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Fecundity and Gonadosomatic Index (GSI) of Common Pandora, *Pagellus erythrinus* (Linnaeus, 1758), Inhabiting Telmatha Coast Eastern Benghazi, Libya

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Abstract: This study was conducted to investigate the biology of Common Pandora in Tellmatha coast. Species of (*Pagellus erythrinus* L., 1758) were caught in Tellmatha using longline during the period from April 2017 to August 2017. A total of 80 mature female specimens were examined for fecundity and gonadosomatic index study. The fecundity of the fish ranged from 1177.7 to 5818.18 eggs with an average value of 3512.09 eggs. The relationship between fecundity and gonad weight was most significant ($r= 0.9775$) than that of fecundity with other factors. The relations between fecundity and total length and body weight are linear. The regression equation are i) $\text{Log}_{10}F=4.6248+2.1379\text{Log}_{10}TL$, ii) $\text{Log}_{10}F=2.7203+1.4081\text{Log}_{10}TW$, iii) $\text{Log}_{10} F= 0.5063+3.8624 \text{Log}_{10} Gw$ $r = 0.8818$. The spawning period started in June and continued until October. This data shows that the stock of the Common pandora of Tellmatha coast is being exploited in the limit. It would be desirable to take measures to protect the spawning stock and recruits, for example by introducing a closed season or various changes in fishing patterns.

Keywords: Common pandora (*Pagellus erythrinus*), Gonads, Fecundity and Gonadosomatic index.

INTRODUCTION

The common pandora, *Pagellus erythrinus* (Linnaeus, 1758), which belongs to the family *Sparidae*, is a valuable species for aquaculture and fisheries. The species has a relatively wide distribution, inhabiting the Black and Mediterranean seas and from Norway to Angola (Bauchot and Hureau, 1986). The depth range of the common pandora varies generally between 20-100 m and 320 m down in various habitats (Bouchot, 1987; Ozaydın, 1997; Tosunoğlu, Akyol, Metin, Tokaç, & Ünsal, 1997), Stergiou and (Hoşsucu & Çakır, 2003; Stergiou & Moutopoulos, 2001) have all conducted studies on population characteristics of the species inhabiting the Aegean Sea. Depending on size, common pandora is widely distributed from shallow coastal waters to 300 m depth. (Livadas, 1989; Mytilinéou, 1989; Orsi Relini &

Romeo, 1985; J. Pajuelo & Lorenzo, 1998; Papaconstantinou, Mytilineou, & Panos, 1988; Somarakis & Machias, 2002; Vassilopoulou, Mytilineou, & Papaconstantinou, 1986; Spedicato *et al.*, 2002). Furthermore, (Relini and Romeo 1985) have researched the biological characteristics of the species from different seas. (Valdés *et al.*, 2004) reported that the common pandora is a suitable species for aquaculture in the Mediterranean and that the correct determination of the species spawning period is also very important.

The common pandora is of commercial importance and has been captured by gill or trammel nets, longline, and trawl in İzmir Bay. This *Sparidae* is well known and appreciated also in the Japanese markets which have been importing large quantities of

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Mediterranean pandora for many years (Tomiyama, 1974). The result is that this *Sparidae* is currently severely overfished in several Mediterranean countries (Ghorbel, 1996; J. M. G. Pajuelo, Nespereira, & Mata, 1996). Signs of overexploitation of the species standing stock have been reported in diverse Mediterranean geographical sub-areas (GSAs) (Abella, Colloca, Sartor, & Mannini, 2010; Gurbet, Akyol, & Yalcin, 2012; Jarboui, Ghorbel, & Bouain, 1998; Mehanna, 2011; Vassilopoulou et al., 1986). The current conservation legislation on fisheries sets the minimum size limit for this species at 150 mm TL (EU Regulation 1967/2006). Also in Algerian waters, this length is the same (J.O.R.A.D.P, 2004; Valdés et al., 2004), and they reported that the common pandora is a suitable species for aquaculture in the Mediterranean and that the correct determination of the species spawning period is also very important.

Spawning period, sex-ratio, GSI, length at first maturity and length-weight relationship were studied in different regions such as Aegean sea (Hoşsucu & Çakır, 2003; Metin, Ilkyaz, Soykan, & Kinacigil, 2011). The main objective of this study was to determine spawning period, fecundity, and gonadosomatic index of the Common Pandora in Tellmatha Libyan Sea. The findings were compared with previous studies and discussed from the perspective of a sustainable fisheries policy.

To date, there is no information published on the biology of this Sparid in Tellmatha coast. Nevertheless, a number of studies were conducted, for instance (Motaref, 2014) in Ain El-Ghazala Gulf of eastern Libya.

MATERIALS AND METHODS

A total of 80 common pandora samples were collected by bottom trawl (mesh:40mm) from Tellmatha Coast (32°42'53.86"N; 20°56'47.01E) (Figure 1), between depths of

30 and 100 m by R/V Egesüf (26.8 m length, 463 HP engine and 110 gross weight) from April 2017 to August 2017. A commercial bottom trawl was used for sampling. The cod-end used featured a knotless diamond shape and was made of polyamide (PA) material with 22 mm stretched mesh size netting. Fish samples were brought to the laboratory and total length (L) was measured to the nearest millimeter in the natural body position. Total weight (W) and gonad weight (Wg) was measured to the nearest 0.01 g, and sex was recorded.

The spawning period was established with monthly variations of the gonadosomatic index (GSI) from the equation $GSI = [Wg / (W - Wg)] \times 100$, where Wg is the gonad weight (g), and W is the total weight (g) of fish (Ricker, 1975).

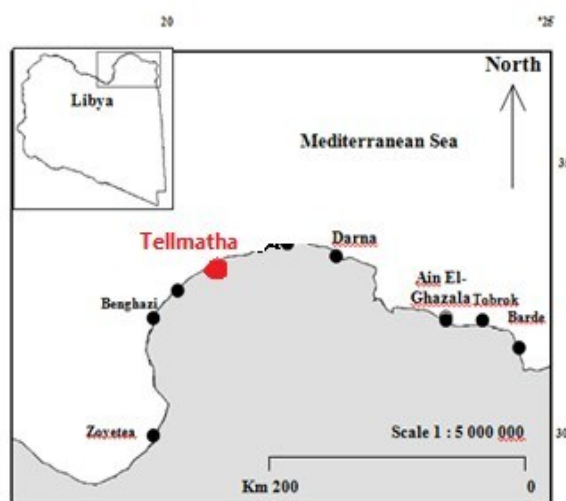


Figure (1). Sampling area.

Statistical analysis: The relationship between each paired parameters was calculated by using regression

RESULTS AND DISCUSSION

Fifty gravid females were collected randomly for the study of fecundity of *P. erythrinus*. Data showed that a fish with a mean total length of 22.4 cm and a mean total weight of

135.40 g produces 3512.09 eggs in an average (table1).

Table: (1). Mean fecundity counts of various length ranges of *P. erythrinus*

Class interval	Total length (cm)	Body weight (g)	Gonad weight (g)	Fecundity
16.0-18.0	18	72.245	0.63	1177.7
18.0-20.0	19.6	90.72	2.19	2997.44
20.0-22.0	21	122.65	3.03	3420.63
22.0-24.0	23.4	138.79	3.75	3635.32
24.0-26.0	24.8	168.64	4.68	4023.25
26.0-28.0	27.5	219.34	6.51	5818.18
Average	22.4	135.40	3.495	3512.09

The highest fecundity 5818.18 was observed in a fish having a total length of 27.5 with a total body weight of 219.34 g, and the minimum fecundity 1177.7eggs was found in a fish with a total length of 18 cm and a total body weight of 72.24 g. This study revealed that older fish were more fecund than younger fish.

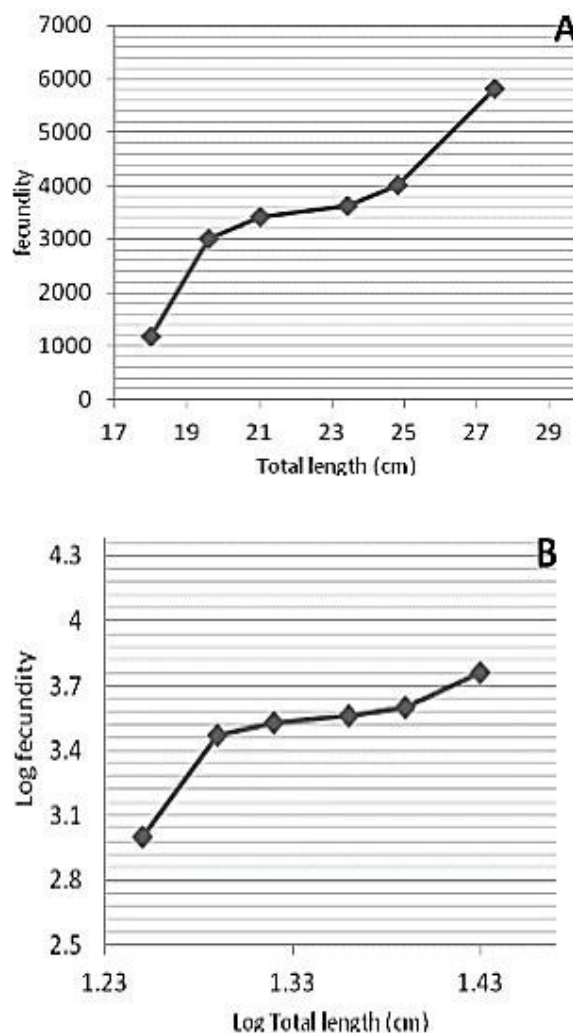
The correlation coefficient, regression equation, and the significance of fecundity correlation with total length, body weight and ovary weight of *P. erythrinus* are given in Table 2.

Table: (2). Correlation coefficient, values of regression coefficient, values of intercept of correlation with total length, body weight, and gonad weight.

Relationships	Correlation coefficient	Value of regression(b)	Values of intercept(a)
Fecundity(F) and Total length(TL)	0.8909	24487	90587
Fecundity(F)and Total weight(TW)	0.9126	13676	3550.2
Fecundity(F)and gonad weight(GW)	0.9775	2301.2	3845.1

Correlation coefficient reveals that the variation of fecundity with ovary weight is highly correlated (r=0.9549) than that of total length (r= 0.7906) and body weight(r=0.9126). Sim-

ilar finding was also observed for *liza parsia* by (Rhemam, Islam, Shah, Mondal, & Alam, 2002) *P. erythrinus* by Ben Smida and Hdhri (2014).



Figure(2). The Relationship between Total length and Fecundity of *P. erythrinus* A). anti-log and B). log.

The fecundity in relation to different parameter Fecundity (F) and total length (TL) relationship: (Fig. 2 a, b) Shows the total length and fecundity relationship in anti-log and log forms respectively. The study revealed the following equations:
 $F = 90578 - 24487 TL$ $r = 0.8909$
 $\log_{10} F = 4.62818 + 2.1379 \log_{10} TL$ $r = 0.7917$
 Or, $F = 0.2659 TL^{3.0303}$

Where, F= Fecundity, TL= Total Length.

Fecundity and total body weight relationship: The relationship between the fecundity and body weight of *P. erythrinus* are of linear type (Fig.3 a, b). The relationship of fecundity against body weight produced a regression, which can be stated as follows:

$$F = 3550.2 - 13676TL \quad r = 0.9126$$

$$\text{Log}_{10} F = 2.7203 + 1.481 \text{Log}_{10} Tw \quad r = 0.8176$$

$$\text{Or, } F = 9.3567 Tw^{1.2037}$$

Where, F= Fecundity, TW= Total weight.

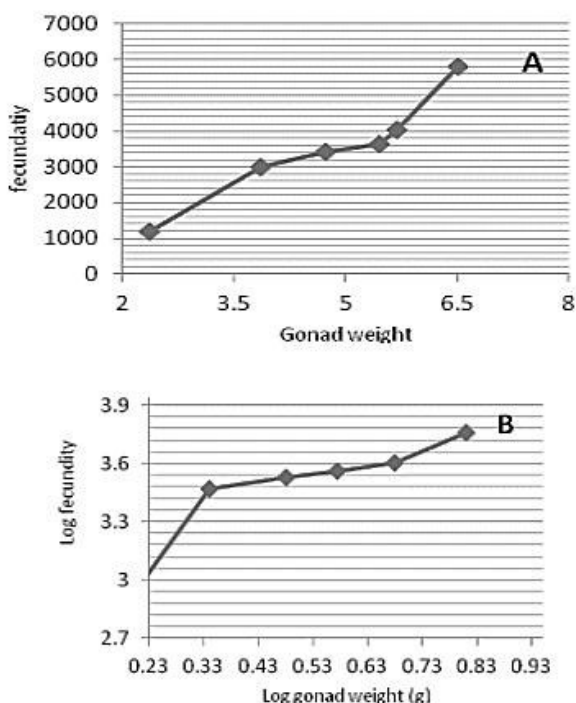


Figure (3). Relationship between Body weight and Fecundity of *P. erythrinus* a). Anti-log and B) log

Fecundity and gonad weight relationship: The scatter diagram of fecundity and ovary weight suggested a linear relationship between the variables (Fig. 4A) It could be seen from Fig. 4B that a straight line through the origin would fit the point well showing the direct proportion between the number of eggs and gonad weight of the fish. Similar findings were also observed by earlier studies

(Rhemana et al., 2002) on *Liza parsia*.

$$F = 1723.3 - 1728 GW \quad r = 0.9775$$

$$\text{Log}_{10} F = 0.5063 + 3.8624 \text{Log}_{10} Gw \quad r = 0.8958$$

$$\text{Or, } F = 1634 Gw^{0.6455}$$

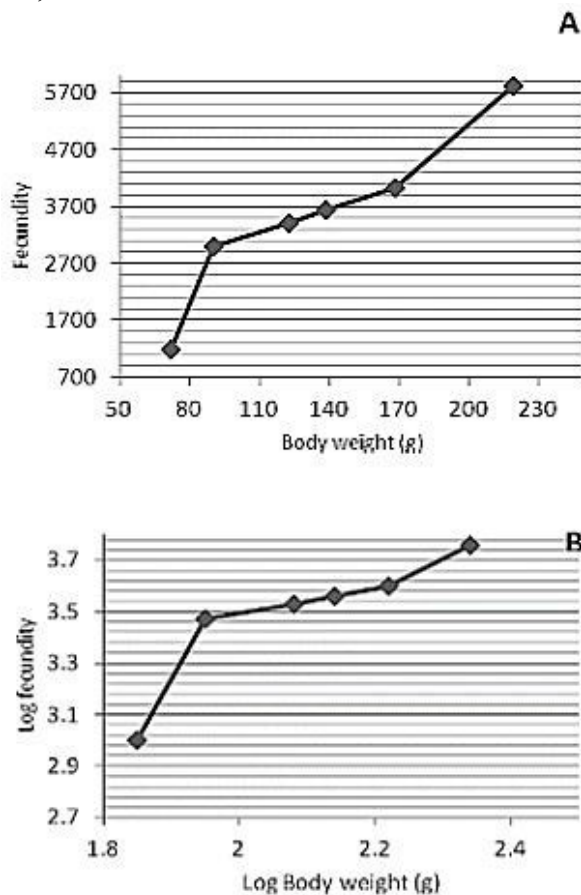


Figure (4). Relationship between Gonad weight and fecundity of *P.erythrinus* , A). anti-Log and B).Log.

Gonadosomatic index: Gonadosomatic index indicates gonadal development and maturity of fish. It increases with the maturation of fish and declines abruptly thereafter (parameswara et al., 1974). The gonadosomatic index varied between 2.26 to 3.89, it also produced two highest peaks in July (2.38) and the lowest was in April (1.07). (Fig .5), (Table 3).

Table (3). Month-wise gonadosomatic index of *P. erythrinus*. females

Month	Total length	Total weight	Gonad weight	Mean *GSI
April	14.5-23.5	34.51- 195.2	0.4– 2.86 1.49	0.591– 4.230 1.07
May	19- 27.5	81.08- 219.34	0.6 – 4.5 2.5	0.925– 3.211 1.98
June	18.5- 26.0	85.24- 242.59	0.9 – 6.8 2.75	1.23– 3.258 2.25
July	24.3- 29.1	115.36- 323.69	1.3 – 6.8 2.95	2.263– 3.894 2.38
August	18.2- 28.2	78.66-388.9	0.6 – 2.20 1.21	0.36– 2.20 1.39

*GSI =Gonadosomatic Index

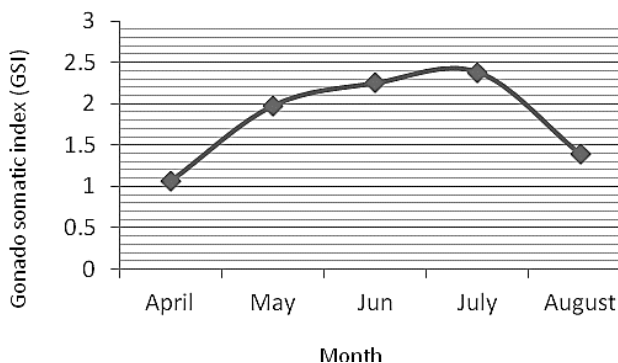


Figure (5). Monthly fluctuation in the gonadosomatic index of the berried *P. erythrinus*.

Therefore, the fish spawn for several months with two spawning peaks. Similar findings were also observed by (Mahdi, Talet, & Boutiba, 2018) in western Algeria. The evolution of mean GSI for males and females shows similar patterns. The monthly values of GSI ranged between 0.13 and 3.80 in females and from 0.11 and 2.38 in males. From May to July the mean values reached the highest values, a second peak was observed in October. Those values were low from November to April. In different areas of Mediterranean Sea such as: Bay of Monastir (Valdés et al., 2004); (Ben Smida., 2014); (Mahdi et al., 2018), Gulf of Tunis (Zarrad, Cherif, Gharbi, Jarboui, & Missaoui, 2010), Gulf of Gabès (Ghorbel, 1996), Southern Portugal (Coelho et al., 2010), and Canary Islands (J. Pajuelo & Lorenzo, 1998), the Common pandora have the same behavior and generally spawns in spring/summer, a second spawning period in autumn has also

been reported by some authors (Dieuzeide et al. 1955; Ghorbel & Ktari 1982; (Vassilopoulou & Papaconstantinou, 1990). In the relationship between the fecundity and gonadosomatic index (GSI) (fig.6), the GSI values increase with the maturation and fecundity of fish.

The GSI values of females were usually higher than those of males. The highest values occurred in August for females and in September for males, and spawning periods are noted. The peaks in April, August, and October show that the spawning period of this species is long (April-October) Ünsal, 1984; Özaydın, 1997 (Hoşsucu & Çakır, 2003; Mahdi et al., 2018). Spawning occurs between May-September according to many studies (Larrañeta 1964; Girardin and Quignard, 1985;(Livadas, 1989; J. Pajuelo & Lorenzo, 1998; Papaconstantinou et al., 1988). This information might be helpful for the proper management of *P. erythrinus*.

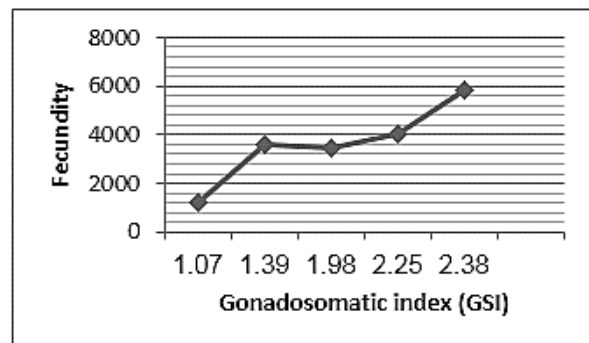


Figure (6). Relationship between Gonadosomatic index and fecundity of *P. erythrinus*

CONCLUSION

At the light of this first data about the reproductive cycle of *P.erythrinus* in Tellmatha coast in eastern Libya, we conclude that there is a significant difference between males and females *P.erythrinus* with a predominance of females. The spawning period extends from May to July with a second peak in October.

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الخصوبة ومعامل الدليل المنسلي لسمكة المرجان الأحمر (*Pagellus erythrinus* (Linnaeus, 1758)، المستوطنة على ساحل ظلمية شرق بنغازي

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المستخلص: هذه الدراسة اجريت للتعرف على خصوبة ومعامل الدليل المنسلي لأسماك المرجان الأحمر *Pagellus erythrinus* حيث تم صيد الأسماك من خلال الصيد التقليدي بمرقاً ظلمية شرق بنغازي باستخدام الخيط الطويل للصيد، خلال الفترة من أبريل 2017 إلى أغسطس 2018 م، تم فحص حوالي 80 أنثى من سمك المرجان الأحمر. تراوحت خصوبة السمكة من 1177.7 إلى 5818.18 بيضة بمتوسط قيمة 3512.09 بيضة. العلاقة بين الخصوبة ووزن الغدد التناسلية كانت أكثر أهمية ($r = 0.9775$) من العلاقة بين الخصوبة وعوامل أخرى. تكون العلاقات بين الخصوبة والطول الكلي ووزن الجسم خطية. بحيث كانت معادلة الانحدار كالتالي: i) $\text{Log}_{10}F = 4.6248 + 2.1379\text{Log}_{10}TL$ ii) $\text{Log}_{10}F = 2.7203 + 1.4081\text{Log}_{10}TW$ iii) $\text{Log}_{10}F = 0.5063 + 3.8624 \text{Log}_{10}Gw$ $r = 0.8818$ حتى أكتوبر. توضح هذه البيانات أن المخزون من سمكة المرجان الأحمر في ساحل ظلمية يتم استغلاله في الحد الأقصى وبذلك نوصي باتخاذ تدابير لحماية مخزون وضع البيض وصغار الأسماك لهذا النوع، على سبيل المثال عن طريق إدخال موسم مغلق أو إحداث تغييرات مختلفة في أنماط الصيد.

الكلمات المفتاحية: المرجان الأحمر، الغدد التناسلية، الخصوبة، معامل الدليل المنسلي.



Thermal Properties of Poly (Vinyl Alcohol) / Lignin Blends

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Abstract: In Libya, municipal and agricultural wastes are increasing each year leading to disposal problems. The use of municipal and agricultural wastes, particularly the natural polymers as compost are well known and the making of new products is receiving greater attention by researchers. The aim of this work was to study the thermal properties of biodegradable films which prepared from the reaction of PVA with lignin at a mass ratio of 1:2, 2:2, 3:2, and 4:2 respectively. Prepared biodegradable films used in this study have been thermally characterized by thermogravimetry (TGA) and differential scanning calorimetry (DSC) techniques. The results showed that the polymer blends were moderately thermally stable and the prepared PVA-lignin blended film may be potentially suitable as an eco-friendly packing material.

