differences between the trends and incidences of infection range between 37.5-40%. July was the highest month in terms of infection and the older leaves of roses had the highest infection rate through all the months of our study.

Keywords: Survey, fungal diseases, rose leaves, Al-Bayda city, Libya.

***Corresponding Author:** Nwara A. Mohamed nwboshakoa@gmail.com , Plant protection Department, Agriculture Faculty, Omar El-Mukhtar University, Al-Bayda, Libya.