Keywords: Thermal; Properties; lignin; polyvinyl alcohol

INTRODUCTION

The use of biologically derived polymers (biopolymers) is emerging as an important component of economic development. By transforming forest and agricultural feedstocks, new renewable, biodegradable, and biocompatible materials (biomaterials) are being produced. Emerging applications for biopolymers range from packaging to industrial chemicals to medical implant devices and drug delivery to computer storage media. In addition to producing green materials with unique physical and functional properties, the processes used to create bio-based materials lead to new manufacturing opportunities that minimize energy consumption and waste generation (Mohanty, Misra, & Drzal, 2005). Owing to its biodegradability, renewability, abundance, and low cost, lignin is considered to be a good candidate as a functional filler and reinforcement for a variety of polymers. Several studies have shown that the use of lignin or lignin derivatives can improve the

mechanical and thermal properties of the polymeric materials (Kubo & Kadla, 2003; Xu, Ren, Wang, Sun, & Fang, 2013). Polyvinyl alcohol (PVA) is a nontoxic, highly polar, water-soluble, and biodegradable polymer which has been used in blends and composites with various polymers (Li, Lin, Zhuo, & Luo, 2013). PVA is widely used for packaging purposes, as an emulsifier, and as a sizing and coating in textile and paper industries (Chiellini, Corti, D'Antone, & Solaro, 2003).

A study conducted by (Tian et al., 2017) showed that the lignin nanoparticles were able to interact with the PVA macromolecular chains through hydrogen bonding and radical-scavenging reactions and also provide good interfacial adhesion between lignin and poly (vinyl alcohol). The use of lignin with PVA has been reported to form miscible blends and provide good thermal and mechanical performance, which has been attributed to the formation of strong intermolecular hydrogen bonds between the hydroxyl

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groups of PVA and lignin (Korbag & Mohamed Saleh, 2016; Tian et al., 2017). The objective of this study was to investigate the thermal properties of a lignin/PVA blend system using thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC).

MATERIALS AND METHODS

The materials used in this paper are polyvinyl alcohol with molecular weight $M_w = 205,000$ purchased from Sigma-Aldrich, Germany, lignin, acetic acid, and distilled water.

Preparation of Films: Polyvinyl alcohol films were prepared using a casting method of aqueous polymer solutions. In order to improve the solubility of lignin, drops of acetic acid were added each half an hour and the solution was kept at pH 4 during the stirring and heating of the mixture at 80 °C for two hours. After that, various amounts of the PVA-lignin blends 1:2, 2:2, 3:2 and 4:2 were added respectively. The mechanical mixing was performed in a temperature range of 60–70 °C for 6 h. Finally, the mixture was poured into Petri dishes to make films. All films were kept for 1 h at 25 °C temperature and then oven dried at about 50 °C for 24 h. After drying, the films were peeled from the Petri dishes and stored in desiccators at room temperature.

TGA Analysis: The thermal degradation behaviors of polymer films and sample powders were studied using a Thermal Analyzer, Manufacturer and model: Mettler Toledo TGA/SDTA 851, fitted with Fourier Transform Infrared (Mettler Toledo). The samples of approximately 10 mg were placed into platinum pans and then heated from 50 to 900 °C at the heating flow rate of 10 °C. min^{-1} in nitrogen gas at the flow rate of 30 ml min^{-1} .

DSC Analysis: The compositional analysis and thermal stabilities of all polymer films and sample powders were studied and per-

formed on a Perkin-Elmer Pyris-1 Differential Scanning Calorimetry (DSC). The samples of approximately 5 mg were placed in aluminum pans and then heated from -50 to 150 °C at the heating flow rate of 10 °C. min^{-1} in nitrogen gas at the flow rate of 20 ml min^{-1} .

RESULTS AND DISCUSSION

TGA was used to investigate the thermal stability and degradation of pure PVA, lignin and PVA-lignin films. This analysis comprised various stages of moisture removal and weight loss as a result of heating. The PVA (black color curve in Fig.1) showed 8.60 % weight loss attributed to water removal in the first stage of heating which started at about 30 °C followed by thermal stability in the second stage. The most significant loss of about 47 % weight exhibits the decomposition of the side chain of PVA beginning at 209 °C. In the third stage, the weight loss of 29 % showed the decomposition of the main chain of PVA which was detected at 392 °C.

The last stage started at 498 °C, and the weight loss was 12 % which was attributed to the release of carbon dioxide. It can be clearly seen that the major weight losses were observed at about 76 wt % in the range of 200–450 °C which corresponded to the structural decomposition of PVA. This result was in agreement with (Othman, Azahari, & Ismail, 2011; Su et al., 2013). The initial thermal decomposition behavior of lignin (brown color) started at 29 °C with 13% weight loss due to water removal. The second stage of the decomposition appeared at 139 °C and showed a weight loss of 12 % due to the elimination of residue water. The third decomposition stage began at 295 °C with a weight loss of about 26 % which was attributed to volatile carbon dioxide. The last decomposition stage was started at 644 °C with 14 % weight loss due to volatilization of large amounts of carbon monoxide, and carbon dioxide generated by the breaking of the side chains.

This is in good agreement with results reported by (Hussin, Rahim, Ibrahim, & Brosse, 2013; Tejado, Pena, Labidi, Echeverria, & Mondragon, 2007).

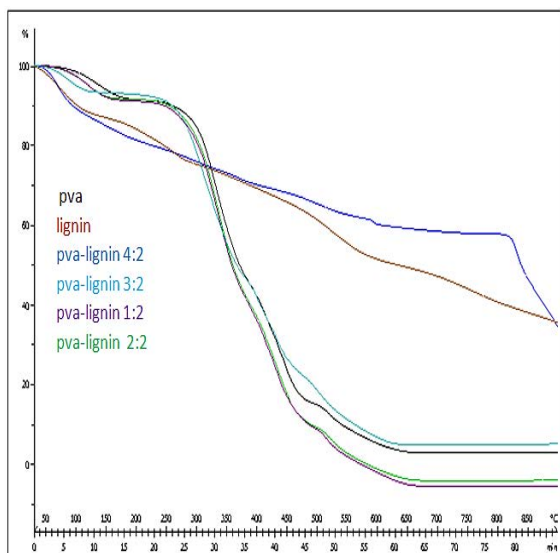


Figure: (1). TG-FTIR Thermogram of Pure Poly (vinyl alcohol), Lignin, and PVA-Lignin Films

Thermal decomposition behavior of four ratios 1:2, 2:2, 3:2 and 4:2 PVA-lignin blended films are shown in Fig. 1. The initial thermal decomposition behavior of 1:2 PVA-lignin film (dark blue color) started at 30 °C with 20 % weight loss due to water removal in the film. The second stage of decomposition appeared at 230 °C and showed a weight loss of 6 % due to the elimination of residual water. Third, fourth, and fifth decomposition stages showed an almost similar weight loss of 6 %, 5 %, and 7 % respectively, this is due to the decomposition of the main chains in the blended film. These stages were noticed at a range from 333.59 °C to 571.07 °C.

The last decomposition stage started at 785 °C with 23 % weight loss due to volatilization of large amounts of carbon monoxide and carbon dioxide generated by the breaking of the side chains in PVA-lignin film. This film has six stages which may be due to the amount of lignin added to the blended film is larger than the amount of polyvinyl alcohol.

TGA results showed that a PVA-lignin composite suppresses the thermal stability of PVA and there was intermolecular interaction between PVA and lignin as shown in Fig. 1. It is noted that, introducing lignin to the system decreases the thermal stability of PVA (Othman et al., 2011).

The initial thermal decomposition behavior of 2:2 PVA-lignin film (light blue color) started at 30 °C with 6 % weight loss due to water removal from the film. The second stage of decomposition appeared at 145 °C and showed the highest weight loss of 47 % exhibiting the decomposition of the main chains in PVA-lignin film. The third decomposition stage started at about 384 °C and showed a 10 % weight loss due to the decomposition of the side chain in the blended film. The fourth decomposition stage started at about 419 °C with 14 % weight loss due to volatilize gaseous generated the breaking of the side chains in PVA-lignin film. The final decomposition stage started at about 478 °C with 17 % weight loss due to volatilization of large amounts of carbon monoxide and carbon dioxide, which was generated by the breaking of the side chains in PVA-lignin film. This film has five stages, which may be due to the equal ratio of the blended film. The result in Fig. 1 showed that the thermal stability of the blends are slightly decreased due to the amount of lignin added to the amount of polyvinyl alcohol in the blended film, and also lignin was poorly dispersed in the PVA matrix. Therefore, the thermal stability of the blends was moderately thermally stable (Othman et al., 2011).

When the amount of polyvinyl alcohol is increased, the initial thermal decomposition behavior of 3:2 PVA-lignin films (violet color) started at 30 °C with 9 % weight loss due to water removal from the film. The second stage of decomposition observed at 196 °C and showed the highest weight loss of 51 % which exhibits the decomposition of the main chains in PVA-lignin film. The third decom-

position stage started at about 389 °C and showed a 30 % weight loss due to the decomposition of the side chain in the blended film. Fourth and last decomposition stage started at about 495 °C with 14 % weight loss due to volatilization of carbon monoxide and carbon dioxide which was generated by the breaking of the side chains in PVA-lignin film. This film has four stages which may be due to the high ratio of polyvinyl higher than the ratio of lignin in the blended film. It can be clearly noted that the major weight loss was observed at about 80 wt % in the range of 200-550°C corresponding to the structural decomposition of PVA - lignin.

The thermal stability of the reaction film has decreased due to the amount of polyvinyl alcohol added which was higher than the amount of lignin so the thermal stability of the film was lower than the stability of the PVA film. While when the amount of polyvinyl alcohol is increased, the initial thermal decomposition behavior of 4:2 PVA-lignin films (green color) started at 30 °C with 8 % weight loss due to water removal from the film. The second stage of decomposition was observed at 193 °C and showed the highest weight loss of 52 % which exhibits the decomposition of the main chains in PVA-lignin film. The third decomposition stage started at about 392 °C and showed a 29 % weight loss due to the decomposition of the side chain in the blended film. Fourth and last decomposition stage started at about 499 °C with a 13 % weight loss due to volatilization of carbon monoxide and carbon dioxide generated by the breaking of the side chains in PVA-lignin film. It can be clearly noted that the major weight loss was observed at about 80 wt % in the range of 200-550 °C which corresponded to the structural decomposition of PVA-lignin. The four blended films showed similar thermal decomposition behavior where all films showed a small mass loss in first decomposition stage and then more significant weight loss observed in second decomposition stage due to the decom-

position of the main chains in PVA-lignin film. TGA results showed that the thermal stability of the composite films was slightly improved when lignin was incorporated with PVA. These results were in agreement with a study reported by (Tian et al., 2017). The result showed that all blends are moderately thermally stable.

In Fig .(2) the PVA-lignin blended films and PVA film exhibited a fast weight loss in the vicinity of 285 °C and 350 °C respectively. The peak at around 285 °C of 2:2 blended films was short and broad. However, the other peaks around 350 °C of films had a similar behavior and they were long and sharp. The obtained results were in agreement with other works reported by (Su et al., 2013; Xu et al., 2013).

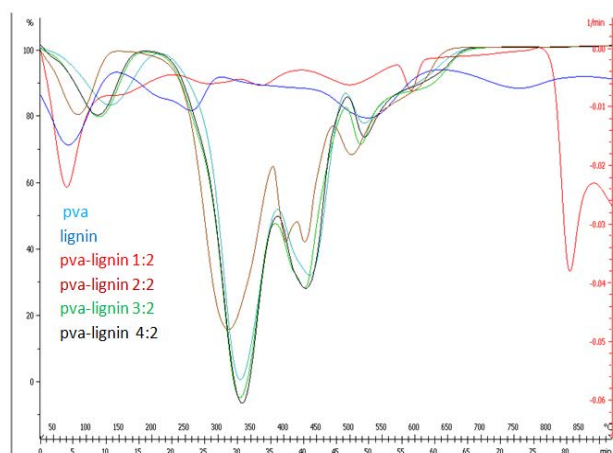


Figure (2). DTG Thermogram of Pure Poly (vinyl alcohol), lignin, and PVA-Lignin Films.

DSC is the technique used to determine the quantity of heat either absorbed or released when substances undergo physical or chemical changes. PVA is one of the partially crystalline polymers exhibiting both the glass transition temperature, T_g (characteristic of amorphous phase) and melting isotherm, T_m (characteristic of crystalline phase).

In Fig. (3), curve (a) shows the change of the thermal transition of pure PVA. The DSC curve of the Pure (PVA) showed one T_g ap-

peared at 52 °C while the sharp peak of crystallization temperature observed at 191 °C and ΔH of crystallization was 45 J/g while the DSC curve of lignin showed one Tg which appeared at 65 °C.

DSC curves of the four films showed nearly similar behavior. When the film ratio contains 1:2 PVA-lignin, the crystallization temperature decreased which observed at 186 °C, giving a small peak due to the blending of polyvinyl alcohol with lignin. The ΔH of crystallization is reduced to 21 J/g. While when the film ratio contains 2:2 PVA-lignin, the crystallization temperature decreased and observed at 188 °C given a broad peak due to the blending of polyvinyl alcohol with lignin. The ΔH of crystallization is reduced to 19.128 J/g.

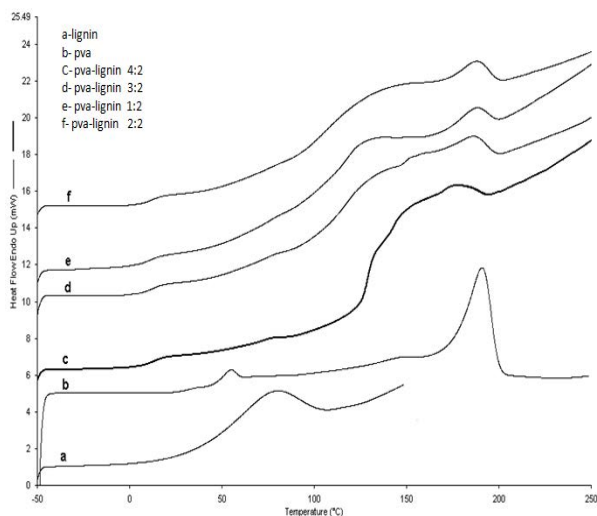


Figure (3). DSC thermogram of pure poly (vinyl alcohol), lignin, and PVA-Lignin films.

When the blend ratio contains 3:2 PVA-lignin, the crystallization temperature decreased and observed at 188 °C given a broad peak due to the blending of polyvinyl alcohol with lignin and the amount of polyvinyl alcohol is larger than the amount of lignin in the blended film. The ΔH of crystallization is reduced to 14 J/g. While when the film ratio contains 4:2 PVA-lignin, the crystallization temperature decreased and observed at 177

°C given a broad peak due to the blending of polyvinyl alcohol with lignin, and the amount of polyvinyl alcohol is larger than the amount of lignin in the blended film.

The ΔH of crystallization reduced to 10.19 J/g. It can be concluded that the higher the crystallization temperature (T_c) value, the more stable the molecules are, and that can be clearly seen in Fig. (3). PVA has more stable molecules than PVA-Lignin blended film. Fig. 3 showed that the crystallinity of PVA-lignin composites decreased slightly over the pure PVA due to the incorporation of the amorphous lignin. Disrupted hydrogen bonding network and new hydrogen bonds were formed between lignin and PVA matrix, leading to less crystalline regions formed in the composite films. Therefore, the blending with lignin reduced the crystallinity of the PVA fraction.

It is well known that in homogenized blends, the melting temperature shifts to the lower side. Melting enthalpy (ΔH_m) and crystallization enthalpy (ΔH_c) also showed a decreasing value with the incorporation of lignin, this indicates that there is an interaction between PVA and Lignin which has interrupted the crystallization of PVA. These behaviors showed the cumulative effects of PVA upon hydrolysis and also the reorganization in the degradation process. This finding has been supported by the results of other researchers (Jiang, Qiao, & Sun, 2006; Orts et al., 2007; Othman et al., 2011; Sarti & Scandola, 1995; Thakore, Desai, Sarawade, & Devi, 2001).

CONCLUSION

In this paper, the thermal behavior of PVA/lignin blends was studied. It appears that lignin is able to form hydrogen bonds with a semicrystalline and crystalline polymer, even though the blend system is slightly miscible. However, the blending with lignin reduced the crystallinity of the PVA fraction. TG and DSC analyses of polyvinyl alcohol

and lignin blends suggest that the blends were moderately thermally stable and also suggest intermolecular interactions between polyvinyl alcohol and lignin chains are favored. As a result, PVA/lignin blends may be useful for membrane and packaging applications.

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الخواص الحرارية لمزيج البولي فينيل الكحول واللجنين

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المستخلص: في ليبيا، تزداد النفايات البلدية والزراعية كل عام مما يؤدي إلى خلق مشاكل عند التخلص منها. إن استخدام النفايات البلدية والزراعية، وخاصة البوليمرات الطبيعية كسماد معروف جيداً، وعملية تصنيع منتجات جديدة تحظى باهتمام أكبر من جانب الباحثين. الهدف من هذا العمل هو دراسة الخواص الحرارية للأغشية القابلة للتحلل الحيوي والتي تم تحضيرها من تفاعل البولي فينيل الكحول مع اللجنين بمعدل كتلة 2:1، 2:2، 2:3، و 2:4 على التوالي. الأفلام القابلة للتحلل البيولوجي المستخدمة في هذه الدراسة تم توصيفها حرارياً باستخدام تقنيات (TGA) و (DSC). النتائج بينت أن المزيج المكون من البولي فينيل الكحول واللجنين متوسط الاستقرار حرارياً وقد يكون مناسباً للاستخدام كمواد تعبئة صديقة للبيئة.

الكلمات المفتاحية: حراري؛ خواص؛ لجنين؛ بولي فينيل الكحول.



Biodiversity, Abundance and Seasonal Fluctuation of Ground Beetles on Massa Region

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Abstract: The present study was carried out to investigate the biodiversity, abundance and seasonal fluctuation of ground beetles on Massa region from June 2015 to October 2016. The beetles were collected using 20 pitfall traps which were operated on a weekly basis, a total of 2867 specimen representing two families Carabidae and Tenbrionidae and 10 genera (*Blaps polychresta*, *Zophosis punctata*, *Pimelia interpunctata*, *Blaps nitens*, *Adesmia dilatata*, *Scaurus vicinus*, *Tentyria cyrenaica*, *Laemostenus complanatus*, *Ditomus cilpeatun* and *Akis costitubera* were recorded. Overall diversity was 81% and 83% Simpson's scale and Shannon's scale respectively. The highest index; 0.116841 (Simpson's index) and 0.36693 (Shannon's index) was found in species *Z. punctata*. Results showed the influence of temperature on *A. costitubera*, *B. polychresta* and *D. cilpeatun* with the *A. costitubera* being a better predictor, addition to constant of *A. costitubera* Beta =0.818 ; constant of *A. costitubera* and *B. polychresta* Beta = 0.625 and 0.53 and constant of *A. costitubera* , *B. polychresta* and *D. cilpeatun* Beta = 0.629 , 0.335 and 0.191. The results concluded the importance of using ecological indexes in studying the abundance and seasonality of ground beetles fluctuated during different seasons.

Keywords: Ground beetle, Biodiversity, Abundance, seasonal fluctuation.

INTRODUCTION

Beetles are endopterygotes; they undergo complete metamorphosis, a biological process by which an animal physically develops after a birth or hatching, undergoing a series of conspicuous and relatively abrupt changes in its body structure. Males may fight for females in various ways, and such species tend to display marked sexual dimorphism. Beetles play an important role in ecosystems. Prominent epigeal examples are the Tenebrionidae that play an important role as primary Decomposers (J. R. Henschel, Grohmann, Siteketa, & Linsenmair, 2010). Different beetles are beneficial for us, Carrion beetles feed on dead and decaying material and help in decomposition cycle. Scientific literature on

beetles of Pakistan already reported by (Rafi et al., 2010) on tiger beetle,(Sultan et al., 2008) on tortoise beetle, (Darilmaz & Ahmed, 2009) on (Coleoptera: Dytiscidae). Soil beetles may play important roles in the ecosystem through their activities as predators, herbivores, and scavengers (Brussaard, 1997).

Herbivorous beetles may cause crop damage and yield loss while, in contrast, predatory beetles can perform as biological control agents against the crop pests (Kalshoven, 1981). Scavenger beetles comminute and decompose soil organic matters. In agroecosystems, beetles are often exposed to soil tillage, chemical pesticide, inorganic fertiliz-

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er applications, and monoculture planting system. Tillage could damage beetle micro niches and foraging sites while insecticide could toxify them. Meanwhile, monoculture system could in one hand limit food access for a number of species but on the other hand allow excessive exploitation for only few other species of herbivorous beetles. In Libya, there is not much detailed information about Coleoptera in El-Jabal Alakhdar and their diversity and abundance. Thus, the objectives of this study were to investigate beetles population diversity in Massa region, recognition of seasonal fluctuation, and describe the abundance of species and its relationship in the community by using diversity indices.

MATERIALS AND METHODS

Study site

The site of study is an area of 10 hectares located very close to Massa region, which is located in the west of Al-Bayda city (Libya) between latitude 32°45' north and longitudes 21° 37' east, and at an altitude of 495 meters above sea level. The area is characterized with forest trees such as, *Cupressus sempervirens* L., *Ceratonia siliqua* L., *Pistacia lentiscus* L., *Phillyrea latifolia* L., *Arbutus pavarii*, *Olea europaea* (hoffing&link), *Rhamnus lycioides* L. Jahandez, *Erica multiflora* L., *Globularia alypum* linn., *Cistus parviflorus* Lam. And *Calicotome villosa* (Poir.) link.

Sampling

The studies were performed between June 2015 and October 2016. In 2015, the collection of beetles started from June until October, and in 2016 started from April and until October, where there is an activity of beetles. About 20 pitfall traps were used in the site separated by 10 m distance, and checked once a week. Each trap was a glass cup of 8 cm in diameter and 15cm in depth with a small amount of soil in the bottom filled with bait to attract the insects. The collected specimen killed by using Ethel acetate. Collected specimens were identified by labels and according to field data, and separat-

ed to different taxa to count the number of each species caught.

Biodiversity index

Shannon and Simpson biodiversity indices were used to assess the habitat preference of the ground beetles. α -diversity (The diversity of species within a community or habitat). **Simpson's index:** $D = \sum p_i^2$, **Shannon's indices of diversity and evenness:** $H' = -\sum (P_i \ln P_i)$, **Equitability or evenness:** $H'/ \ln S$. where, D = diversity measure, S = number of species, p_i = proportion of individuals belonging to species.

Statistical analysis

One way ANOVA was used to analyze data to determine differences in beetle abundance ($P < 0.005$). If ANOVA results showed significant differences, mean numbers were separated by Tukey's Protected Least Significant Differences (LSD, $P < 0.05$). t -Test was used to compare between the mean numbers of abundance of species among the years 2015 and 2016. Analysis was run on a SPSS Statistical package programme (SPSS Version 17).

RESULTS

A total of 2867 specimens of beetles representing two families were captured by pitfall traps in Massa region and identified during the two sampling years 2015-2016. Tenebrionidae beetles formed the dominant group in our investigation, comprising 93.8% of all individuals, whereas Carabid beetles and other Coleoptera formed 6.2% of all individuals (Table 1). The beetles collected by pitfall traps were: *Blaps polychresta* (Forskd 1775), *Zophosis punctate* Brulle 1832, *Pimelia interpunctata* klyu 1830, *Blaps nitens* Laporte de catelenau 1884 , *Adesmia dilatata* (Klug 1830), *Scaurus vicinus* Solire 1838, *Tentyria cyrenaica* Schuster 1919, *Laemostenus complanatus* (Dejean 1828), *Ditomus cilpeatun* Bonelli 1810 and *Akis costitubera* Marseul 1883. The species *Zophosis punctate* recorded the highest number of all collection (34%). Followed by the species *Akis costitubera* (18.52), *Tentyria Cyrenaica* (13.32), and *Blaps polychresta* with

(9.034%).

Table (1). Overall abundance of beetle species collected by pitfall traps in Massa region through the years 2015 and 2016.

Species	No. of individuals	%
Tenebrionidea		
<i>Blaps polychresta</i> (Forskd 1775)	259	9.0338
<i>Zophosis punctuate</i> Brulle 1832	981	34.182
<i>Pimelia interpunctata</i> kluy 1830	120	4.1856
<i>Blaps nitens</i> Laporte de catele-nau 1884	196	6.8364
<i>Adesmia dilatata</i> (Klug 1830)	70	2.4416
<i>Scaurus vicinus</i> Solire 1838	151	5.2668
<i>Tentyria cyrenaica</i> Schuster 1919	382	13.324
<i>Akis costitubera</i> Marseul 1883	531	18.521
		93.791
Carabidae		
<i>Laemostenus complanatus</i> (De-jean1828)	149	5.1971
<i>Ditomus cilpeatun</i> Bonelli 1810	29	1.0115
		6.2086

The Beetles abundance during the year 2015

The analysis of Varian's at ($P < 0.005$) of data collected during 2015 revealed significant differences in their abundance in each month of the following species: *Zophosis punctuate*, *Pimelia interpunctata*, *Blaps nitens*, *Adesmia dilatata*, *Akis costitubera* and *Laemostenus complanatus*, and their activities recorded fluctuation in their numbers from one month to another. While the species belonging to *Blaps polychresta*, *Scaurus vicinus*, *Tentyria cyrenaica*, and *Ditomus cilpeatun* showed no significances in their abundance between the months and all species showed significant differences in their numbers through each month.

The Beetles abundance during the year 2016

The analysis of Varian's at $P < 0.005$ of data collected during 2016 revealed significant differences in their abundance between the months recorded, the species *Zophosis punctuate*, *Pimelia interpunctata*, *Blaps niten*, *Adesmia dilatata*, *Scaurus vicinus*, *Akis costitubera* and *Ditomus cilpeatun*, and their activities recorded fluctuation in their numbers

from one month to another. While the species belonging to *Blaps polychresta*, *Tentyria cyrenaica*, *Laemostenus complanatus* showed no significances in their abundance between the months, and the species showed significant differences in their numbers in May, June, July, and September and no significant differences in their abundance through April and October.

T-test analysis to compare the abundance of species of Coleoptera during 2015-2016

The t-test analysis was used to compare between the mean number of individuals during the years 2015 and 2016, and thus had been compared to every species over the two years period. We found that *Blaps polychresta* had no significant differences in abundance between the years ($P = 0.612$), while *Zophosis punctate* showed significant differences in abundance ($P = 0.006$), where the mean collected beetles (34.71) during the 2016 was higher than (0.45) in 2015. *Pimelia interpunctata* showed no significant differences in the number of species between the years ($P = 0.595$). *Blaps nitens* showed differences in abundance through the years of collection ($P = 0.015$), where the mean individual (5.39) during the year 2016 was higher than the average sample (2.25) in 2015. The results showed no significant differences in the abundance of species *Adesmia dilatata* through the two years ($P < 0.309$), *Scaurus vicinus* recorded significant differences in the abundance of species between the two years ($P = 0.007$), where the sample mean (5.07) during 2016 was higher than the average sample (0.45) in 2015. The species *Tentyria cyrenaica* showed significant differences in the abundance of species between the years ($P = 0.005$), where the mean collected sample (12.79) during 2016 was higher than the average sample (1.20) in 2015, *Laemostenus complanatu* recorded significant differences in the abundance of species between the two years ($P = 0.022$), where the sample mean (4.75) during the year 2015 was higher than the sample mean (1.93) during the year 2016. The species *Ditomus*

cilpeatun recorded no significant differences in the abundance through the two years (P = 0.678), also the species *Akis costitubera* rec-

ordred no significant differences in the abundance of species between the two years (P = 0.125).

Table (2). T-test analysis to compare the abundance of species of Coleoptera during 2015-2016

Species	Year	N	Mean	Std. Dev.	S.E Mean	t-test	P<0.05
<i>Blaps polychresta</i>	2015	20	4.90	3.227	0.721	-0.511	0.612
	2016	28	5.75	6.899	1.304		
<i>Zophosis punctate</i>	2015	20	0.45	0.826	0.185	-2.893	0.006
	2016	28	34.71	52.792	9.977		
<i>Pimelia interpunctata</i>	2015	20	2.15	3.498	0.782	-0.535	0.595
	2016	28	2.75	4.043	0.764		
<i>Blaps nitens</i>	2015	20	2.25	2.918	0.652	-2.533	0.015
	2016	28	5.39	4.962	0.938		
<i>Adesmia dilatata</i>	2015	20	0.95	1.572	0.352	-1.029	0.309
	2016	28	1.82	3.539	0.669		
<i>Scaurus Vicinus</i>	2015	20	0.45	1.395	0.312	-2.834	0.007
	2016	28	5.07	7.175	1.356		
<i>Tentyria cyrenaica</i>	2015	20	1.20	2.648	0.592	-3.837	0.000
	2016	28	12.79	13.276	2.509		
<i>Laemostenus complanatus</i>	2015	20	4.75	3.447	0.771	2.362	0.022
	2016	28	1.93	4.472	0.845		
<i>Ditonus cilpeatun</i>	2015	20	0.45	1.234	0.276	-0.418	0.678
	2016	28	0.71	2.623	0.496		
<i>Akis costitubera</i>	2015	20	9.00	5.400	1.207	-1.563	0.125
	2016	28	12.54	9.012	1.703		

The mean difference is significant at the 0.05 level.

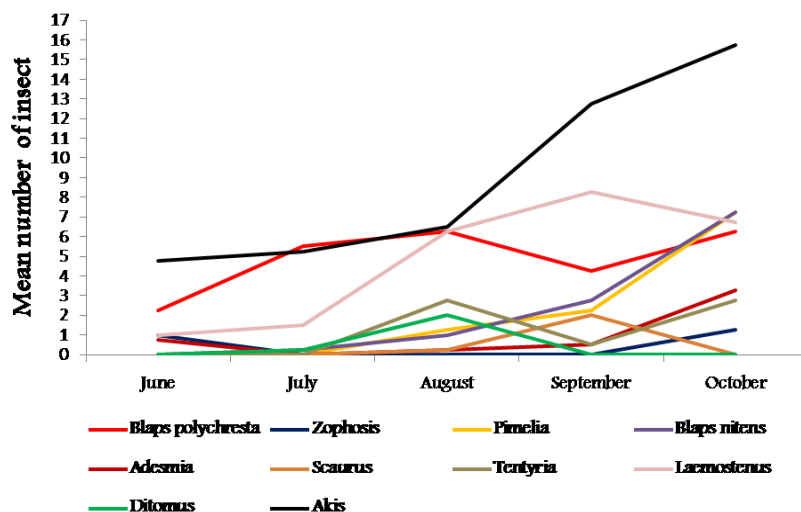


Figure (1). Seasonal abundance of dominant Coleoptera species during the season 2015

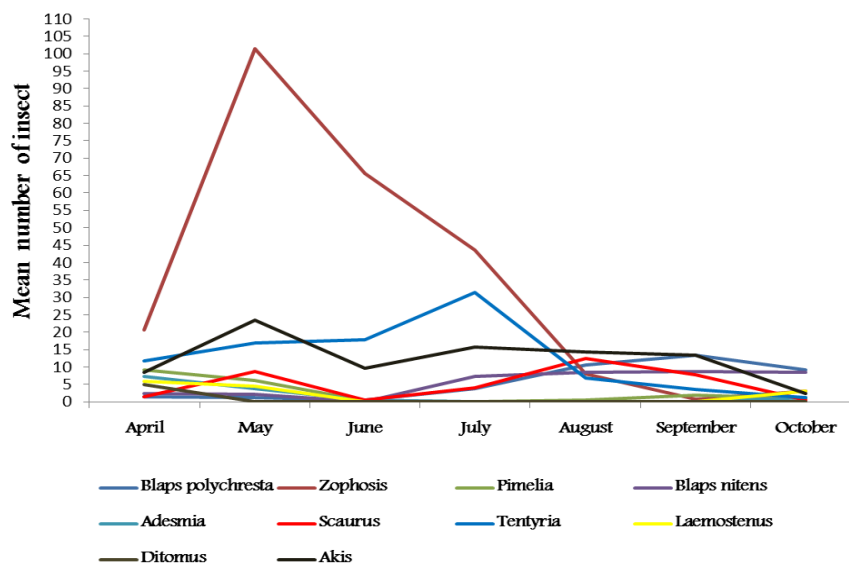


Figure (2). Seasonal abundance of dominant Coleoptera species during the season 2016

Measuring abundance species by using diversity index: The overall diversity of beetles worked out on the basis of the number of beetles using (Simpson, 1949) equation index of dominance, a value of 0.189657 was obtained for beetles communities in the study area from Massa site (Table 4). The Shannon's index value

of 1.92708 was obtained. *Zophosis punctata* with values of 0.116841 (Simpson's index) and 0.36693 (Shannon's index) was the dominant species. The overall beetles diversity (1-D=0.810342581) on Simpson's scale was 81% and on the Shannon's scale ($H / \ln S=0.83692$) is 83 % (Table 23).

Table (4). Diversity indices of individual numbers of different beetle species (2015/2016).

Species	Total Abundance	Percentage%	Pi	Pi ² Simpson's	Pi ² (ln Pi) Shannon's
<i>Blaps polychresta</i>	259	9.033833	0.090338	0.008161	-0.21719
<i>Zophosis punctata</i>	980	34.18207	0.341821	0.116841	-0.36693
<i>Pimelia interpuntata</i>	120	4.18556	0.041856	0.001752	-0.13283
<i>Blaps nitens</i>	196	6.836414	0.068364	0.004674	-0.18341
<i>Adesmia dilatata</i>	70	2.441577	0.024416	0.000596	-0.09064
<i>Scaurus vicinus</i>	151	5.266829	0.052668	0.002774	-0.15504
<i>Tentyria cyrenaica</i>	382	13.32403	0.13324	0.017753	-0.26856
<i>Laemostenus complatus</i>	149	5.19707	0.051971	0.002701	-0.15368
<i>Ditomus cilpeatus</i>	29	1.01151	0.010115	0.000102	-0.04647
<i>Akis costitubera</i>	531	18.5211	0.185211	0.034303	-0.31231
Total	2867			D=0.189657 1-D= 0.810342581	H =1.92708

D=diversity measure, p_i= proportion of individuals belonging to species i, p_i²=Square p_i

Multiple Regressions according to independent variables:

To investigate the contribution of the dependent variable; temperature effects on the predic-

tion of the *Blaps polychresta*, *Zophosis*, *Pimelia*, *Blaps Adesmia*, *Scaurus*, *Tentyria*, *Laemostenus*, *Ditonus* and *Akis*, a multiple stepwise regression method was used.

Table (5). Stepwise Regression for Independent Variables and the temperature Scores

Model	Unstandardised Coffi.		Standardised Coffi.	T	P<0.05
	B	Std. Error	Beta		
1- (Constant)	1.445	.1480	.8180	9.761	.000
<i>Akis costitubera</i>					
2- (Constant)	1.104	.1540	.6250	7.182	.000
<i>Akis costitubera</i> and <i>Blaps polychresta</i>	1.085	.2680	.3520	4.051	.000
3- (Constant)	1.111	.1430	.6290	7.753	.000
<i>Akis costitubera</i> , <i>Blaps polychresta</i> and <i>Ditonus cilpeatun</i>	1.032	.2500	.3350	4.123	.000
	2.072	.7370	.1910	2.810	.007
Model Summary					
Model	R	R Square	Adjusted R Square	Stand.Error of Estimate	
1- <i>Akis costitubera</i>	.8180	.6700	.6630	13.865	
2- <i>Akis costitubera</i> and <i>Blaps polychresta</i>	.8700	.7570	.7460	12.032	
3- <i>Akis costitubera</i> , <i>Blaps polychresta</i> and <i>Ditonus cilpeatun</i> .	.8900	.7930	.7790	11.220	

Results showed the influences of temperature on *Akis costitubera*, *Blaps polychresta* and *Ditonus cilpeatun*. with the *Akis costitubera* being a better predictor, in addition to constant of *Akis costitubera* Beta =0.818 ; (P< 0.05) constant of *Akis costitubera* and *Blaps polychresta* Beta = 0.625 and 0.53(P< 0.05) and constant of *Akis costitubera* , *Blaps polychresta* and *Ditonus cilpeatun* Beta = 0.629 , 0.335 and 0.191 (P<0.05) .

DISCUSSION

The number of invertebrates species collected by pitfall trap in any habitat is well correlated not only with species abundance but also with activity (Aldryhim, Mills, & Aldawood, 1992; Saji & Al Dhaheri, 2011). The pitfall traps have been considered as a reliable method for beetles and long-term trapping is required to understand the biodiversity, community composition, and the activity of different species in

different climatic conditions (J. Henschel, Mtuleni, Pallett, & Seely, 2003).

The present study shows for the first time the species abundance distribution of the beetle faunal diversity in Massa region. 2867 specimens of beetles representing two families were captured by pitfall trap in Massa region, and identified during the two sampling years 2015-2016. Tenebrionidae beetle formed the dominant group in our investigation, comprising 93.8% of all individuals, whereas Carabid beetles and other Coleoptera formed 6.2% of all individuals (Table 1). This was a two-year study and long-term inferences may not be reliable. However, our results suggest that extent of dispersal alone may not determine population abundance of ground beetles in habitats. Other factors such as variation in soil properties, micro- and macroclimatic conditions, intra- and interspecific competition, predation and parasitism, and chemical and cultural treatment of the land (e.g., pesticide use and

tillage practices) probably affect ground beetle populations over time, Tenebrionidae and Carabidae are important groups in ecological researches. They show clear associations with environmental parameters such as soil type and vegetation cover and are thus good indicators of environmental change (Gardner, 1991; Koivula, 2011). The number of beetles collected by pitfall traps on Massa site was high in October of 2015 (202 samples) whereas in 2016 the number was high during the month of May (675 samples).

Annual variation in the number of ground beetle species and their abundances may be expected in both temporary and permanent (Den Boer, 1986; Luff, 1990). However, in this study, the overall capture rate of ground beetles was quite similar between years in the species diversity. Some species may have highly restricted activity periods, whereas others may extend their activity over several weeks or months (Koivula, 2011; Stork, 1990)

The analysis of Varian's at ($P < 0.005$) of data collected during 2015 revealed significant differences in beetles abundance in each month for the following species: *Zophosis punctuate*, *Pimelia interpunctata*, *Blaps nitens*, *Adesmia dilatata*, *Akis costitubera* and *Laemostenus complanatus*, and their activities recorded a fluctuation in their numbers from one month to another. While the species belonging to *Blaps polychrest*, *Scaurus vicinus*, *Tentyria cyrenai-ca*, and *Ditomus cilpeatun* showed no significances in their abundance between the months, and all species showed significant differences in their numbers through each month. The analysis of Varian's at $P < 0.005$ of data collected during 2016 revealed significant differences in their abundance between the month, and were recorded in the species *Zophosis punctuate*, *Pimelia interpunctata*, *Blaps niten*, *Adesmia dilatata*, *Scaurus vicinus*, *Akis costitubera* and *Ditomus cilpeatun*, and their activities recorded fluctuation in the numbers from one month to another. While the species belonging to *Blaps polychresta*, *Tentyria cyrenaica*, *Lae-*

mostenus complanatus showed no significances in their abundance between different months, and the species showed significant differences in their numbers in May, July and September and no significant differences in their abundance through April and October. Beetle species behavior in different months suggests that the population of various species depends upon a favorable environment, including high-quality food resources and the weather (Seastedt & Crossley Jr, 1983). The beetles showed a rich faunal diversity in Massa area, and the present study may help in the conservation of beetles and their habitats in El-Jabal Alakhdar regions.

The study shows the habitat-specific occurrence of beetles, which may be due to food preferences, etc. That means the Massa based soil system was highly conducive to the survival of beetles. The family Tenebrionidae was represented by the heights number of species. Environmental parameters regulate the distribution of Tenebrionidae beetles (Colombini, Fallaci, & Chelazzi, 2005). The representatives of Tenebrionidae presented the maximum diversity of species and contributed to the highest (93.791%) faunistic composition, followed by Carabidae (6.2086%). The results concluded the importance of using ecological indexes in studying the abundance and seasonality of ground beetles fluctuated during different seasons.

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التنوع الحيوي والوفرة الموسمية للخنافس الأرضية في منطقة مسّة

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المستخلص: أجريت تجارب هذا البحث بالقرب من منطقة مسّة خلال الأعوام 2015-2016 لمعرفة التنوع الحيوي للخنافس الأرضية المتواجدة بمنطقة مسّة بالجبل الاخضر و تحديد و فرتها الموسمية، وقد بينت النتائج وجود عدد من الأنواع التابعة لعائتي Tenebrionidae وعائلة Carabidae وهي الأنواع التالية: *Blaps polychresta*, *Zophosis punctuate*, *Pimelia interpunctata*, *Blaps nitens*, *Adesmia dilatata*, *Scaurus vicinus*, *Tentyria cyrenaica*, *Laemostenus complanatus*, *Ditomus cilpeatun* and *Akis costitubera*. وكان النوع *Zophosis punctuate* الأعلى تواجدا خلال فترة الدراسة (34%) ثم *Akis costitubera* (18%) و *Tentyria Cyrenaica* (13.32%)، كما سجلت الأنواع الأخرى ولكن بأعداد قليلة جدا منها: *Thorectes punicollis*, *Aethiessa floralis*, *Trox granulipennis*, *Brosus laevigatus*. كما أظهر التحليل الإحصائي ANOVA وكذلك T-test اختلافا معنويا واضحا ($P < 0.05$) بين تواجد الأنواع وكذلك خلال الأشهر المختلفة وأظهرت تذبذبا واضحا في نشاطها. كما بينت المقاييس البيئية مثل مقياس سمسون وكذلك مقياس شانون أن الخنفساء *Zophosis punctuate* سجلت الأعلى من بين كافة الأنواع المتواجدة خلال فترة الدراسة. وأوضحت الدراسة أهمية عوامل المناخ و التي من بينها درجة الحرارة و مدى ارتباطها بنشاط الخنافس في منطقة الدراسة و خاصة الأنواع *Akis costitubera*, *Blaps polychresta* and *Ditomus cilpeatun*. واستخلصت الدراسة الي تأثير العوامل البيئية وكذلك اهمية استخدام المقاييس البيئية في دراسة تواجد ووفرة الخنافس.

الكلمات المفتاحية: الخنافس الأرضية، التنوع الحيوي، الوفرة الموسمية.



Evaluation of Methods of Gastroesophageal Reflux Disease Diagnosis in Thawra Teaching Hospital Al-Bayda -Libya

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Abstract: Gastroesophageal reflux disease (GERD) results from the reflux of gastric contents, causing symptoms and injury to esophageal tissue. In this study, we evaluate methods of diagnosis of GERD and pattern of clinical, endoscopic, and histological findings in consecutive individuals. Patients were referred to endoscopy unit of Thawra Teaching Hospital, Al-Bayda-Libya for various reasons, they have Questionnaire-based assessment scales and were examined for the presence of reflux esophagitis, via endoscopy, and microscopic via histopathology. We had 48 patients with mean age of 45.5, 30 female, 18 male. Total patients with microscopic esophagitis were 29 (60.4%), and without microscopic esophagitis 19 (39.6%). The RDQ with a score of ≥ 8 as the diagnostic criteria of GERD, is not a conclusive diagnosis of GERD in isolation, but is of value in determining the need for further investigation. A normal endoscopy does not exclude GERD when endoscopy is inconclusive, adjunctive evidence from biopsy findings can add confidence for a GERD diagnosis. The finding of glandular mucosa without intestinal metaplasia in the distal 2 cm of the tubular esophagus is regarded as normal but indicates a much chronic acid exposure of the lower esophagus.

Keywords: reflux esophagitis, GERD, ERD, NERD; Gastroesophageal Reflux Disease Questionnaire (RDQ) Los Angeles classification, endoscopy, microscopic esophagitis.

INTRODUCTION

Gastroesophageal reflux disease (GERD) is a common disease. The incidence of GERD is rising worldwide with a prevalence of 10-33% (Sandhu & Fass, 2018). Chronic GERD causes metaplastic changes, this may lead to intestinal metaplasia and Barrett's esophagus. Chronic reflux esophagitis is a key risk factor for the development of Barrett's esophagus, which is a precursor lesion for esophageal adenocarcinoma (Lagergren & Lagergren, 2013) (Sharma, 2009). The prevalence of Barrett's esophagus among patients undergoing endoscopic examination is 1% (Pera, 2003). American College of Gastroenterology published guidelines for diagnosis of GERD on the basis of typical symptoms, improvement of reflux symptoms on

empiric medical therapy with a proton pump inhibitor (PPI) which confirms this symptom-based diagnosis (so-called PPI test) (Katz, Gerson, & Vela, 2013; Krugmann, Neumann, Vieth, & Armstrong, 2013). The Gastroesophageal Reflux Disease Questionnaire (RDQ) is a 6-item questionnaire that helps identify patients with gastroesophageal reflux disease (GERD). (Mouli & Ahuja, 2011). Patients are asked to report frequency of symptoms over the past 7 days. The symptoms suggestive of GERD in the RDQ included heartburn, substernal chest pain, acid eructation, and food regurgitation. Erosive Reflux Disease (ERD) is the major cause of inflammation and mucosal breaks of the squamous epithelium in the distal esophagus, it is sufficient to distinguish erosive lesions of any degree by endoscopy. GERD in-

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cludes more than half of patients that show no endoscopic abnormality whatsoever, the so called Non-Erosive Reflux Disease (NERD). The accurate assessment of NERD has proved difficult, as endoscopy does not provide any useful information, symptoms may be variable or atypical, and even prolonged monitoring of esophageal pH shows no abnormality in about one-third of patients with otherwise typical symptoms (Quigley, 1992), while there are no indications for routine esophageal biopsies in patients with esophageal or extraesophageal symptoms of gastro-esophageal reflux disease (J Dent et al., 1999) and the lack of a gold standard diagnostic test for patients without macroscopic lesions (NERD) makes histology very attractive in this group of subjects (John Dent, 2007).

Aim of the study In this study, we evaluate methods of diagnosis of GERD correlation and pattern of clinical, endoscopic and histological findings in consecutive individuals who underwent routine upper endoscopy as part of a routine examination in the endoscopy unit

MATERIALS AND METHODS

patients were referred to endoscopy unit of Thawra Teaching Hospital, Al-Bayda-Libya for various reasons. Based on a standard protocol including, a questionnaire, patients were examined for the presence of reflux esophagitis, macroscopic via endoscopy and microscopic via histopathology. Demographic details of the patients were recorded including age, sex, smoking habits, tea, coffee and alcohol consumption, and concurrent medical conditions including hypertension and diabetes mellitus. All subjects completed the detailed questionnaire-based assessment scales for (GERD) with the help of a doctor before endoscopy. The Gastroesophageal Reflux Disease Questionnaire (RDQ) score was calculated as the sum of scores, giving a total score ranging from 0 to 18. Those with a score of 8 or more have a high likelihood of having Gastroesophageal Reflux Disease (GERD), and those with

less than 8 have low or no likelihood. For more detailed scoring information, see the reference in the Source section (Am Fam Physician. 2010 ; Jones et al., 2009) .

Upper endoscopic examinations were performed using a standard video upper endoscope (Olympus GIF series). Diagnosis and classification of reflux esophagitis were based on the Los Angeles classification (Amano, Adachi, Katsube, Watanabe, & Kinoshita, 2001; Sami & Rangunath, 2013). Erosive Reflux Disease (ERD) is defined as GERD with esophageal mucosal breaks evident on routine endoscopy, whereas None-Erosive Reflux Disease (NERD) is defined as those with symptoms, but without mucosal breaks or erosions on endoscopy (Vakil et al., 2006). Endoscopic biopsies: level of the gastroesophageal, were defined by the distance from the incisor teeth. Each level had four biopsies at GE junction, 2 cm and 4 cm above.

These samples were fixed with 10% buffered formalin and biopsies were stained with Giemsa stain in addition to hematoxylin-eosin stain. The term “microscopic esophagitis” refers to a group of histological lesions observed in patients with GERD, both Erosive Reflux Disease (ERD) and None Erosive Reflux Disease (NERD) (Fiocca, Mastracci, Milione, Parente, & Savarino, 2011).

The diagnosis of microscopic esophagitis was based upon the presence of one or more of the following criteria: basal zone hyperplasia, focal or diffuse infiltration of the epithelium by polymorphonuclear (PMN) leucocytes, dense infiltration of mononuclear inflammatory cells, and/or an easily recognized infiltrate of neutrophils in lamina propria (Chandrasoma et al., 2000). Microscopic esophagitis was further graded into 5 categories based on the microscopic finding and length of esophageal involvement. Table (1).

Table (1). Microscopic esophagitis, (GEJ) Gastro Esophageal Junction)

• No Microscopic esophagitis	at GEJ
• Microscopic esophagitis With or without glandular mucosa	at GEJ
• Microscopic esophagitis without Intestinal metaplasia	at GEJ, extending to 2cm above GEJ
• Microscopic esophagitis with glandular and Intestinal metaplasia “short-segment Barrett’s esophagus”	at GEJ, extending to 2cm above GEJ
• Microscopic esophagitis with glandular and Intestinal metaplasia “long-segment, classic Barrett’s esophagus”	at GEJ, extending more than 2cm above GEJ

Statistical analysis: The data analyzed statistically, using the Chi-Square test. All tests for $p < 0.05$ and $p < 0.001$ were considered significant. SPSS version 17 was used for statistical analysis.

RESULTS

We have 48 patients with a mean age of 45.52 (Std. Deviation 16), 30 female, 18 male; mean BMI 27% , 4 (8%) male smokers. Those with a Gastroesophageal Reflux Disease Questionnaire (RDQ) score of 8 or more were 18 (37.5%), 11 (22.9%) female and 7 (14.6%) male without significant differences (P: 0.951). Taking the microscopic changes as reference, RDQ sensitivity was 50 %, specificity was 79% (Kappa value as a measure of agreement 0.267; P: 0.045). We have 13 (27%) patients with definite Erosive Reflux Disease (ERD) evident on endoscopy. Based on the Los Angeles (LA) classification, we have LA A six patients, LA B four patients and LA C two patients. Taking the microscopic changes as references for endoscopic changes, sensitivity was 54 %, and specificity 100%, (Kappa value as a measure of agreement 0.412; P: 0.000). Total patients having microscopic esophagitis were 29 (60.4%), 13 patients 45% with ERD (Microscopic esophagitis with definite Erosive Reflux Disease) and 16 patients 55% with

NERD (Microscopic esophagitis without definite Erosive Reflux Disease), and 19 patients have no microscopic esophagitis making 39.6%. See table (2).

Table (2). Microscopic esophagitis categories; (NERD: None Erosive Reflux Disease, ERD: Erosive Reflux Disease, GEJ: Gastro Esophageal junction)

Microscopic esophagitis categories	No (%)
• No Microscopic esophagitis	19 (39.6%)
• Microscopic esophagitis	29 (60.4%)
• Microscopic plus Macroscopic esophagitis (ERD)	13 (45%)
• Microscopic without Macroscopic esophagitis (NERD)	16 (55%)
• Microscopic esophagitis	29 (60.4%)
• Microscopic esophagitis (at GE junction)	16 (33%)
▪ Without Goblet cells	7 (14.6%)
▪ With Goblet cells	
• Microscopic esophagitis without Intestinal metaplasia at GEJ, extending to 2cm above GEJ	4 (08.3%)
• Microscopic esophagitis with intestinal metaplasia at GEJ, extending to 2 cm above GEJ “short-segment Barrett’s esophagus”	2(04.2%)
• Microscopic esophagitis with Intestinal metaplasia at GEJ, extending more than 2cm above GEJ “long-segment, Barrett’s esophagus”	0(00%)

We found that endoscopic finding has a positive correlation with histopathological findings and RDQ while histopathological findings do not correlate with RDQ see table (3).

Table (3). correlations between RDQ, endoscopic and histologic picture.

	Correlations (Pearson)	P Value *Not significant ** Significant
Microscopic Esophagitis and RDQ	= 0.275	P=0.059*
Microscopic and Macroscopic Esophagitis RDQ and Macroscopic Esophagitis	= 0.493	P= 0.000**
RDQ and Macroscopic Esophagitis	= 0.496	P= 0.000**

DISCUSSION

GERD subjects diagnosed based on RDQ score of 8 or more were 37.5%, which was high compared to other regional and international studies. In a review article based on 15 studies from 1999 to 2010, the prevalence of GERD in Iran had been reported to be about 6.8% to 33% (Delavari, Moradi, Birjandi, Elahi, & Saberifiroozi, 2012), and in a review article by El-serag *et al.* in 2013 the prevalence of GERD was 18.1%-27.8% in North America, 2.5%-7.8% in East Asia, 8.8%-25.9% in Europe, and 8.7%-33.1% in the Middle East based on the weekly occurrence of GERD symptoms. The GERD prevalence was 28.7% in Saudi Arabia (Alsuwat, Alzahrani, Alzhrani, Alkhathami, & Mahfouz, 2018).

Most studies using questionnaires might have failed to distinguish the functional heartburn (Jung, 2011). Our study sample was biased toward persons undergoing upper endoscopy, who are more likely to have more gastrointestinal symptoms than the general population and who may have GERD symptoms more frequently, it was also biased because of small sample size and this explains the low RDQ sensitivity (50%), specificity (79%). Up to 27% of our patients have positive upper gastrointestinal endoscopy findings, which is similar to other regional and international studies that reported up to 30% upper gastrointestinal endoscopy findings. (Mohamed *et al* 2014) ("[5.pdf](#)",), (Elmas Kasap, Zeybel, Aşık, Ayhan, & Yüceyar, 2011). The Los Angeles classification system is based on the detection of mucosal breaks in conventional endoscopy (Fock, Teo, Ang, Tan, & Law, 2009). Upper endoscopy is considered by many as an insensitive test for GERD as it often yields normal endoscopic findings, in our study two-thirds of patient have normal endoscopic finding. It is also more invasive and expensive. It is widely used in GERD for identifying and grading severe esophagitis, monitoring patients with Barrett's esophagus, or when other com-

plications of GERD are suspected. However, endoscopy is the gold standard for the diagnosis of erosive GERD. In this study the sensitivity of endoscopy for GERD is poor, but it has an excellent specificity of 100% (E. Kasap, Zeybel, Asik, Ayhan, & Yuceyar, 2011; Richter, 1994). The term "microscopic esophagitis" (ME) refers to a group of histological lesions observed in most patients with GERD, both ERD and NERD. Microscopic esophagitis found in 29 (60.4%), ERD (Microscopic plus Macroscopic esophagitis) 13 patients 45% and NERD (Microscopic without Macroscopic esophagitis) 16 patients 55% (E. Kasap *et al.*, 2011). This goes with who found that histopathological findings were more prevalent than the endoscopic changes. In symptomatic patients of GERD, when endoscopy does not show mucosal breaks, histopathological evaluation of distal esophageal mucosa may have a promising diagnostic value and the recognition of microscopic changes in NERD is important in some subgroups of patients (i.e., those with typical symptoms), and the histological diagnosis of GERD is generally believed to be of limited value as an initial tool for GERD evaluation (McDonald, Graham, Lavery, Wright, & Jansen, 2015; Schindlbeck, Wiebecke, Klauser, Voderholzer, & Müller-Lissner, 1996).

The finding of glandular mucosa without intestinal metaplasia in the distal 2 cm of the tubular esophagus was found in 7 (14.6%) of our patients, it is currently regarded as normal, but indicates a much chronic acid exposure of the lower esophagus. Specialized intestinal metaplasia with goblet cells in the esophagus, the lower 2 cm of the tubular esophagus "short-segment Barrett's esophagus", was found in 4.2% of our patients and also indicated a much more severe acid exposure. (Csendes *et al.*, 1993; Jain, Aquino, Harford, Lee, & Spechler, 1998).

In this study we could not find any case with long segment Barrett's esophagus, and this apparently is due to the small sample size of

our study. In 2008, Fan and Snyder conducted a retrospective study in the United States evaluating the medical records and endoscopic reports of 4,500 patients, they reported a prevalence of Barrett's esophagus of 4.4% and 1.5% in those with and without gastroesophageal reflux symptoms, respectively (Fan & Snyder, 2009). The prevalence of Barrett's esophagus was 3.77% in a Greek population undergoing upper endoscopy not referred for GERD.

The histologic lesions in GERD are usually limited to the distal esophagus. Standard sampling should include the last 2 cm above the Z line (2 biopsies at 2 cm and 2 biopsies on the esophageal side of the Z line) (Schneider NI, et al 2015). More proximal biopsies are less informative. Endoscopy has a good correlation with clinical symptoms and histopathology findings, but no correlation was observed between clinical symptoms and histological findings, see table (3). Our results are comparable to the literature published in 2005 in Pakistan (Zuberi BF, 2005).

CONCLUSION

The Gerd Q questionnaire with a score of ≥ 8 as the diagnostic criteria of GERD is not a conclusive diagnosis of GERD in isolation, but is of value in determining the need for further investigation. Endoscopy is not a necessary prerequisite to therapy for typical reflux symptoms, but it is indicated at the first presentation for patients with alarm symptoms referable to the upper gastrointestinal tract. A normal endoscopy does not exclude GERD when endoscopy is inconclusive, adjunctive evidence from biopsy findings can add confidence for a GERD diagnosis. The disease follows a rather benign course in most patients, the finding of glandular mucosa without intestinal metaplasia in the distal 2 cm of the tubular esophagus is currently regarded as normal, but indicates a much chronic acid exposure of the lower esophagus (Gyawali et al., 2018). The histologic lesions in GERD are usually limited to the

distal esophagus, more proximal biopsies are less informative.

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تقييم طرق تشخيص الجزر المريئي بمستشفى الثورة التعليمي البيضاء/ ليبيا

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المستخلص: مرض الجزر المريئي ناتج عن انعكاس أو ارتجاع لمحتويات المعدة مسبباً أعراضاً وإصابات لأنسجة المريء، ومن طرق التشخيص، استبيان خاص بمرض الجزر بني على تسجيل نقاط محسوبة، ويعتبر مجموع نقاط الاستبيان لأكثر من 8 كافياً سريريا لتشخيص المرض (الارتجاعي) لئلا يعانیه المريض من أعراض). ولكن يظل تنظير المريء عاملاً مساعداً لتأكيد تشخيص التهاب الجزر (الارتجاعي) لتأكل المريء ومن ثم تحديد درجة العطب النسيجي. من الدراسات السابقة، أكثر من نصف المرضى الذين يعانون من التهاب المريء الجزري (الارتجاعي) لا توجد لديهم أية تغيرات أو عطب نسيجي وقت التنظير (يسمى: جزراً مريئياً بدون تآكل)، الأمر الذي جعل التحليل المجهرى النسيجي مطلوباً لتلك المجموعة. في هذه الدراسة قمنا بتقييم طرق تشخيص الجزر المريئي وأنماطه الإكلينيكية، و نتائج المنظار (حسب تقسيمات لوس أنجلوس لتقييم تآكل المريء بالمنظار)، وكذلك نتائج التحليل المجهرى النسيجي. تم دراسة المرضى المحالين إلى وحدة المناظير بمستشفى الثورة التعليمي بالبيضاء لغرض إجراء منظار لعدة أسباب حيث تم سؤالهم عن طريق استبيان معدّ مسبقاً لتقصّي مرض الجزر المريئي وحساب نقاط الاستبيان، بعدها جرى المنظار ثم تؤخذ عينات نسيجية من أماكن مختلفة وترسل إلى المعمل لغرض الفحص المجهرى للأنسجة. عدد الذين أجريت عليهم الدراسة 48 مريض، متوسط أعمارهم (45.5)، 30 منهم من النساء و15 من الرجال. مجموع المرضى ممن وجد لديهم تغيرات نسيجية 29 مريضاً بنسبة (60.4%) وبدون تغيرات نسيجية 19 مريضاً بنسبة (39.6%). وجدنا أن مجموع نقاط الاستبيان أكثر من 8 نقاط لا يعتبر دقيقاً لتشخيص الجزر المريئي بمفرده ولكنه ذو قيمة للمضي إلى فحوصات أخرى دقيقة. وكذلك خلو فحص المنظار من تآكل الأنسجة لا يفي أو لا يستبعد التهاب الجزر المريئي، وعند إضافة أخذ عينات نسيجية لغرض التحليل ممكن أن يزيد مدى دقة التشخيص. عند إجراء الفحص النسيجي ووجود النسيج الغدّي بدون وجود تغيرات نسيجية معوية مهاجرة على مسافة 2سم من الجزء السفلي من المريء تعتبر طبيعية ولكنها تدل على تعرض الجزء الأسفل للمريء للأحماض والعصارة المعدية.

الكلمات المفتاحية: التهاب الجزر المريئي، الجزر المريئي، التهاب المريء غير الجزري، استبيان مرض الجزر المريئي، تقسيمات لوس أنجلوس، المنظار، التهاب المريء المجهرى.

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Admission Patterns and Outcome in a Pediatric Intensive Care Unit at Tobruk Hospital

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Abstract: This study aims to describe the admission pattern and outcome of patients in the pediatric intensive care unit (PICU) at Tobruk medical center. We have retrospectively reviewed medical files of PICU over the period from January to December of 2016 for children aged from 1month-15 years. A total of 1026 children were admitted to PICU at Tobruk medical center. Of the total, 55% were males and 44.9% were females with male to female ratio of 1.2: 1. Age distribution showed that 64% were infants (1month -1 year). Majority of admission during cold months (December, January, and February) had the highest admission rate. Central nervous system and respiratory system diseases (23%, 12%) respectively were the most diseases requiring PICU admission. Congenital heart diseases 10/26 (38.4%) was the most common cause of total death. 668(65%) patients improved and were discharged from ICU, and 201 (19.5%) were transferred to pediatric ward for further management and discharged in satisfactory condition. 99 (9.6%) patients left against medical advice, and 32 (3%) patients transferred to more specified hospital and 26 patient died (2.5%). The observed difference in the mortality was with the respect to age, length of stay, and the involved systems. Neurological system remains a major cause for admission in ICU mainly for febrile convulsion and was associated with considerable morbidity and mortality. Respiratory system was the second cause mainly for pneumonia, and CHD was the major cause of death. The results concluded that epidemiologic analysis of the pattern of patients admitted to our PICU showed different etiologies for admission.

Key words: Pediatric intensive care unit (PICU), children and mortality, Tobruk- Libya

INTRODUCTION

Intensive care is predominantly concerned with the management of patients with acute life-threatening conditions in a specialized unit. Caring for critically ill children remain one of the most demanding and challenging aspects of the field of pediatrics (Carpenter, Dobyns, & Lane, 2003).

Patients are admitted to a pediatric intensive care unit because they require a very high level of monitoring of vital signs and other body functions. These patients may need mechanical ventilation invasive intravascular procedures and frequent attention by both the nursing and medical staffs (Frankel, 2004). Children having

acute neurological deterioration, respiratory distress, cardiovascular compromise, severe infections, and accidental poisoning constitute the major admission to a pediatric intensive care unit (Jaimovich, 2004). Patients may be discharged or ambulated from pediatric intensive care unit once the disease process has reversed itself and care can be provided in less intense environment (Frankel, 2004).

Disease pattern in a pediatric intensive care unit, particularly in the early age group, is a sensitive indicator of the availability, utilization, and effectiveness of mother and child health services in the community. Disease pattern changes between different places and from

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time to time even at the same place (Parkash & Das, 2005). Therefore, regular review of the disease pattern in any particular setting is important for providing better services to the patients. In the past two decades, improvement in life-sustaining technologies resulted in an increase in the number of ICUs. Care of the critically ill patients is a resource-intensive, and 15-20% of hospital budgets are spent on the ICUs. The focus on the quality and safety of medical care is increasing because of the high cost of healthcare and the potential for harm. There are many evaluations of mortality and incidence of complications, such as nosocomial infection in the ICUs, with an increased emphasis on the quality improvement efforts and the evaluation of outcome (Curtis et al., 2006; Luce & Rubenfeld, 2002; Mehta et al., 2007). This retrospective study was undertaken in order to document the most common type of diseases with which the children are admitted in the intensive care unit, and the outcome of this admission.

MATERIALS AND METHODS

Study design: This retrospective descriptive cross-sectional study was conducted from January to December of 2016.

Study sitting: The PICU is a part of the pediatric department (34 beds capacity), it contains 14 beds and equipped with central oxygen supply, suction lines, infusion pumps, and conventional mechanical ventilator. PICU is staffed by a consultant, 2seniors, and 2 resident doctors on duty supported by 2 trained nurses.

Data were extracted from the patient's files filled by resident doctors. Extracted data included the following:

- 2- Age, sex, residency, nationality, address, date of admission, and date of discharge.

2-Clinical characteristic: provisional diagnosis, any interventions, and the treatments received.

3-Relevant investigations including CBC and differential blood count, CSF analysis for cell counts and culture, blood sugar, serum calcium,

CRP, ESR, X-ray, CT scan, and MRI..

4-Length of stay (LOS), discharge, LAMA, referral to another hospital for treatment, and comparing the outcome between patients with direct admission to ICU and patients transferred to ICU from the pediatric ward with increased emphasis on the quality improvement efforts and evaluation of outcome.

Data analysis:

Data were entered and analyzed using (SPSS) Version 18. Statistics like mean, median, and standard deviation were computed, and results were presented as frequency tables and figures.

RESULTS

A total of 5133 children were admitted to the pediatric department at Tobruk Medical Center during the study period, and 1026 were admitted to pediatric intensive care unit (PICU), 3150 admitted to pediatric ward. Males were 565 (55 %) and females were 461 (45%). Male to female ratio was 1.2:1. Out of 1026, 1005(98%) were Libyans and Non-Libyans children represented 21 (2%). Out of 1026, 930 (90%) were form Tobruk and 96 (9.3%) were from outside Tobruk, their age ranged from 1 month to 15 years. Of the total admitted children, 67.4% were between (1month -1 year), followed by > 1-5 years (20.9%), while children aged from 5 to 10 years and >10 years were (9.3%) and (2.2%) respectively. (Table 1).

Table (1). Distribution of patients according to age

Age group	No.of patients	%
1month-1 year	692	67.4%
>1 -5 years	215	20.9%
>5 – 10 years	96	9.3%
>10 years	23	2.2%
Total	1026	100%

We noticed that December, January, and February had the highest admission rates (131, 123, and 118 respectively). Central nervous system diseases (n=255, 24.8%), respiratory

illnesses (n=159, 15.4%), and gastrointestinal (n=120, 11.6%) were the most common diseases requiring ICU admissions in this analysis. Admissions also include cardiovascular (n=68, 7%), endocrine (n=23, 2.2%), hematology (n=10, 0.9%), and others (n=167, 11.9%).

Commonest central nervous system diseases requiring ICU care were febrile convulsion (n=142/255 pts), meningitis (33/255 pts), cerebral palsy (n=28/255 pts), epilepsy (n=24/255 pts), encephalitis (11/255 pts), Brain tumor (3/255 pts), hydrocephalus e shunt (9/255), facial palsy (4/255), and CVA (1/255).

Respiratory diseases required ICU admission were pneumonia (n=83/159 pts, 52.2 %), aspiration pneumonia (n=14/159 pts, 8.8%), bronchial asthma (n=30/159pts, 18.8%), acute bronchiolitis (n=17/159pts, 10.6%), whooping cough (n=11/159pts, 6.9%), choking n=2/159pts, 1.25%), and foreign body aspiration (n=2/159pts, 1.25%).

Cardiac cases admitted include: congenital heart disease (n=65 pts), myocarditis (n=2pts) and supraventricular tachycardia (n=1 pt).

Regarding children with severe dehydration (n=57 pts), 5 of them were hypernatremic dehydration, and (52pts) were isonatremic dehydration.

Endocrine diseases in this study were: diabetic ketoacidosis (n= 17pts), hypoglycemic attack (n=1 pts), and Hypocalcaemia (n=4 pts). Among hypocalcaemia, two patients had rickets and one case with hypoparathyroidism, and they were presented with carpopedal spasm.

The renal illnesses admitted were a chronic renal failure (n=4 pts), nephrotic syndrome (n=5 pts), congenital adrenal hyperplasia (n=1pt).

Others include: hematology (hemophilia, G6PD, plastic anemia, leukemia), drowning, snake bite, scorpion bite, head trauma with convulsion, and electric shock. Poisoning in-

clude: drug ingestions (n =8 pts) ,organ phosphorus, hysterical (n=1pt),

Surgical cases include (hypertrophic pyloric stenosis (n=6 pts), intestinal obstruction (n=4 pts), intussusception (n=5pt), and operating esophageal Artesia with a gastrostomy tube (n=1pt).

The outcome:

- Most of the patients, 668 (65%), improved and were discharged from ICU, and 201 (19.5%) were transferred to the ward when they were not in need of intensive care or were discharged home from ICU with a satisfactory condition.
- 32 patients (3%) were referred to another specialized hospital for further management.
- Ninety-nine patients (9.6%) were left against medical advice (LAMA).
- Twenty-six patients (2.5%) died (Figure 1).

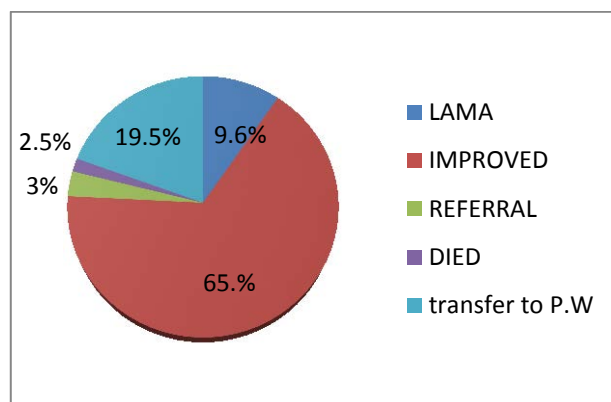


Figure (1). Distribution of patients according to the outcome

The commonest diseases requiring PICU admission were central nervous system diseases, mainly febrile convulsion disease, followed by respiratory system diseases

DISCUSSION

In various studies, it has been shown that intensive care had a positive outcome for the vast majority of critically ill children. However, caring for critically ill children is a challenge in

developing countries, where health needs often outstrip available resources. Necessary equipment is scarce and often is malfunctioned, and trained manpower is limited. Management of critically ill patients requires significant human, infrastructural, and financial resources and these resources are typically limited in low-income countries (Butt et al., 1990; Gemke, Bonsel, & van Vught, 1995; Isamade, Yiltok, Uba, Isamade, & Daru, 2007; Oke, 2001; Watters, 1993).

We noticed that infants (1 month-1 year) and children up to 5 years were the most vulnerable age groups representing the majority of admitted patients to PICU, this is in consonance with a study documented in Cairo by (Rady, 2014). In a study in Bangladesh, 93.3% were below 5 years of age (Hoque, Masud, & Ahmed, 2012). Another study in India found that 72.7% were below 5 years of age (Abhulimhen-Iyoha, Pooboni, & Vuppali, 2014). Male babies outnumbered their female counterparts with a ratio of 1.2:1 (568 vs 465), this reflects a gender bias in parental health seeking behavior regarding their children, or alternatively there may be an epidemiological reason for male susceptibility to infection or other conditions requiring admission. The male predominance at admission is consistent with an Indian study where infants represent 31%, and 63% of them were males (Shah, Shah, Thapa, Shah, & Mishra, 2014). Similarly, in study done in Ethiopia, where they observed that admission of male children was more than that for females children (93 vs. 77) with a male to female ratio of 1.2:1 (Abebe & Girmay, 2015), As well as other studies, We found that December, January, and February had the highest admission rates which is similar to a study in Egypt where they found that November and December had the highest admission rate (Rady, 2014), which reflects a possibility of droplet infection (respiratory manifestation) in winter season.

Neurological system was the most common involved system (24.6%) in total admission.

Diseases like febrile convulsion, meningitis, encephalitis, and cerebral palsy were the commonest indications for admission in our set, followed by respiratory illness, which represent (15.5%) of the total admission, like pneumonia, aspiration pneumonia whooping cough, and acute bronchiolitis. This could be a reflection of disease prevalence under five years of age; this may be decreased by incorporating pneumococcal vaccine in the national immunization program. The predominance of neurological diseases and respiratory illness at admission in our study is similar to studies from Egypt and Bangladesh (Hoque et al., 2012; Rady, 2014), and another study also showed that respiratory diseases 40%, followed by neurological illness 27% were the common cause of illness in their PICU (Singhal, Kumar, Puliyeel, Singh, & Srinivas, 2001). In the current study, cardiovascular diseases represent 4% of the total admission, and 92.5% of them had congenital heart disease, the most common cause of deaths in PICU, where in studies in India, they represents 41.1% and 6.5% respectively (Abhulimhen-Iyoha et al., 2014; Shah et al., 2014) While in a study in Pakistan, they found that post cardiac surgery 34% to be the most common condition (Haque & Bano, 2009).

In our study acute gastroenteritis represent 5.5% of the total admission, this may be due to incorporating ROTA viral vaccine in the national vaccination program whereas in a study done in India diarrheal diseases were the commonest cause of admission 26.8% (Sharma et al., 2012). Out of 1026 child admitted, 668(65%) child were improved and transferred to the ward or discharged home in satisfactory condition, and 32 (3%) child were referred to other specialized hospitals. The referred patients include: children with surgical problems, patients for cardiac surgery, some patients need special investigation like bone marrow aspiration and MRI, and some patients were referred to based on a family request in spite of the unnecessary referral because of the lack of confidence in the care provided to their children. 99

out of 1026 patients (9.6%) left against medical advice (LAMA), mainly for domestic reasons including the lack of caring for children, and the lack of confidence on the level of care provided to these children whereas in a study in Bangladesh they found that 6 out of 119 (5%) left against medical advice for the same reasons (Hoque et al., 2012).

Twenty-six patients died during the course of admission, giving an ICU mortality rate of 2.5%. This mortality rate was underestimated because some of the referred children were very sick, and some cases were received dead but not registered for medico-legal causes. This value is near to the result documented in reported in India 2.6% and less than Hong Kong 6.7%, (Choi et al., 2005; Khilnani et al., 2004). It is, however, less than the overall mortality of 16.7% recorded in other parts of India, and 15% mortality rate documented in Brazil in 2010, and also less than that shown in Greece 9.7% (Costa, Delgado, Ferraro, & Okay, 2010; Klem, Pollack, & Getson, 1990). ICU mortality rate varies depending on the case age, gender, length of stay and organizational aspects of the unit (El - Nawawy, 2003). This study is a little effort to determine the pattern of admission and the outcome of critically ill children, and to help these angles by making the critical care more feasible.

CONCLUSION

Epidemiologic analysis of the pattern of patients admitted to our PICU shows different etiologies for admission. On the top, there were neurological and respiratory systems; and congenital heart disease was the major cause of death. The absence of a high-dependency unit at our hospital led to the admission of some patients who were not ill enough to require ICU admission. The high referral rate to special units like pediatric surgery and ENT unit for bronchoscopy may provide an argument for establishing pediatric surgical and ENT department. Death rate was underestimated be-

cause some patients were brought in a serious condition and we do not know their fate and some cases were received dead but not registered for medico-legal causes.

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أنماط الدخول والنتائج في وحدة العناية المركزة للأطفال في مركز طبيرق الطبي، ليبيا

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المستخلص: استهدفت الدراسة توصيف معدل دخول الاطفال من عمر (شهر إلى 15 سنة) الذين تعرضوا لأمراض حرجة والمحولين إلى وحدة العناية المركزة في قسم طب الأطفال بمركز طبيرق الطبي، وذلك من خلال دراسة ملفات المرضى بأثر رجعي من الفترة من يناير 2016 إلى ديسمبر 2016. حيث بلغ عدد الأطفال المقبولين في وحدة العناية المركزة في مركز طبيرق الطبي 1026 طفلاً، 55% من الذكور و44.9% من الإناث وبنسبة الذكور إلى الإناث: 1.2 : 1. وأظهر التوزيع العمري أن 64% من العدد الكلي هم من الرضع من (1شهر -1 سنة). بينت الدراسة أن نسبة امراض الجهاز العصبي المركزي والجهاز التنفسي (23%، 12%) على التوالي وتعتبر هذه الامراض من الأمراض الأكثر شيوعا والتي تتطلب دخول وحدة العناية المركزة، من الدراسة تبين أيضا أن معظم حالات الدخول كانت في فصل الشتاء شهر (يناير، فبراير وديسمبر) معدل الوفيات الإجمالي (26)2.5% وكانت نسبة الوفاة أعلى في الذكور 17 \ 26 مقارنة بالإناث 9 \ 26 وكانت هذه الإحصائيات مختلفة معنويا. كان امراض الخلفية بالقلب السبب الأكثر شيوعا للوفاة حيث كان 10 / 26 مريضا (39%). 668 مريضا من العدد الكلي (65%) تحسنت حالتهم، 99 مريضا (9.6%) غادروا بدون المشورة الطبية، وأحيل 32 مريضا (3%) إلى مستشفى أكثر تحديدا، وتوفي 26 مريضا بمعدل نسبة الوفيات (2.5%). كان الالتهاب الرئوي امراض القلب الخلفية، التشوهات الخلفية، التهاب الجهاز العصبي والرئوي أكثر الأسباب شيوعا للوفاة.

الكلمات المفتاحية: وحدة العناية المركزة، مركز طبيرق الطبي- ليبيا.



Effect of Probiotic, Prebiotic, Synbiotic and Medicinal Plants on Productive Performance of Broilers Fed on Different Levels of Protein

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Abstract: The aim of this study was to investigate the response of broilers fed on test diets containing non-antibiotic growth promoters; Probiotic (Bio Plus 2B), Prebiotic (Techno Mos), Synbiotic, and medicinal herbs (Mixture of *Origanum majorana*, *Foeniculum vulgare*, and *Carum carvi* in ratio 1:1:1), each within two dietary protein levels (normal and low), on these broiler performance. The study was carried out at the Poultry Research Center, Faculty of Agriculture; Alexandria University, Egypt. The experimental period lasted for 42 days. A total number of 500 days from Cobb broiler chicks, with similar average live body weight, were randomly distributed into 10 treatments. Each treatment comprised of 5 replicates of 10 chicks each. Ten experimental diets were formulated to be approximately isocaloric and cover all nutrients required for broiler throughout two stages of growth periods, starter diets (1 - 21) and finisher diets (22 - 42) days of age. Ten experimental diets were consisting of two levels of crude protein (recommended or low (85% of recommended)) and five feed-additive programmes (control, probiotic, prebiotic, synbiotic and medicinal plants). In general, feeding broiler lower crude protein levels (-10% of NRC) resulted in poorer growth performance, which was partially compensated with the non-antibiotic additives. Among the additives, synbiotic had positively significant effects on FCR, BW.

Keywords: probiotic, prebiotic, synbiotic, medicinal plants, Performance, Broilers, Protein

INTRODUCTION

Feeding on sub-therapeutic levels of antibiotics have been historically a common practice in some sectors of the commercial broiler industry in order to promote growth performance, protect overall flock health, and prevent diseases (Goodarzi, Landy, & Nanekarani, 2013). However, the repeated use of antibiotics in poultry diets has resulted in severe problems such as higher resistance of pathogen to antibiotics, imbalance of normal microflora in the gut, reduction in beneficial intestinal microflora, and accumulation of antibiotics residue in animal products and consequently increasing the nega-

tive impact on the environment (Barton, 2000; Hinton, Kaukas, & Linton, 1986).

As Barton (2000) reported, the emergence of antibiotic resistance is closely related to the amount of antibiotic residues in the environment, as the resistance to antibiotics is increasing due to the misuse of antibiotics as growth promoters (AGP) in animal feeds as well as the treatment of humans and animals (Goodarzi et al., 2013). The European Union recently has released a report concluding that about 25,000 patients die each year from infections caused by drug-resistant bacteria, which is equivalent to €1.5 billion of medical healthcare costs (Salim et al., 2013; Ziggers, 2011). Such data

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indicates the seriousness of the problem throughout the globe and explains why many countries world-wide have banned antibiotic usage in livestock feeds.

Beneficial effects of dietary additives such as probiotics, prebiotics and organic acids, on the energy and protein utilization of poultry have been reported (Angel, Dalloul, & Doerr, 2005; Pirgozliev, Murphy, Owens, George, & McCann, 2008; Samarasinghe, Wenk, Silva, & Gunasekera, 2003; Yang et al., 2008). It has also been suggested that feed additives may be more efficient when low nutrient diets are fed. Generally, low density diets are more profitable and resulted in less environmental pollution problems. In recent years, the high price of protein sources as well as environmental concerns related to high nitrogen excretion have resulted in increasing interest for using low protein diets in poultry production (Torres-Rodriguez et al., 2005). Considering the positive effects of probiotics, prebiotics and organic acids on protein utilization, using low protein diets supplemented with these additives in broiler nutrition may be practical. In this regard, Angel et al. (2005) reported that feeding on low nutrient diets resulted in poorer performance, but dietary inclusion of probiotics helped the birds to overcome this negative effect by improving nutrient retention. Moreover, it has been reported that probiotics, prebiotics, and organic acids have positive effects on the immunity system (Huang et al., 2007; SA, El-Sanhoury, El-Mednay, & Abdel-Azeem, 2008; Zulkifli, Abdullah, Azrin, & Ho, 2000). However, there are only a few comparative reports on the effects of probiotics, prebiotics and organic acids on performance, immunity and the intestinal morphology of broilers fed on different levels of protein. Consequently, the current study was designed to investigate the response of broilers to diets supplemented with non-antibiotic growth promoters (probiotic (BioPlus 2B), prebiotic (TechnoMos), symbiotic, and medicinal herbs (Mixture of *Origanum majorana*, *Foeniculum vulgare* and *Carum carvi* in ratio

1:1:1), within two dietary protein levels (normal and low), on the Performance of Broilers.

MATERIALS AND METHODS

This study was conducted at Poultry Research Center, Faculty of Agriculture, Alexandria University. The experimental work was carried out at the broiler Production Unit, the current study was designed to investigate the response of broilers fed on test diets containing non-antibiotic growth promoters (probiotic (BioPlus 2B), prebiotic (TechnoMos), Synbiotic, and medicinal herbs (Mixture of *Origanum majorana*, *Foeniculum vulgare* and *Carum carvi* in ratio 1:1:1), within two dietary protein levels (normal and low), on broiler performance .

(Probiotic (BioPlus 2B) and prebiotic (TechnoMos) were purchased from the local market which were German originated products and imported within the same production season, and the medicinal herbs (Mixture of *Origanum majorana*, *Foeniculum vulgare* and *Carum carvi* in ratio 1:1:1) was purchased from the local market, and a sample was utilized for further chemical evaluation.

Additives (probiotic, prebiotic and Herbs).

All additives were commercial products in powder form and added to the diets according to the levels recommended by the manufacturers. Additives and their dosages were:

Probiotic (BioPlus 2B):

Mixture of *Bacillus licheniformis* spores and *Bacillus subtilis* spores (DSM5750) in ratio 1:1, at 1g/kg of the starter and finisher diets.

Prebiotic, TechnoMos:

Biological active materials from the cell wall, fractions of *Saccharomyces cerevisiae* rich in 1,3 B-glucans and mannans 1000g, contains

Total Glucans	24%
B-glucans	20%
a-glucans and free glucans	4%
Total mannans:	18%

Synbiotic: (Mixture of Probiotic and Prebiotic in ratio 1:1).

Herbs:

(Mixture of *Origanum majorana*, *Foeniculum vulgare* and *Carum carvi* in ratio 1:1:1).

Experimental diets

This experiment was designed in a 2 × 5 factorial arrangement with two levels of dietary crude protein (CP) and a four feed-additive programmer. The two levels of protein were the recommended: 230 and 200 g CP/kg for starter and finisher diets, respectively (Council, 1994), and low levels: 195 and 170 g CP/kg for starter and finisher diets, respectively. The feed-additive programmer was as follows:

1. The basal diet without any feed additive served as the control.
2. The basal diet supplemented with probiotic (1g/Kg).
3. The basal diet supplemented with prebiotic (1g/Kg).
4. The basal diet supplemented with probiotic and prebiotic (Synbiotic) (1g/Kg).
5. The basal diet supplemented with medicinal herb (1.5g/Kg).

The compositions of the experimental diets are presented in Table 1.

Table (1). Composition and Calculated Analysis of the basal Experimental Diets (g/kg).

Ingredients,%	Experimental diets			
	Starter 1 to 21 Day		Grower 21 to 42 day	
	Recommended Protein	Low Protein	Recommended Protein	Low Protein
Yellow Corn	552.00	660.00	600.00	706.00
Soybean Meal 44%	310.00	230.00	262.00	190.00
Corn Gluten Meal	80.00	60.00	80.00	50.00
Di-calcium phosphate	15.00	15.00	15.00	16.00
Lime stone	13.00	14.00	13.00	13.00
Salt (NaCl)	3.5	4.5	3.5	3.5
Veg. oil	20.00	10.00	20.00	15.00
L-lysine	0.00	1.52	0.20	2.00
DL-Methionine	1.58	2.00	1.95	2.25
Premix *	3.00	3.00	3.00	3.00
Total	1000	1000	1000	1000
Calculated analysis				
Crude Protein %	23.46	19.2	21.3	17.4
M.E. (kcal/ kg)	3149	3156	3285	3297
C/P	134	164	154	189
Fat	5.8	7.20	6.4	7.8
Crude Fiber, %	2.44	2.9	2.63	3.1
Calcium, %	1.02	1.07	0.98	1.03
Phosphorus	0.50	0.50	0.50	0.50
Methionine %	0.45	0.46	0.43	0.42
Lysine %	1.19	1.18	1.07	1.05

* premix each kg contain vit. A (12 M.I.U.), vit. D3 (3 U.I.U.), vit. E (10g), vit. K2 (1g), vit. B1 (1g), vit. B2 (5g), vit. B6 (1.5g), vit. B12 (10g), Pantathenic acid (10g), Nicotinic acid (20g), Folic acid (1000 mg), Biotin (100g), Choline chloride (500g), Copper (15g), Iodine (9g), Iron (35g), Manganese (66g), Zinc (66g), Selenium (30g).

The 2 levels of CP were the (Council, 1994) - recommended level (23 % CP, for the starter and %21 grower diets, respectively) or the low level (19 % CP for the starter and %17 finisher diets, respectively).

The starter and grower diets in mash form were fed from 1 to 21 d and 22 to 42 d of age, respectively.

Statistical Analysis:

Data from all response variables were subjected to one analysis of variance applying SAS program (SAS, 2008) using General Linear Model (GLM). Significant differences among treatment means were separated using Duncan's multiple range procedure (Duncan, 1955) at 0.05, 0.01 and 0.001 probabilities.

The statistical model used was as follows:

$$Y_{ijk} = \mu + S_i + J_j + (S_j)_{ij} + e_{ijkl}$$

Where:

Y_{ijk} = Observed value of the dependent variable.

μ = Overall mean.

S_i = Effect of protein level.

J_j = Effect of feed additives inclusion.

$(S_j)_{ij}$ = Interaction between protein level and feed additives inclusion.

e_{ijkl} = The experimental random error.

RESULTS AND DISCUSSION

Performance traits:

Live Body Weight

The average live body weights of broilers throughout the six weeks experimental period as affected by different dietary additives under two levels of protein are presented in Table (2). It is clearly shown that no significant differ-

ences in body weight could be detected in initial body weight at day one of age. The interaction effect between the different additives and the two levels of protein started to show at two weeks of age with the probiotic and synbiotic treatments under the recommended level of protein having the highest body weights with a 5.1 and 2.6% increase compared to the control treatment under the recommended protein level ($p \leq 0.001$), respectively. Lowest live body weight was observed with the prebiotic treatment under the low level of protein with a reduction of 21.7% compared to the control treatment under the recommended level of protein and 7.5% compared to the control treatment under the low level of protein ($p \leq 0.001$). These effects were sustained to the end of the experimental period. At 6 weeks of age, the highest body weights were observed under the herb, synbiotic and probiotic treatments under the recommended level of protein with 4.9, 4.7 and 4.5% increases compared to the control treatment under the recommended level of protein, respectively ($p \leq 0.05$). At the end of the experiment period, the lowest body weight was observed with the probiotic treatment under the low level of protein with a reduction of 4.49% compared to the control treatment under the recommended level of protein, and 1.4% compared to the control treatment under the low level of protein ($p \leq 0.05$).

Effects of different levels of protein on live body weight regardless of feed additives are presented in Table (2). After only one week of treatment, the effect of low protein level was observed and sustained until the end of the experimental period. Low protein levels significantly reduced live body weight by 5.5, 19.4, 24, 39, 45.8 and 43.6% compared to the recommended protein treatment throughout the 6 weeks experimental period, respectively ($p \leq 0.001$).

Effects of different feed additives on live body weight regardless of protein levels are presented in Table (2). Different feed additives effects

started to show from the second week of age. By the end of the experimental period, different feed additives increased live body weight to reach 103, 102, 105 and 103% of control values with the probiotic, prebiotic, symbiotic, and herb treatments, respectively ($p \leq 0.05$).

(SM Kabir, 2009; Torres-Rodriguez et al., 2007) reported that administration of probiotic to turkeys increased the average daily gain and market body weight, representing an economic alternative to improve turkey production. However, (Aksu, Esenbuga, & Macit, 2006; SM Kabir, 2009) used *Saccharomyces cerevisiae* as a dietary probiotic to assess performance and found no overall weight gain difference. Probiotic is a generic term, and products can contain yeast cells, bacterial cultures, or both that stimulate microorganisms capable of modifying the gastrointestinal environment to favor health status and improve feed efficiency (Dierick, 1989; SM Kabir, 2009). Several studies reported that probiotics have beneficial effects on growth performance (Apata, 2008; Awad, Ghareeb, Abdel-Raheem, & Böhm, 2009; Dizaji, Hejazi, & Zakeri, 2012; SML Kabir, Rahman, Rahman, Rahman, & Ahmed, 2004; Khaksefidi & Ghoorchi, 2006; Kralik, Milaković, & Ivanković, 2004; Mountzouris et al., 2007; Sen et al., 2012; Shim et al., 2010; Solis de los Santos et al., 2005).

Table (2). Effect of protein level and non- antibiotic feed additives and their interaction on body weight at different ages of broilers.

Protein level	Additives	Body weight d 1	Body weight d 7	Body weight d 14	Body weight d 21	Body weight d 28	Body weight d 35	Body weight d 42
Interaction Effect								
Recommended	Control	40.36 ± 0.61	169.36 ± 2.28	438.20 ^b ± 7.47	838.28 ^b ± 8.54	1438.88 ^b ± 14.06	2060.84 ^{ab} ± 36.66	2508.48 ^c ± 59.45
	Probiotic	40.32 ± 0.46	164.28 ± 2.18	460.68 ^a ± 6.77	880.24 ^a ± 12.70	1486.28 ^a ± 17.57	2066.80 ^{ab} ± 34.26	2621.12 ^a ± 28.03
	Prebiotic	40.40 ± 0.38	170.60 ± 2.60	444.84 ^{ab} ± 4.50	815.68 ^b ± 14.79	1411.44 ^b ± 13.13	2005.46 ^b ± 36.89	2556.58 ^b ± 29.22
	Synbiotic	40.32 ± 0.39	169.84 ± 2.37	449.64 ^a ± 8.16	856.28 ^{ab} ± 14.78	1474.80 ^a ± 17.32	2051.72 ^{ab} ± 22.81	2625.96 ^a ± 31.26
	Herb	40.84 ± 0.54	167.44 ± 2.96	443.80 ^{ab} ± 8.19	857.88 ^{ab} ± 12.53	1487.76 ^a ± 16.59	2119.96 ^a ± 38.73	2630.52 ^a ± 40.63
Low	Control	40.72 ± 0.68	158.40 ± 1.29	371.08 ^c ± 6.69	662.32 ^c ± 6.14	924.00 ^c ± 13.40	1169.12 ^c ± 28.36	1445.28 ^{dc} ± 39.96
	Probiotic	40.50 ± 0.57	159.62 ± 1.16	347.62 ^{dc} ± 6.09	648.12 ^{cd} ± 12.2	877.83 ^d ± 14.03	1100.50 ^d ± 24.95	1425.46 ^c ± 63.23
	Prebiotic	40.48 ± 0.40	158.08 ± 1.60	343.32 ^c ± 5.18	641.80 ^{cd} ± 9.79	874.44 ^d ± 15.31	1104.68 ^d ± 26.13	1478.56 ^d ± 31.61
	Synbiotic	39.64 ± 0.52	161.16 ± 1.22	362.68 ^d ± 5.97	654.40 ^{cd} ± 8.70	880.00 ^d ± 17.00	1085.21 ^c ± 16.57	1493.08 ^d ± 34.05
	Herb	40.88 ± 0.52	157.6 ± 5.428	376.88 ^c ± 5.62	620.96 ^d ± 8.06	894.60 ^d ± 20.09	1121.28 ^{cd} ± 33.12	1456.32 ^{dc} ± 46.75
Main Effects of Protein Level								
Protein	Recommended	40.44 ± 0.21	168.30 ^a ± 1.11	447.43 ^a ± 3.21	849.67 ^a ± 5.98	1459.8 ^a ± 7.46	2061.40 ^a ± 15.44	2588.79 ^a ± 17.98
	Low	40.44 ± 0.24	158.98 ^b ± 1.20	360.41 ^b ± 2.86	645.50 ^b ± 4.22	890.27 ^b ± 7.31	1116.54 ^b ± 11.96	1459.75 ^b ± 19.63
Main Effects of Feed Additives								
Additives	Control	40.54 ± 0.45	163.88 ± 1.52	404.64 ^{ab} ± 6.90	750.30 ^{abc} ± 13.60	1181.44 ^a ± 38.01	1614.98 ^a ± 67.70	1976.88 ^b ± 83.81
	Probiotic	40.40 ± 0.36	162.01 ± 1.28	405.30 ^{ab} ± 9.32	766.55 ^a ± 18.89	1188.27 ^a ± 45.30	1593.51 ^{ab} ± 72.84	2035.49 ^{ab} ± 92.63
	Prebiotic	40.44 ± 0.27	164.34 ± 1.76	394.08 ^b ± 8.00	728.74 ^c ± 15.21	1142.94 ^b ± 39.63	1545.88 ^b ± 68.68	2006.57 ^{ab} ± 80.65
	Synbiotic	39.98 ± 0.32	165.50 ± 1.45	406.16 ^{ab} ± 7.97	755.34 ^{ab} ± 16.73	1177.40 ^a ± 44.15	1578.33 ^{ab} ± 71.13	2071.08 ^a ± 84.87
	Herb	40.86 ± 0.37	162.56 ± 3.13	410.34 ^a ± 6.85	739.42 ^{bc} ± 18.46	1191.18 ^a ± 44.28	1620.62 ^a ± 75.66	2043.42 ^{ab} ± 89.29
ANOVA								
S. O. V								
Pr × Add		NS	NS	***	*	*	*	*
Protein (Pr)		NS	***	***	***	***	***	***
Additives (Add)		NS	NS	*	*	*	*	*

a,b,c,... Means with different superscripts in certain column for each effect at certain age are significantly different (P ≤ 0.05)

NS= Non- significant. (* P ≤ 0.05) (** P ≤ 0.01) (***) P ≤ 0.001).

Live Body Weight Gain

The body weight gain of broilers throughout the six weeks experimental period as affected by different dietary additives under two levels of protein are presented in Table (3). There were no significant differences in body weight gain from day one till the first week of age. During the second week of age, the highest body weight gain was observed with the probiotic treatment under the recommended level of protein with an increase of 10.3% compared to the control treatment under the same level of protein ($p \leq 0.01$). Lowest body weight gain at the same age was observed with the prebiotic treatment under the low level of protein with a decrease of 31.1% compared to the control treatment under the recommended level of protein, and 12.9% compared to the control treatment under the low level of protein ($p \leq 0.01$). At 6 weeks of age, the highest body weight gain was observed under the synbiotic treatment under the recommended level of protein with 4.9% increase compared to the control treatment under the same level of protein, ($p \leq 0.05$). At the end of the experiment period, the lowest body weight gain was observed with the control treatment under the low level of protein with a reduction of 43% compared to the control treatment under the recommended level of protein ($p \leq 0.05$). Overall the whole experimental period, the highest body weight gain was observed with the herb treatment under the recommended level of protein, and the lowest with the probiotic treatment under the low level of protein ($p \leq 0.05$).

Effects of different levels of protein on body weight gain regardless of feed additives are presented in Table (3). After only one week of treatment, the effect of low protein level was observed and sustained to the end of the experimental period. Low protein level significantly reduced body weight gain to reach 93, 72.6, 70.5, 40, 37.7 and 69.2% of the recommended protein treatment values throughout the 6 weeks experimental period, respectively ($p \leq 0.001$). Over all the experimental period,

the gain under the low level of protein was lower than the gain obtained with the recommended level of protein by 44% ($p \leq 0.001$).

Effects of different feed additives on body weight gain regardless of protein levels are presented in Table (3). Different feed additives did not show significant effects except at the end of experimental period. By 6 weeks of age, different feed additives increased body weight gain to reach 137, 127.5, 135.6 and 117% of control with the probiotic, prebiotic, symbiotic, and herb treatments, respectively ($p \leq 0.001$). Over the whole experimental period, the highest gain was obtained with the synbiotic treatment ($p \leq 0.01$).

Table (3). Effect of protein level and non- antibiotic feed additives and their interaction on body weight gain at different ages of broiler

Protein	Additives	Body weight gain d 1-7	Body weight gain d 7-14	Body weight gain d 14-21	Body weight gain d 21-28	Body weight gain d 28-35	Bodyweight gain d 35-42	Body weight gain Over All
Interaction Effect								
Recommended	Control	129.0 ± 2.22	268.84 ^{ab} ± 7.65	400.08 ^b ± 9.18	600.60 ^b ± 16.55	621.96 ^a ± 33.96	446.48 ^c ± 35.55	2468.12 ^c ± 59.60
	Probiotic	123.96 ± 2.40	296.40 ^a ± 7.13	419.56 ^a ± 11.49	606.04 ^b ± 24.08	580.52 ^b ± 32.03	554.32 ^{ab} ± 27.74	2580.80 ^{ab} ± 28.14
	Prebiotic	130.20 ± 2.64	274.24 ^{ab} ± 4.98	370.84 ^c ± 16.76	595.76 ^b ± 17.11	588.66 ^b ± 33.11	551.12 ^{ab} ± 34.15	2516.21 ^b ± 29.09
	Synbiotic	129.52 ± 2.20	279.80 ^{ab} ± 7.19	406.96 ^b ± 14.63	618.20 ^a ± 16.78	576.92 ^b ± 26.03	568.92 ^a ± 32.80	2585.64 ^{ab} ± 31.32
Low	Herb	126.60 ± 2.76	276.36 ^{ab} ± 8.07	414.08 ^a ± 14.18	629.88 ^a ± 19.81	632.16 ^a ± 41.84	510.56 ^b ± 23.62	2589.68 ^a ± 41.02
	Control	117.68 ± 1.42	212.68 ^c ± 6.74	291.24 ^d ± 10.70	261.68 ^c ± 13.69	245.12 ^c ± 20.38	276.16 ^g ± 29.40	1404.56 ^c ± 40.10
	Probiotic	121.70 ± 2.25	193.58 ^d ± 7.82	293.16 ^d ± 14.86	228.45 ^d ± 14.63	218.70 ^d ± 20.28	434.87 ^c ± 46.03	1389.01 ^f ± 59.82
	Prebiotic	117.60 ± 1.51	185.24 ^d ± 4.96	298.48 ^d ± 12.56	232.64 ^d ± 17.17	230.24 ^{cd} ± 16.06	373.88 ^e ± 23.17	1438.08 ^{cd} ± 31.62
	Synbiotic	121.52 ± 1.30	201.52 ^d ± 6.08	291.72 ^d ± 11.77	225.60 ^d ± 14.75	208.58 ^e ± 12.76	407.87 ^d ± 28.10	1453.50 ^d ± 33.89
	Herb	116.80 ± 5.47	219.20 ^c ± 6.02	244.08 ^e ± 10.83	273.64 ^c ± 21.66	226.68 ^d ± 17.32	335.04 ^f ± 20.33	1415.44 ^{cd} ± 46.85
Main Effects of Protein Level								
Protein	Recommended	127.85 ^a ± 1.10	279.12 ^a ± 3.22	402.30 ^a ± 6.13	610.09 ^a ± 8.47	600.13 ^a ± 15.0	526.08 ^a ± 14.23	2548.35 ^a ± 18.03
	Low	119.04 ^b ± 1.27	202.51 ^b ± 3.01	283.66 ^b ± 5.66	244.53 ^b ± 7.54	226.06 ^b ± 7.82	364.65 ^b ± 14.32	1420.10 ^b ± 19.24
Main Effects of Feed Additives								
Additives	Control	123.34 ± 1.53	240.76 ± 6.44	345.66 ± 10.44	431.14 ± 26.44	433.54 ± 33.29	361.32 ^c ± 25.87	1936.34 ^b ± 83.87
	Probiotic	122.85 ± 1.63	246.04 ± 9.07	357.65 ± 12.99	421.10 ± 30.66	403.30 ± 32.24	495.81 ^a ± 27.71	1997.06 ^{ab} ± 91.85
	Prebiotic	123.90 ± 1.75	229.74 ± 7.24	334.66 ± 11.58	414.20 ± 28.57	405.79 ± 31.49	460.69 ^{ab} ± 23.96	1966.14 ^{ab} ± 80.65
	Synbiotic	125.52 ± 1.39	240.66 ± 7.27	349.34 ± 12.41	421.90 ± 30.14	396.51 ± 30.28	490.04 ^a ± 24.39	2031.12 ^a ± 84.81
	Herb	121.70 ± 3.11	247.78 ± 6.44	329.08 ± 15.01	451.76 ± 29.30	429.42 ± 36.62	422.80 ^b ± 19.87	2002.56 ^{ab} ± 89.35
ANOVA								
S. O. V								
Pr × Add		NS	**	**	*	*	*	*
Protein (Pr)		***	***	***	***	***	***	***
Additives (Add)		NS	NS	NS	NS	NS	***	*

Feed Intake

The feed intake of broilers throughout the six weeks experimental period as affected by different dietary additives under two levels of protein are presented in Table (4). Effects of different additives under the two levels of protein fluctuated throughout the experimental period with the control group under the recommended protein level consuming highest amounts of food. By the end of the experimental period, the lowest feed was consumed by the herb treated group under the low level of protein representing 46% of feed consumed by the control group under the recommended level of protein, and 71% of feed consumed by the control group under the low level of protein ($p \leq 0.001$). Over all the experimental period, the highest amount of food was consumed by the control treatment under the recommended level of protein and the lowest by the probiotic treatment under the low level of protein ($p \leq 0.001$).

Effects of different levels of protein on feed intake regardless of feed additives are presented in Table (4). After only one week of treatment, the effect of low protein level was observed and sustained to the end of the experimental period. Low protein level significantly reduced feed intake to reach 83, 86, 87, 74, 58 and 58% of the recommended protein treatment values throughout the 6 weeks experimental period, respectively ($p \leq 0.001$). Over the whole experimental period, the low protein groups consumed 68% of the feed consumed by the recommended protein groups ($p \leq 0.001$).

Effects of different feed additives on feed intake regardless of protein levels are presented in Table (4). At the end of the experimental grower period (35-42 d), different feed additives of probiotic, prebiotic, symbiotic or herbs reduced the amount of feed intake to reach 94, 85, 85 and 85% of that of the control group, respectively. Over all the experimental period, the highest amount of feed was consumed by

the control group and the lowest was by the probiotic groups.

The improvement in growth performance and feed efficiency of broiler chickens fed diet supplemented with different strains of probiotics (Awad et al., 2009; Awad, Ghareeb, & Böhm, 2010; SML Kabir et al., 2004; Mountzouris et al., 2007; Sen et al., 2012) are supposed to be induced by the cumulative effect of probiotic action including the improvement of feed intake and digestion (Shim et al., 2010), increased digestive enzyme activity and decreased ammonia production (Jin, Ho, Abdullah, & Jalaludin, 2000; Sen et al., 2012), maintenance of beneficial microbial population (Fuller, 1989), and alteration of bacterial metabolism (Jin et al., 2000; Sen et al., 2012).

Table (4). Effect of protein level and non- antibiotic feed additives and their interaction on Feed intake of broiler at different ages of broiler

protein	Additives	Feed intake (g) d 1-7	Feed intake (g) d 7-14	Feed intake (g) d 14-21	Feed intake (g) d 21-28	Feed intake (g) d 28-35	Feed intake (g) d 35-42	Feed intake (g) 1- 42d
Interaction Effect								
Recommended	Control	173 ^a	284	497 ^a	807 ^a	961 ^a	1072 ^a	3794.06 ^a
	Probiotic	170 ^a	270	466 ^{ab}	724 ^{bc}	857 ^b	1008 ^b	3494.08 ^c
	Prebiotic	174 ^a	271	471 ^{ab}	764 ^b	841 ^b	969 ^c	3472.40 ^c
	Synbiotic	172 ^a	268	468 ^{ab}	730 ^{bc}	869 ^b	967 ^c	3474.25 ^c
	Herb	160 ^b	264	459 ^{ab}	822 ^a	910 ^{ab}	1028 ^b	3644.11 ^b
Low	Control	142 ^{cd}	245	449 ^b	597 ^c	609 ^c	698 ^d	2740.10 ^d
	Probiotic	158. ^b	237	410 ^c	539 ^d	482 ^d	646 ^c	2280.90 ^g
	Prebiotic	149 ^c	232	406 ^c	576 ^{cd}	504 ^d	543 ^f	2408.25 ^c
	Synbiotic	129 ^d	228	399 ^c	537 ^d	493 ^d	545 ^f	2330.10 ^f
	Herb	128 ^d	224	390 ^c	591 ^c	487 ^d	493 ^f	2313.25 ^f
SEM		1.7	0.8	1.6	2.7	3.8	6.4	8.7
Main Effects of Protein Level								
Protein	Recommended	170 ^a	271 ^a	472 ^a	769 ^a	887 ^a	1009 ^a	3575.68 ^a
	Low	141 ^b	233 ^b	410 ^b	568 ^b	515 ^b	584 ^b	2415.46 ^b
SEM		0.82	1.07	1.64	2.94	4.11	9.71	18.06
Main Effects of Feed Additives								
Additives	Control	157.500 ^c	264.500 ^a	473.000 ^a	702.000 ^b	785.000 ^a	885.000 ^a	3267.03 ^a
	Probiotic	164.183 ^a	253.959 ^b	438.448 ^b	633.571 ^d	673.734 ^d	830.877 ^b	2899.83 ^c
	Prebiotic	161.500 ^b	251.500 ^{cb}	438.500 ^b	670.000 ^c	672.500 ^d	751.653 ^c	2940.20 ^{cb}
	Synbiotic	150.500 ^d	248.000 ^{cd}	433.500 ^c	633.500 ^d	681.000 ^c	756.000 ^c	2902.05 ^c
	Herb	144.000 ^c	244.000 ^d	424.500 ^d	706.500 ^a	698.500 ^b	760.500 ^c	2978.50 ^b
SEM		2.21	3.11	4.56	14.41	26.67	34.13	85.69
ANOVA								
S. O. V								
Pr × Add		***	NS	***	***	***	***	***
Protein (Pr)		***	***	***	***	***	***	***
Additives (Add)		***	***	***	***	***	***	***

a,b,c,.. Means with different superscripts in certain column for each effect at certain age are significantly different ($P \leq 0.05$)

NS= Non- significant. (* $P \leq 0.05$) (** $P \leq 0.01$) (*** $P \leq 0.001$).

4. Feed conversion ratio

The feed conversion ratio of broilers throughout the six weeks experimental period as affected by different dietary additives under two levels of protein are presented in Table (5). By the end of the experiment period, synbiotic treatment showed the best feed conversion ratio under both protein levels ($p \leq 0.05$), whereas the worst was attributed to the low protein control treatment followed by the normal protein control treatment. It was noticed that different treatment improving effect was more profound under the low protein diet compared to their effect under the recommended protein diet. Feed conversion ratio under the recommended protein level improved by 28, 26, 30 and 21% and by 49, 48, 53, and 47% under the low protein diet with the probiotic, prebiotic, synbiotic and herb treatments, respectively. This comes in good agreement with previous findings, in general, these additives have proved to be most effective under conditions of stress, possibly the presence of unfavorable organisms, extremes in ambient temperature, diseases, crowding and poor management (Midilli et al., 2008) or in this case low protein diet. Over the whole experimental period, the worst feed conversion ratio was attributed to the low protein control and the best to the synbiotic treatment under the recommended protein level although without a significance.

Effects of different levels of protein on feed conversion ratio regardless of feed additives are presented in Table (5). During the six weeks experimental period, low protein groups had the worst feed conversion ratio compared to the recommended protein groups except for those at periods. Over the whole experimental period for groups fed on low protein diets, their feed conversion ratio was worse by 23% compared to those fed on recommended protein levels ($p \leq 0.001$).

Effects of different feed additives on feed conversion ratio regardless of protein levels are presented in Table (5). By 6 weeks of age, dif-

ferent feed additives improved feed conversion ratio by 39, 38, 42 and 35% compared to control with the probiotic, prebiotic, synbiotic and herb treatments, respectively ($p \leq 0.001$). Over all the experimental period, the synbiotic groups had the best feed conversion ratio.

As a feed additive, probiotics has a good impact on the poultry performance (Stavric and Kornegay, 1995; Rowghani, Arab, & Akbarian, 2007). Mechanisms by which probiotics improve feed conversion efficiency include alteration in intestinal flora, enhancement of growth of nonpathogenic facultative anaerobic and gram-positive bacteria forming lactic acid and hydrogen peroxide, suppression of growth of intestinal pathogens, and enhancement of digestion and utilization of nutrients (SM Kabir, 2009). Therefore, the major outcomes from using probiotics include improvement in growth, reduction in mortality (SM Kabir, 2009; Kumprecht & Zobac, 1998), and improvement in feed conversion efficiency, which are consistent with the findings of Tortuero and Fernandez (Tortuero & Fernandez, 1995) who observed an improvement in feed conversion efficiency as supplemented diet with probiotic with the supplementation of probiotic to the diet (SM Kabir, 2009).

Table (5). Effect of protein level and non- antibiotic feed additives and their interaction on Feed conversion ratio at different ages.

protein	Additives	Feed conversion (g) d 1-7	Feed conversion (g) d 7-14	Feed conversion (g) d 14-21	Feed conversion (g) d 21-28	Feed conversion (g) d 28-35	Feed conversion (g) d 35-42	Feed conversion (g) Over All					
		Interaction Effect											
Recommended	Control	1.34 ± 0.02	1.08 ± 0.03	1.25 ^{cd} ± 0.02	1.36 ^c ± 0.03	1.68 ^c ± 0.11	2.70 ^b ± 0.19	1.55 ± 0.03					
	Probiotic	1.38 ± 0.02	0.92 ± 0.02	1.13 ^c ± 0.03	1.25 ^c ± 0.07	1.77 ^c ± 0.28	1.92 ^d ± 0.09	1.35 ± 0.01					
	Prebiotic	1.35 ± 0.02	0.99 ± 0.01	1.34 ^c ± 0.07	1.30 ^c ± 0.03	1.52 ^d ± 0.08	1.99 ^{cd} ± 0.18	1.39 ± 0.01					
	Synbiotic	1.33 ± 0.02	0.97 ± 0.02	1.20 ^d ± 0.06	1.20 ^c ± 0.03	1.59 ^d ± 0.08	1.90 ^d ± 0.17	1.34 ± 0.01					
	Herb	1.28 ± 0.02	0.97 ± 0.03	1.13 ^c ± 0.03	1.33 ^c ± 0.04	1.67 ^c ± 0.16	2.13 ^c ± 0.11	1.41 ± 0.02					
Low	Control	1.20 ± 0.01	1.18 ± 0.04	1.59 ^a ± 0.06	2.41 ^b ± 0.11	3.05 ^a ± 0.32	3.13 ^a ± 0.26	1.98 ± 0.03					
	Probiotic	1.29 ± 0.01	1.25 ± 0.04	1.55 ^{ab} ± 0.15	2.62 ^{ab} ± 0.19	2.56 ^b ± 0.22	1.59 ^e ± 0.10	1.67 ± 0.03					
	Prebiotic	1.27 ± 0.01	1.27 ± 0.03	1.42 ^b ± 0.06	2.88 ^a ± 0.26	2.47 ^b ± 0.18	1.60 ^e ± 0.10	1.69 ± 0.03					
	Synbiotic	1.06 ± 0.01	1.15 ± 0.03	1.41 ^b ± 0.05	2.62 ^{ab} ± 0.16	2.60 ^b ± 0.18	1.47 ^c ± 0.09	1.62 ± 0.03					
	Herb	1.14 ± 0.04	1.04 ± 0.02	1.69 ^a ± 0.09	2.49 ^b ± 0.19	2.47 ^b ± 0.20	1.63 ^c ± 0.12	1.67 ± 0.04					
		Main Effects of Protein Level											
Protein	Recommended	1.33 ^a ± 0.01	0.99 ^b ± 0.01	1.21 ^b ± 0.02	1.29 ^b ± 0.02	1.65 ^b ± 0.07	2.13 ^a ± 0.07	1.41 ^b ± 0.01					
	Low	1.19 ^b ± 0.01	1.18 ^a ± 0.01	1.53 ^a ± 0.04	2.60 ^a ± 0.08	2.63 ^a ± 0.10	1.89 ^b ± 0.08	1.73 ^a ± 0.02					
		Main Effects of Feed Additives											
Additives	Control	1.27 ^b ± 0.01	1.13 ^{ab} ± 0.02	1.42 ± 0.04	1.89 ± 0.09	2.37 ± 0.19	2.91 ^a ± 0.16	1.77 ^a ± 0.04					
	Probiotic	1.34 ^a ± 0.01	1.08 ^{ab} ± 0.03	1.33 ± 0.08	1.92 ± 0.14	2.16 ± 0.18	1.76 ^b ± 0.07	1.51 ^b ± 0.02					
	Prebiotic	1.31 ^{ab} ± 0.01	1.13 ^a ± 0.02	1.38 ± 0.04	2.09 ± 0.17	2.00 ± 0.12	1.79 ^b ± 0.10	1.54 ^b ± 0.02					
	Synbiotic	1.20 ^c ± 0.02	1.06 ^{bc} ± 0.02	1.30 ± 0.04	1.91 ± 0.13	2.09 ± 0.12	1.69 ^b ± 0.10	1.48 ^b ± 0.02					
	Herb	1.21 ^c ± 0.02	1.00 ^c ± 0.02	1.41 ± 0.06	1.91 ± 0.12	2.07 ± 0.14	1.88 ^b ± 0.08	1.54 ^b ± 0.03					
		ANOVA											
S. O. V													
Pr × Add		NS	NS	*	*	*	*	NS					
Protein (Pr)		***	***	***	***	***	*	***					
Additives (Add)		***	***	NS	NS	NS	***	***					

a,b,c,... Means with different superscripts in certain column for each effect at certain age are significantly different (P ≤ 0.05)
 NS= Non- significant. (* P ≤ 0.05) (** P ≤ 0.01) (***) P ≤ 0.001.)

CONCLUSION

There is a worldwide attempt to reduce antibiotic use in animal production as it cause an increase in microbial resistance to antibiotics, and also residues in animal products can be harmful to consumers (Jin, Ho, Abdullah, & Jalaludin, 1998; Wang & Gu, 2010). Therefore, the need for alternative techniques for poultry production is increasing and the contribution of probiotics may be considerable (Patterson & Burkholder, 2003; Wang & Gu, 2010).

Based on the gained results, it can be concluded that the addition of synbiotic in broilers chicken diet has a significant influence on productive performance and the final body weight. It could be concluded, under conditions of the current study, that synbiotic showed significant effects on the performance of broiler chickens. Further research is still in need to verify current results.

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تأثير البروبيوتيك، البريبايوتيك، السانبيوتيك والأعشاب الطبية على الأداء الإنتاجي لدجاج اللحم المتغذي على نسب مختلفة من البروتين

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المستخلص: الهدف من هذه الدراسة كان لمعرفة مدى تأثير منشطات النمو الطبيعية، بروبيوتيك (BioPlus 2B)، بريبيوتيك (TechnoMos)، سانبيوتيك ومخلوط الأعشاب الطبيعية (مكونة من الشمر والبردقوش والكرابوية بنسب خلط (1:1:1) مع مستويين مختلفين من البروتين (مثالي ومنخفض) على الأداء الإنتاجي لدجاج اللحم. أجريت هذه الدراسة بمركز بحوث الدواجن - كلية الزراعة-جامعة الإسكندرية - مصر. استمرت التجربة لمدة 42 يوماً. تم توزيع عدد 500 كتكوت لحم عمر يوم من سلالة كوب ووزعت الطيور عشوائياً على 10 مجاميع تجريبية بكل مجموعة خمس مكررات وبكل مكررة 10 كتاكيت. تم تجهيز عشرة تركيبات علفية (بادي ونامي) لتغطية جميع متطلبات المواد الغذائية لكتاكيت اللحم خلال مرحلتي النمو البادي (1 - 21) يوماً والنامي (22 - 42) يوماً من العمر. تتألف التركيبات العلفية من مستويين من البروتين الخام الموصي به والمنخفض (85% من الموصي به) وخمسة إضافات غذائية هي البروباوتيك، البريبايوتيك، السنبيوتيك، مخلوط الأعشاب الطبية تم إضافتها للعليقة الكونترول لتشكيل العلائق المختلفة. بشكل عام أدى انخفاض مستويات البروتين الخام لدجاج اللحم (-10% من NRC) إلى انخفاض أداء النمو، والذي تم تعويضه جزئياً بمنشطات النمو الطبيعية ومن بين الإضافات، كان لـ synbiotic تأثيرات مهمة بشكل إيجابي على الوزن الحي ومعامل التحويل الغذائي.

الكلمات المفتاحية: بروبيوتيك، بريبيوتيك، سانبيوتيك، الأعشاب الطبية، الأداء الإنتاجي، دجاج اللحم، البروتين.

Prevalence of Urinary Tract Infection in Children Admitted to Benghazi Children's Hospital



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Abstract: Urinary Tract Infections (UTIs) are predictable bacterial infections which occur frequently especially during infancy. The aim of the present study was to evaluate the etiology and antimicrobial resistance patterns among infants and children who approached our hospital for the treatment of UTIs. In this observational study which was carried out from January 2009 to December 2010. Two hundred and six (206) urine samples, which were collected from children admitted to Benghazi Children's Hospital (Nephrology department) with suspected UTIs, were studied. Demographic characteristics, etiological agents, and antimicrobial resistance were evaluated. 58 patients (28.2%) had a positive urine culture, and the majority of UTIs were occurring in females. The most common presenting symptoms were fever, dysuria, and abdominal pain. The most common isolated pathogen was *Escherichia coli* (67.2%), followed by *Klebsiella pneumonia* (20.7%), *Pseudomonas aeruginosa* (3.4%), *Proteus mirabilis* (3.4%), *Klebsiella oxytoca* (1.7%), *Enterobacter casseliflavus* (1.7%) and *Enterobacter cloacae* (1.7%). In the current study, most of the infected cases were females, and fever was the most common presenting symptom. All isolated bacteria were highly sensitive to Meropenem (98.1%), Imipenem (96.3%), Amikacin (96.2%), Cefoxitin (81.1%), and Ciproflaxacin (80%), and had a high resistance rate to Ampecillin (89.1%) and Cephalothin (60.4%). This phenomena may be contributed to the frequent useage and miss-use of antibiotics without medical prescription.

Keywords: Urinary tract infection, urine culture, Antibiotic susceptibility

INTRODUCTION

Urinary tract infection (UTI) is defined by the presence of multiplying organisms in the urinary tract, which is usually sterile (Svanborg & Godaly, 1997). UTI is a term applied to a variety of clinical conditions ranging from asymptomatic presence of bacteria in the urine to severe infection of the kidney with resultant sepsis (Tanagho, 2008). UTI may be caused by any pathogen that colonizes the urinary tract (eg, Bacteria, Fungi, Parasites, and Viruses). UTI of bacterial infection affects any part of the urinary tract (Alinea & Mantaring III,

2002). Its clinical spectrum ranges from asymptomatic to severe infection inflammatory markers due to a colonization of the urinary tract like bacteriuria, pyuria, or an infection of the upper urinary tract consisting of the kidney and its pelvis, which is known as pyelonephritis. Infection of the lower tract may involve the bladder (cystitis), urethra (urethritis), or prostate (prostatitis), the genital organ that surrounds and communicates with the first segment of the male urethra, because all portions of the urinary tract are joined by a fluid medium. Infection at any site may spread to involve other areas of the system (Elder, 2004 ;Ryan,

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K.J. 2004). Clinical symptoms of UTI usually include frequent dysuria, abdominal pain, back pain, fever, and urgency. Repeated infections may even cause complications leading to renal scarring, it may also signify an underlying anatomic abnormality (Zorc, Kiddoo, & Shaw, 2005). Follow-up urine cultures may be needed to definitively diagnose a UTI (Svanborg & Godaly, 1997). The current study concern is about UTI caused by bacteria, which is considered the most common bacterial infections among children and the most frequent cause of hospital admissions and outpatient consultations in pediatric practice (Alinea & Mantaring III, 2002; Elder, 2004). Presence of more than 100,000 cfu/ml after doing a urine culture, a patient is considered suffering from UTI regardless of symptoms, or as the growth of a known bacterial pathogen more than 10,000 cfu/ml in association with a positive dipstick or urinalysis (Zorc, Levine, et al., 2005). Common bacterial pathogens include gram-negative species such as *Escherichia coli*, *Klebsiella*, *Proteus*, and gram-positive organisms, including group B *streptococci*, *Enterococcus spp.*, and *Staphylococcus aureus*. The objective of our study was to investigate the most common bacteria, antibiotics susceptibility, resistance patterns, and generate a basis for the empiric antibiotic treatment of childhood UTI in our region.

MATERIALS AND METHODS

In this study, data are belonging to the urinary culture of 206 consecutive children with the diagnosis of UTI. Patients were selected among children who admitted to the Department of Nephrology in Benghazi Children Hospital, Libya (the main big referral Pediatric hospital in the Estrean part of Libya , about 350 beds capacity). The time frame for the current estimates was from January 2009 to December 2010 and age for the studied cases was between four days (4 days) to fifteen years (15 years). Their files were reviewed retrospectively. Data about, gender, age, symptoms, urinalysis, urine culture results were included.

Before any antimicrobial agent is given, urine sampling must be performed. Approximately 50 ml urine samples which were taken from urine bag, by suprapubic aspiration of urine, or mid-stream urine after standard cleaning of the genital area were sent to the laboratory within thirty minutes (Kayaş, Yolbaş, Ece, Kayaş, & Kocamaz, 2011). Dipsticks and microscopes are commonly used for urinalysis. Most dipsticks test for nitrite, leukocyte esterase, and using Multisticks of Medi-Test combi 10[®]SGL. A dipstick test that is positive for leukocyte esterase and nitrite is highly sensitive for UTI (Roberts, 2011; Whiting et al., 2006). A test that is negative for leukocyte esterase and nitrite ruled out UTI (Whiting, P.; Westwood, M.; Bojke, L.; et al. 2006). Then; 15 ml urine samples after 3000 rpm of a centrifuge in the centrifuge tube for 5 minutes were investigated. A drop of the sample from the sediment of dipped part of the tube for bacteria, leukocyte, and epithelial cells was examined using a microscope under a high power field (Kayaş et al., 2011). The presence of more than 5 WBCs/HPF indicates pyuria. Microscopy is used to detect pyuria and bacteriuria. Bacteriuria alone has a higher sensitivity than pyuria alone, although if both are positive, there is a high likelihood of having UTI (Whiting et al., 2006).

The classical definition of UTI was the presence of more than 10⁵ colony-forming unit (CFUs) /ml and the presence of any CFU/ml of the organism isolated from a suprapubic bladder aspiration. While Less than 10⁴ (CFUs) /ml is not significant, 10⁴–10⁵(CFUs) /ml is a doubtful significance (Cheesbrough, 2006). In addition, the presence of two or more types of microorganism or the presence of bacteria less than 10³/ml was accepted as contamination (Kayaş et al., 2011).

Statistical Analysis: Data were expressed in Percentage. A frequency table (Crosstabs procedure) is used to create contingency tables, which describe the interaction between two categorical variables.

RESULTS

A total of 206 files were reviewed, 129 (62.6%) of the cases were females and 77 (37.4%) were males. The urine culture in this study showed, no growth culture result was observed in 91(44.2%) of urine samples of the patients, 28.2% (58 of 206 patients) showed positive urine culture. However, contaminated growth observed in nine patient urine samples (4.4%), while non significant growth result were only 2.4% (5 of 206 patients), and not done urine culture 20.9% (43 of 206 patients). (Table 1) Total female cases included in this study (129 of 206 total children) 34.9% (45 of 129 females) showed a positive urine culture, 38.8% (50 of 129 females) had a negative urine culture, 19.4% (25 of 129 females) urine culture not done, 3.9%(5 of 129 females) had contaminated

urine culture and 3.1% (4 of 129 females) urine culture showed non significant growth. While, 16.9% (13 of 77 males) had a positive urine culture, 53.2% (41 of 77 males) had a negative urine culture, 23.4% (18 of 77 males) urine culture not done, 5.2% (4 of 77 males) had contaminated urine culture and 1.3% (1 of 77 males) had non significant growth of urine culture (Table 2).

Table (1): Distribution of patients according to urine culture result

Urine culture	No.	(%)
Contaminated	9	(4.4%)
Negative	91	(44.2%)
Not done	43	(20.9%)
Non significant growth	5	(2.4%)
Positive	58	(28.2%)
Total	206	(100%)

Table (2): Distribution of patients according to gender and urine culture results

Gender	Urine culture					Total
	Contaminated	Negative	Not done	Non significant growth	Positive	
Male	4 5.2%	41 53.2%	18 23.4%	1 1.3%	13 16.9%	77 100.0%
Female	5 3.9%	50 38.8%	25 19.4%	4 3.1%	45 34.9%	129 100.0%
Total	9 4.4%	91 44.2%	43 20.9%	5 2.4%	58 28.2%	206 100.0%

According to age groups the results showed that in group 1 (<1 year), positive urine culture was 41.0% (16 of 39 patients), this rate was similar with negative urine culture, and 12.8%(5 of 39) culture not done ,5.1% (2 of 39 contaminated culture result, non significant growth not detected in this age group. In group 2 (2-4 years) result showed negative urine culture 46% (23 of 50 patients),24% (12 of 50 patients) urine culture not done, non significant growth 6% (3 of 50 patients) and contaminated growth 2% (1 of 50 patients). Third group (5-7years): Negative urine culture 37% (17 of 46 patients), not done urine culture 21.7% (10 of 46 patients), non significant growth 0% (0 of 46 patients) and contaminated growth 8.7% (4 of 46patients).

Whereas, the results showed that the age range from group 4 (8-10 years) showed negative urine culture in 44.7% (17 of 38 patients), not done urine culture 23.7% (9 of 38 patients), non significant growth 2.6% (1 of 38 patients) and no contaminated growth was detected, Fifth group(≥ 11years): Negative urine culture 54.5% (18 of 33 patients), not done urine culture 21.2% (7 of 33 patients), non significant growth 3.0% (1 of 33 patients) and contaminated growth 6.1% (2 of 33 patients). (Table 3).

Table (3): Distribution of patients according to age and urine culture results

Age/year	Urine culture					Total
	Contaminated	Negative	Not done	Non significant growth	Positive	
≤1	2 5.1%	16 41.0%	5 12.8%	0 0%	16 41.0%	39 100.0%
2-4	1 2.0%	23 46.0%	12 24.0%	3 6.0%	11 22.0%	50 100.0%
5-7	4 8.7%	17 37.0%	10 21.7%	0 0%	15 32.6%	46 100.0%
8-10	0 .0%	17 44.7%	9 23.7%	1 2.6%	11 28.9%	38 100.0%
≥11	2 6.1%	18 54.5%	7 21.2%	1 3.0%	5 15.2%	33 100.0%
Total	9 4.4%	91 44.2%	43 20.9%	5 2.4%	58 28.2%	206 100.0%

Results showed that the most common clinical finding was fever 57.8% (119 of 206 patients), while the lowest clinical manifestation was urgency 5.3% (11 of 206 patients), followed by frequency 11.7% (24 of 206 patients), loin pain 18% (37 of 206 patients), changing color of urine 29.1% (60 of 206 patients), abdominal pain 31.1% (64 of 206 patients), vomiting 33.5% (69 of 206 patients) and dysuria 47.1% (97 of 206 patients) (Table 4).

Table (4): Distribution of patients according to the clinical manifestations with Urinary Tract Infection

Symptoms	Yes		No.		Total
	No.	%	No.	%	
Fever	119	57.8	87	42.2	
Dysuria	97	47.1	109	52.9	
Urgency	11	5.3	195	94.7	
Frequency	24	11.7	182	88.3	
Loin pain	37	18	169	82	
Change Color of Urine	60	29.1	146	70.9	
Abd. Pain	64	31.1	142	68.9	
Vomiting	69	33.5	137	66.5	
Total					206(100%)

This study showed that WBCs in urine more than 5 cells/hpf reached 86.2% (50 of 58 patients), and WBCs in urine less than 5 cells/hpf reached 1.7% (1 of 58 patients), while 12.1% of the cases (7 of 58 patients) WBCs were not checked in the urine before cultured (Table 5).

Table (5): Distribution of patients according to positive urine culture and WBCs in urine

WBC	Yes		No		Total	
	No.	%	No.	%	No.	%
<5/hpf	1	1.7%	76	51.4%	77	37.4%
>5/hpf	50	86.2%	44	29.7%	94	45.6%
Not done	7	12.1%	28	18.9%	35	17.0%
Total	58	100.0%	148	100.0%	206	100.0%

Current study showed that the most causative agent of UTI was *E.coli* with 39 isolates (97.2%) from all bacteria isolated, followed by *Klebsiella pneumonia*, 12 isolates (20.7%), *Pseudomonas aeruginosa*, 2 isolates (3.4%), and *Proteus mirabilis*, 2 isolates (3.4%). The lowest causative agents of UTI was for *Enterococcus casseliflavus*, *Enterobacter cloacae*, and *Klebsiella oxytoca* with only 1 isolate each (1.7%), (Table 6).

Table (6): Distribution of patients according to the type of bacteria isolated from urine.

Type of Bacteria	No.	%
<i>E.coli</i>	39	67.2%
<i>Enterobacter cloacae</i>	1	1.7%
<i>E.casseliflavus</i>	1	1.7%
<i>klebsiellaoxytoca</i>	1	1.7%
<i>Klebsiella pneumonia</i>	12	20.7%
<i>P. aeruginosa</i>	2	3.4%
<i>Proteus mirabilis</i>	2	3.4%
Total	58	100.0%

Table 7, showed the sensitivity pattern of bacteria isolated from patients in UTI to different antibiotics used in children hospital-Benghazi. The antibacterial effect of antibiotics showed the highest activity against most bacteria isolated in this study was Meropenem reach to (98.1%), followed by Imipenem (96.3%), Amikacin (96.2%).Cefoxitin (81.1%). Some antibiotics had similar effect like Gentamicin, Nitrofurantoin

and Ciprofloxacin showed (80%). Cefepime (71.7%). Aztreonam (71.2%), Piperacillin, Tazobactam (69.2%). Cefotaxime, Cefuroxime showed(66.7%),Trimethoprim/Sulfamethoxazole (50%), Amoxicillin/Clavulanate (35.7%), lowest antibacterial effect showed by Cephalothin (15.1%) followed by Ampicillin (10.9%) only. Table7.

Table (7): Distribution of the patients according to susceptibility of antibiotics

Susceptibility of antibiotics	Sensitive		Resistance		Intermediate		Total	
	.No	%	.No	%	.No	%	.No	%
Amikacin	51	96.2	1	1.9	1	1.9	53	100
Gentamicin	44	80	7	12.7	4	7.3	55	100
Imipenem	52	96.3	1	1.9	1	1.9	54	100
Meropenem	52	98.1	1	1.9	-	-	53	100
Cephalothin	8	15.1	32	60.4	13	24.5	53	100
Cefuroxime	36	66.7	17	31.5	1	1.9	54	100
Cefoxitin	43	81.1	9	17	1	1.9	53	100
Cefotaxime	36	69.2	16	30.8	-	-	52	100
Cefepime	38	71.7	15	28.3	-	-	53	100
Aztreonam	37	71.2	14	26.9	1	1.9	52	100
Ampicillin	6	10.9	49	89.1	-	-	55	100
AmoxicillinClavulanate	20	35.7	22	39.3	14	25	56	100
PiperacillinTazobactam	36	69.2	10	19.2	6	11.5	52	100
TrimethoprimSulfamethoxazole	28	50	27	48.2	1	1.8	56	100
Nitrofurantoin	40	80	3	6	7	14	50	100
Ciprofloxacin	44	80	8	14.5	3	5.5	55	100

DISCUSSION

Urinary Tract Infection, especially in early childhood, if not treated with suitable antibiotics, can cause serious problems such as hypertension and renal failure and continues to be a very important health problem with high morbidity and mortality rate in developing countries, and high influence on health costs in most countries.

In the present study, urine analysis was conducted in all 206 cases. Among all urine analysis, overall infection rate was 28.2% while 44.2% presented no growth of microorganisms. Similar results were observed by (Bay & Anacleto Jr, 2010), who reported that the UTI rate reached (30%), while the rate of infection in this study was slightly higher compared to

the infection reported by (Barros et al., 2011) which was only (14.8%). This discrepancy may be due to many factors such as patient and hospital characteristics, and criteria used for diagnosing. The factors that influence UTI include host factors and agent factors. Host factors are the resistance of host to infection, these include local and systemic resistance of host. Agent factors include the dose of bacterial contamination and pathogenicity.

In the current study, most of the infected cases were females. Similar results were observed by (Barros et al., 2011; Bay & Anacleto Jr, 2010), who reported that, according to results, the female sex was the most affected. This may be due to their shorter urethra which provides an easy access of bacteria to the bladder.

This study showed that the increasing of age was slightly identified as a specific risk to UTI. (Hansen, 1976; Rodriguez-Encarnacion, 2012; Whiting et al., 2006) found in the first few months of life that infants are at a higher risk for UTI. This susceptibility has been attributed to the incompletely developed immune system. The study showed that fever was the most common presenting symptom accounting for 57.8% of patients. Similar studies by (Bay & Anacleto Jr, 2010; Kayaş et al., 2011) reported that the most common complaints of children were fever, dysuria, vomiting, and abdominal pain. The overall bacterial growth in urine WBC >5 rate reached 86.2% among patients during this study period, this indicates the presence of infection. Similar results were observed by (Gordon, Waxman, Ragsdale, & Mermel, 2013; Simerville, Maxted, & Pahira, 2005).

E.coli was the predominant bacteria isolated in this study. The *E.coli* reached 67.2% of all isolated bacteria. Similarly, (Younis, Quol, Al-Momani, Al-Awaisheh, & Al-Kayed, 2009) reported that *E. coli* was determined to be the predominant microorganism with 71% in patients. In addition, a study by (Ipek, Bozaykut, Arman, & Sezer, 2011) showed that the highest UTI rate was for *E.coli* (81.7%). Another study by (Rodriguez-Encarnacion, 2012) reported that *E. coli* remained the most important bacteria responsible for UTI (75%). (Kayaş et al., 2011) also found that the most frequent microorganism was *E.coli* (63.08%). *E. coli*, a common nosocomial contaminant epidemics, have been traced to many items in the hospital environment. Thus, the results of our study indicated that the presence of *Escherichia coli* as the etiological agent and as a major uropathogen in children had not been changed.

All species were tested for susceptibility to antibiotics using the disc diffusion method and BD phoenix system. The study of sensitivity test to antibiotics showed that all bacteria were sensitive to Meropenem (98.1%), Imipenem (96.3%), Amikacin (96.2%), Cefoxitin

(81.1%), and Ciproflaxacin (80%). Similar studies showed that all bacterial growth were sensitive to Amikacin, Imipenem, Ciprofloxacin and Gentamicin (Barros et al., 2011; Kayaş et al., 2011; Rodriguez-Encarnacion, 2012).

The present study showed a high resistance rate to Ampicillin (89.1%) and Cephalothin (60.4%), this phenomena may be contributed to the frequent and miss-use of the antibiotic without medical prescription. This result was in agreement with that reported by (Ipek et al., 2011; Kayaş et al., 2011; Rodriguez-Encarnacion, 2012).

Multiple drug resistant (MDR) bacterial infections are being increasingly reported from all parts of the world. Multi-resistant microbes are an important cause of hospital-acquired infection. Infections associated with such organisms can pose a serious threat to vulnerable patients. Generally, making a frequent use of antimicrobial agents result in a great likelihood of resistance and multi-drug resistance.

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الإصابة بعدوى المسالك البولية عند الأطفال في مستشفى بنغازي للأطفال

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المستخلص: يعتبر مرض التهاب المسالك الناجم عن العدوى البكتيرية من أكثر الأمراض شيوعاً لدى الأطفال خاصة في سن الرضاعة. تستهدف هذه الدراسة تقييم الجراثيم المسببة لهذا المرض وأنماط مقاومة هذه الجراثيم للمضادات الحيوية لدى هؤلاء الأطفال والرضع الذين دخلوا المستشفى للعلاج من التهاب المسالك البولية. هذه الدراسة قائمة على الملاحظة وأجريت في الفترة من يناير 2009 إلى ديسمبر 2010 حيث تم دراسة (206) عينة بول تم جمعها من الأطفال في مستشفى بنغازي للأطفال (قسم أمراض الكلى) الذين مشتبه أنهم مصابون بالتهاب المسالك البولية. تم تقييم الخصائص الديموغرافية والعوامل المسببة للمرض ومقاومة الجراثيم المسببة للمرض للمضادات الحيوية، وجد أن 58 طفلاً من إجمالي الحالات مصابون بالتهاب المسالك (28.2%) نتائج تحاليل مزرعة البول لديهم إيجابية، وكانت غالبية حالات التهاب المسالك (UTIs) تحدث في الإناث. مقارنة بالذكور كما أن أكثر أعراض المرض شيوعاً هي الحمى وعسر البول والألم البطني. وكان أكثر مسببات المرض المعزولة شيوعاً هو *Escherichia coli* (67.2%)، يليه الالتهاب الرئوي *Klebsiella* (20.7%)، *Pseudomonas aeruginosa* (3.4%)، *Proteus mirabilis* (3.4%)، *Klebsiella oxytoca* (1.7%)، *Enterobacter casseliflavus* (1.7%) و *Enterobacter cloacae* (1.7%)، و كانت الجراثيم الممرضة المعزولة عالية المقاومة للأمبيسلين (89.1%) و السيفالوثين (60.4%)، وحساسية للغاية لـ Meropenem (98.1%)، Imipenem (96.3%)، Amikacin (96.2%)، Cefoxitin (81.1%) و Ciproflaxacin (80%).

الكلمات المفتاحية: عدوى المسالك البولية، تحليل مزرعة، مقاومة المضادات الحيوية.



Investigation into Causes of Allergic Diseases Using Quantitative Measurement of Allergen-Specific Ige in Serum in Al- Bayda, Libya

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Abstract: Allergy is a complex condition that results from different causative factors and different kinds of reactions, which caused by vibrant interactions ranged from genetic predisposition, environmental factors, food reaction, animals, insects, to a dysfunctional immune system. A public concern has grown in response to the increasing prevalence of allergy and related atopic conditions. Although the underlying mechanism of the true causes of allergy is complicated due to insufficient data and variable methodologies, Immunoglobulin E (Ig E) is commonly accepted as a specific index for allergic diseases among many indices used to test allergy. The aim of the study was to perform analysis of food allergens, inhalatory allergens, and other allergens types in patients diagnosed with an allergy by testing specific IgE to understand the risk factors, prediction, preventing, and determine the treatment. The results showed that specific IgE serum levels are significantly higher in patients sensitized to *D. pteronyssinus* and *D. farinae* allergens. However, more data and studies are needed to investigate the local allergens that cause allergy.

Keywords: Immunoglobulin E (Ig E), house dust mite (HDM), atopic dermatitis.

INTRODUCTION

Allergic diseases are a health concern for patients and practitioners that can affect the quality of life and are potentially life-threatening. The genetic, epigenetics and environmental risk factors are increased, creating more obstacles in the prevention and treatment strategies (Mastorilli, Caffarelli, & Hoffmann-Sommergruber, 2017). At pathophysiological level allergies are a complex interaction of epithelial, mucosal, immune system, exposure and microbial in some cases.

The diagnosis of allergy mainly depends on the medical history, sensitivity test, and an oral food challenge. Recently, more specific and accurate methods are introduced for allergy diagnosis such as specific IgE, basophil activa-

tion tests, and DNA methylation signature (Bordon, 2017).

Allergic diseases include hay fever, food allergies, atopic dermatitis, allergic asthma, and anaphylaxis (Guillet, 2000). Hay fever or allergic rhinitis affects about 26% in the UK, it's a long-term case that has a considerable negative impact on quality of life and costly in health care (Porteous et al., 2013).

Food allergies are common, and their prevalence has been increased up to 10% in the last two decades (Jhamnani et al., 2018). Many foods can induce food allergy. However, certain foods are more likely to produce a more severe reaction than others; the most common accused foods include cow's milk, egg, peanut, tree nut, soy, wheat, fish, and shellfish. Milk

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and egg allergy more common in childhood whereas peanut and tree nut allergy can occur during childhood or adulthood (Sicherer & Sampson, 2018).

There are hundreds of different allergens that can cause clinical symptoms of asthma and it is hard to identify which allergen has the most potential to cause clinical symptoms of asthma. House dust mite (HDM) is the most common type of allergen causing allergic asthma, *D. pteronyssinus*, *D. farina*, and *Blomia tropicalis* are the main sources of HDM allergens. Diagnosis of allergy includes skin prick testing, specific serum IgE testing, and oral food challenges (Jang et al., 2009). Many risk factors such as family history of atopy and asthma are the main risk factors for the progress of a food allergy. Other factors including vitamin D deficiency and obesity also could be provokers for food allergy (Bordon, 2017; Boyce et al., 2011).

In general, allergies are IgE-mediated reaction that manifested symptoms ranged from pruritus to anaphylactic shock, and usually appear within minutes or delay for several hours from ingesting or contact of allergen (Fleischer et al., 2012). Symptoms are varied and affecting different systems, which include respiratory tract that leads to sneezing, congestion, rhinorrhea, wheezing, and laryngeal edema. Gastrointestinal symptoms include nausea, vomiting, abdominal pain, and diarrhea. Skin symptoms include urticaria, angioedema, flushing, or pruritus. Tachycardia and hypotension as cardiovascular symptoms (Burks et al., 2012). It is important to distinguish between allergy occurring due to food and the case of food intolerances. Food intolerances can include lactose intolerance and fructose intolerance. Histamine intolerance is nonimmunologic conditions due to foods that contain or cause a release of histamine, for instant, alcoholic beverages, ripe cheese, tomato, and smoked or processed meats (Fleischer et al., 2012; Zukiewicz-Sobczak, Wroblewska, Adamczuk, & Kopczynski, 2013). Food intolerances cannot be detected by

traditional allergy testing, which includes IgE testing or skin prick testing (SPT) (Michael, 2011).

Treatment strategies are directed to strict avoidance of allergen and instant treatment of sensitivity reaction. Patients and parents of children with a food allergy should be educated to avoid allergens, read food content, and be alert for cross-contamination of food (Henson & Burks, 2012).

The aim of this study is to recognize the allergens that lead to allergic diseases using the quantitative method.

MATERIALS AND METHODS

This study was conducted at the outpatient clinic in Al-Beida, Libya. Samples were collected from 83 patients; 43 patients were females and 40 patients were males. All subjects consented to provided assent for the study, and they were suffering from different types of allergies. The samples were tested by using polycheck[®] allergen diagnostic test kit (Atopic 20-I). The test is based on enzymatic immunoassay for the quantitative measurement of allergen-specific IgE in serum. Each well of polycheck cassette contains allergens and standards. Allergen-specific IgE bind to the corresponding allergen after incubation of the patient's serum. Non-bound component serum was removed by washing. The anti-IgE- antibody was bound to allergen IgE complex, and the unbound was washed out. Enzyme-labeled anti-ligand binds to the immune complex. The substrate solution was added, which is specifically bound to the enzyme and convert the colourless substrate to a dark colour. The generated colour is proportional to the respective allergen-specific IgE concentration in a patient's serum. The results were interpreted by using biocheck imaging software.

Statistical differences between different groups were analyzed via single factor analysis of variance (ANOVA), followed by a non-parametric method and a calculation of median. Statistical significance was only presented when p is

≤0.05. Statistical analyses were performed using the GraphPad Prism software.

RESULTS

According to study data, the females percentage was (51.81%), and males percentage was (48.19%). The average age of the subjects was 40.2 years old and ranged from 19 to 59 years of age (Table 1). The participated patients have one or more allergies type, such as allergic asthma, allergic rhinitis, and food allergy. Skin prick test was considered positive if the diameter of the wheal is >3 mm. The specific IgE test was considered significant if the specific IgE levels are >0.35 kU/L. The cut-off value of specific IgE testing is 0.35 - 101 kU/L. In this analytical statistic calculation, data valued <0.15 kU/L were considered as 0 kU/L, while data valued >100 kU/L were considered as 101 KU/L.

The results showed that the highest allergen sensitizations were caused by *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*, which affected about 28.92% of allergic tested patients. About 15.66% of subjects were showed sensitization to Birch-Oak mix where the lowest allergen sensitization was caused by Chicken-meat (4.82%), with the exclusion of sensitization to pork, which was (0%), since pork meat is forbidden in Libya and this is indicated the high sensitivity of test (Figure 1). These percentages represented the subjects that show clear antibody concentrations (>3.5 kU/L) to extremely high antibody concentrations (>100 kU/L). It appeared that specific IgE levels varied widely among subjects. The majority of sensitized patients, for most allergens, ranged from clear to very strong category. Nevertheless, about 19 patients showed extremely high antibody concentrations to *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*, which were the highest levels of IgE and beyond the machine's detection range. Analysis of the difference of specific IgE serum levels was done by comparing the median value and by using a non-parametric

test. The analysis showed that the house dust mite (HDM) is the most common type of allergen causing sensitization of tested patients with higher levels of specific IgE serum, which showed a statistical significance.

Table (1). Characteristic of subjects (n= 83)

Sex (male), n (%)	40 (48.19)
Sex (female), n (%)	43 (51.51)
Age (years), mean (SD)	40.2 (12.04)
Allergen prevalence, n (%)	
Chicken-meat	4 (4.82)
Flour mix	6 (7.32)
Bakers - Yeast	7 (8.43)
<i>D.pteron+D.farinae</i>	24 (28.92)
Birch -Oak mix	13 (15.66)
Grass-Mix	9 (10.48)
Cladosp.herb+Altern.altern.	5 (9.24)
Total-IgE	80 (96.39)

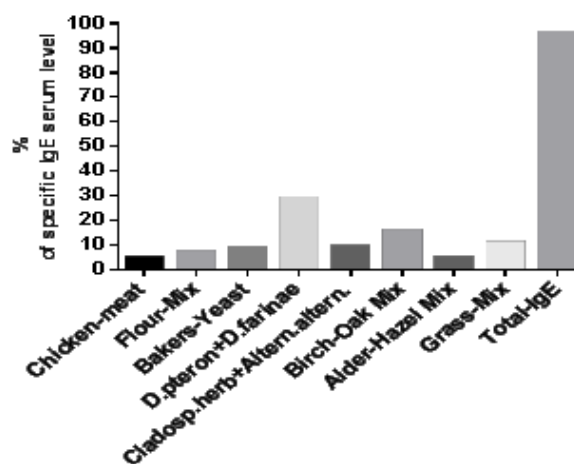


Figure (1). Distribution of specific IgE serum level.

Table(2). Quantitative specific IgE serum level: The results are represented as median, data were analysed by using Kruskal-Wallis statistic test, * P < 0.05, ****P<0.0001 and (ns) represents non-significant.

Allergen type	Median	P-value*
Chicken-meat	0.34	ns
Flour-Mix	0.28	ns
Bakers-Yeast	0.29	ns
<i>D.pteron+D.farinae</i>	4.90	****
Cladosp.herb+Altern.altern.	0.41	ns
Birch-Oak Mix	0.33	*
Grass-Mix	1.00	ns
Total-IgE	38.50	****

DISCUSSION

From the result of this study, we found that the highest allergens prevalence was caused by the exposure to house dust mite (HDM) (28.92%), which is represented in the results by the *D. pteronyssinus* and *D. farinae*. Our data were consistent with previous studies that stated a large number of allergen is responsible for respiratory allergy disease. However, a huge body of literature showed that *D. pteronyssinus* and *D. farinae* are the most common allergens or risk factors that lead to allergic respiratory diseases. A study in the United States using the immunoassay method found that around 38% sensitization in allergic rhinitis patients were caused by *D. pteronyssinus* and *D. farinae* (Zhao et al., 2017). Another study in Indonesia showed that *D. pteronyssinus* allergen prevalence is as high as 77.3%, followed by *D. farinae* (69.6%) (Hannaway & Roundy, 1997).

The results of this study showed that specific IgE serum levels, which is quantitatively measured, is significantly higher in patients sensitized to *D. pteronyssinus* and *D. farinae* allergens, followed by Birch-Oak Mix (Table 2). Furthermore, the measurement of specific IgE levels could not be done with absolute number. Patients with IgE levels below the detection limit (<0.15 kU/L) were considered 0 kU/L, while the IgE levels above the detection limit (>100 kU/L) were calculated as 100 kU/L.

In view of the limitation of using skin prick test and the lack of accuracy of finding the allergen by using skin prick test, the quantitative measurement of specific IgE levels is very sensitive in measuring the IgE levels compared to skin prick test.

Grass pollen is one of the most important allergen sources worldwide and causes severe respiratory symptoms especially in allergic patients. Data from this study showed around (15.66%) of patients are sensitive to Birch-Oak mix, and about 10.54% have a sensitivity toward Grass-Mix. Although these percentages weren't that high, they have a huge impact on subjects health, since the released pollen from

both Birch- Oak mix and Grass-Mix exacerbate allergic sensitization because they transport allergens. These allergens provoke an allergic reaction leading to inflammation. Moreover, pollen grains increase the release of bioactive lipids and enzymes that activate human neutrophils and eosinophils (Traidl-Hoffmann et al., 2003).

In general, serum total IgE is believed to reflect IgE production levels in the body. Our data showed that about (96.36%) (Table 1) of tested patients revealed an increase in total IgE ranged from a strong to extreme levels. Although the measurement of total IgE is still accepted as a tool for the assessment of allergic diseases, it is important to take in our considerations that the increase in total IgE level could not be reflected only by the hypersensitivity disorder, it may be involved in the pathogenesis of other diseases. This may explain why the data showed a very high percentage of total IgE compared to specific-IgE of allergens. Moreover, this high percentage could be due to other allergens that not detected by the polycheck cassette that was used in our study (Atopic 20-I). On the other hand, it has been well documented that the total IgE level has a role in the development of asthma (Park, Lee, & Kho, 2016).

In view of statistical analysis, the median value of specific IgE levels in subjects ranged from 0.28– 4.90 kU/L. The highest median value in this study was caused by *D. pteronyssinus* and *D. farinae* sensitization (Table 2). This number was not that high, considering negative or class 0 patients were also taken into account in the statistical analysis. On the other hand, the highest number that can be measured by the machine is limited to 100 kU/L. Thus, the median value of specific IgE levels in this study did not represent the actual IgE levels in the subject.

CONCLUSION

In summary, this study seeks to clarify the causes of allergies using quantitative serum specific IgE levels. The identification and the elimination of allergens is essential to avoid the

triggers of allergic episodes in susceptible individuals, as well as to help in the prognosis of a proper treatment.

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ETHICS

All the data were collected after outpatient clinic permission and consent of patients.

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التحقيق في مسببات أمراض الحساسية باستخدام القياس الكمي للجلوبيولين المناعي المضاد للحساسية في مصل الدم، البيضاء، ليبيا

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المستخلص: الحساسية هي حالة معقدة تنجم عن عوامل مسببة مختلفة وأنواع مختلفة من التفاعلات الحيوية وكذلك عامل الاستعداد الوراثي، والعوامل البيئية، وحساسية الغذاء، والحيوانات، والحشرات. ويمكن أن تنشأ الحساسية كنتيجة لخلل في الجهاز المناعي. زادت المخاوف العامة كنتيجة على زيادة انتشار الحساسية والظروف الاستثنائية المرتبطة بها. على الرغم من تعقيد وصعوبة آلية معرفة الأسباب الحقيقية للحساسية بسبب عدم كفاية البيانات. إلا أنه يتم بيقى الجلوبيولين المناعي (Ig E) كمؤشر فعال لأمراض الحساسية بين العديد من المؤشرات التي تستخدم لاختبار الحساسية. الهدف من الدراسة هو تحليل وتحديد المواد المسببة للحساسية الغذائية والمواد المسببة لحساسية الاستنشاق وغيرها من أنواع الحساسية في المرضى الذين تم تشخيصهم بالحساسية عن طريق اختبار محددة IgE لفهم عوامل الخطر والتنبؤ والوقاية والعلاج. أظهرت نتائج هذه الدراسة أن مستويات مصلى IgE الخاص بـ *D. pteronyssinus* و *D. farinae allergen* أعلى بشكل ملحوظ لدى كثير من المرضى الذين تم فحصهم، ومع ذلك مازلنا بحاجة إلى المزيد من البيانات والدراسات للتحري عن مسببات الحساسية عن طريق المهيجات المحلية.

الكلمات المفتاحية: الجلوبيولين المناعي (Ig E)، عثّ غبار المنزل، التهاب الجلد التأتبي.

Spices in Local Market and Their Contamination by Aflatoxins, Tripoli - Libya



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Abstract: Aflatoxins are considered the most carcinogenic, mutagenic and teratogenic substances found naturally in foods and feeds. These metabolites cause liver damage to humans and to most experimental animal species tested. This study was conducted to assess the level of contamination of spices such as caraway, mixed spices, cinnamon, black pepper, red pepper and cumin sold in Tripoli market with poisons aflatoxins. The results of this study showed that the highest contamination of Afla B1 was in black pepper samples ($12.1 \pm 0.7 \mu\text{g/kg}$) and the lowest contamination was in mixed spice samples ($3.4 \pm 0.2 \mu\text{g/kg}$). The highest contamination of Afla B2 was in cumin samples as $10.2 \pm 0.1 \mu\text{g/kg}$, whereas the highest contamination of Afla G1 and G2 were also found in cumin samples 12.12 ± 0.09 and $7.6 \pm 0.1 \mu\text{g/kg}$, respectively. The contaminations of spices with aflatoxins were in various concentrations.

Keywords: Aflatoxins; Spices; Tripoli; Libya.

INTRODUCTION

Foods are exposed to certain species of fungi that secrete organic compounds as their metabolites that are mostly poisonous for humans, animals and other microorganisms (Abdulkadar, Al-Ali, Al-Kildi, & Al-Jedah, 2004). The most important recorded fungi as toxin producers are *Aspergillus*, *Fusarium* and *Penicillium* species that produce various kinds of toxins (Agaoglu, 1999). The most important mycotoxins are aflatoxins, ochratoxins, zearalxin and others (Akiyama, Goda, Tanaka, & Toyoda, 2001). These toxins are highly toxic compounds that cause many kinds of diseases including cancers (Bircan, 2005). Aflatoxins are natural and very toxic to the human being (Songsermsakul & Razzazi-Fazeli, 2008). Aflatoxins are occurring carcinogenic substances and recognized as hepatotoxic and carcinogenic agents to humans and capable of inducing liver cancer and cirrhosis (Trombete, Santos, Direito, Fraga, & Saldanha, 2014). Fungi have the capability to grow on all foods without an exception, whether their moisture content was

high or low (although fungi growth requires moisture) (El-Kady, El-Maraghy, & Mostafa, 1995). Fungi grow on crops in the field and after crop harvest and during storage (Erdogan, 2004). Fungi also grow within wide range of temperatures ($15-35 \text{ }^\circ\text{C}$) and causes the damage to these commodities due to what they exposed to from physical (in shape, texture, color, aroma, and taste) and chemical (due to the fungal consumption of nutrients so lowering the food content of organic matter) (Fazekas, Tar, & Kovacs, 2005).

That did not necessarily mean that every fungus infected commodity is producing aflatoxins because fungal growth needs conditions different from that needed to produce toxins such as the moisture of the infected commodity, medium temperature, medium content of oxygen, and other required conditions (Garrido, Jodral, & Pozo, 1992; Romagnoli, Menna, Gruppioni, & Bergamini, 2007). However, not every fungus has the genetic capacity to produce aflatoxins even if belongs to one species known with aflatoxins production due to the differences between the isolated strains from the same spe-

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cies which are accompanied with differences in the capability of toxin (s) production according to the genetic capacity (Hazir & Coksoyler, 1998). The same aflatoxins also may be produced by more than one of toxic fungal species (Macdonald & Castle, 1996), which indicates the similarity of genetic capacity between fungal species. Many studies have been conducted concerning about public health for safety and to determine maximum aflatoxin levels for food and feed. The maximum levels for aflatoxins in various nuts, grains, dried figs, and milk are in the range of 0.5 to 15 $\mu\text{g}/\text{kg}$ (a μgram is one millionth [1×10^{-6}] of a gram) (WHO, 2018).

The main objectives of this study were: (i) to survey the levels of Aflatoxins in Libyan spices by applying a HPLC method; (ii) to evaluate the differences regarding co-occurrence and the level of concentrations. To the best of our knowledge, this is the first survey concerning the presence of aflatoxins in Libyan Spices, collected from different local markets in Tripoli, Libya.

MATERIALS AND METHODS

In this research, a total of 154 samples of crushed spices (caraway, mixed spices, cinnamon, black pepper, red pepper, and cumin) were collected from private markets at Tripoli city. Samples were collected randomly and put into LDPE bags. Sample weight at collection was 100-200 g and information about sample name, weight, and date of collection were recorded on each bag. Samples were transferred under suitable conditions and stored at 4-20 °C until tests were carried out to assess the kinds of aflatoxins (Martins, Martins, & Bernardo, 2001). The assessment steps began with subsampling, preparation and blending of 25 g subsample, extraction with methanol: water (70:30) mixture and filtration through Watman no 4-filter paper. The resulted filtrate was passed through immune affinity column and eluted with methanol 100%. Quantitative as-

essment was carried out on HPLC chromatograph with the following technical specifications: The HPLC equipment was a Shiseido (SI-2) system with 3023 pump, 3023 auto-injector and fluorescence detector set at 360 nm for excitation and 460 nm for emission. A Capcellpack C18 column (4.6- 250 mm, 5 μm particle size, Shiseido, Japan) was used. The mobile phase was distilled water: methanol: acetonitrile (65:25:10) with a flow rate of 1 ml/min. The recovery experiments were carried out in samples which, the four aflatoxins were not found, with the concentration of 7 $\mu\text{g}/\text{kg}$ for each aflatoxin (B1, B2, G1 and G2) and stored for 12 hours at room temperature, prior to the extraction procedure.

Statistical Analysis: The results from aflatoxins analyses were subjected to statistical analysis using GenStat (Release 8.1, Rothamsted Experimental Station, and UK). Analyses of variance were run to evaluate the average of readings, and standard deviation was also calculated for each individual toxin.

RESULTS

Spices are considered as agricultural crops that might expose to the fungal infection especially with aflatoxins producing fungi. In this research, aflatoxins were assessed and the results in table (2) showed that the highest contamination of Afla B1 was in black pepper samples ($12.1 \pm 0.7 \mu\text{g}/\text{kg}$) and the lowest contamination was in mixed spice samples ($3.4 \pm 0.2 \mu\text{g}/\text{kg}$).

Table:(1). Average recovery rate (\pm sd) for total aflatoxins (B1, B2, G1, and G2) that were added to spice samples at a concentration of 7 $\mu\text{g}/\text{kg}$.

Sample	Average recovery rate (%)			
	Afla B1	Afla B2	Afla G1	Afla G2
Caraway	81 \pm 3	82 \pm 5	85 \pm 2	77 \pm 3
Mixed spices	83 \pm 5	86 \pm 3	81 \pm 6	75 \pm 5
Cinnamon	79 \pm 4	84 \pm 2	79 \pm 4	73 \pm 6
Black pepper	80 \pm 3	78 \pm 4	78 \pm 5	71 \pm 6
Red pepper	83 \pm 6	80 \pm 3	81 \pm 3	72 \pm 4
Cumin	84 \pm 2	85 \pm 4	79 \pm 3	70 \pm 5

The highest contamination of Afla B2 was in cumin samples as $10.2 \pm 0.1 \mu\text{g/kg}$, whereas the highest contamination of Afla G1 and G2 were also found in cumin samples 12.12 ± 0.09 and $7.6 \pm 0.1 \mu\text{g/kg}$, respectively. The contamination concentrations were different from spice to another.

Table:(2). Average concentrations (\pm sd) and positive samples within the different kinds of spices.

Sample	Positive samples	Average concentration of aflatoxins ($\mu\text{g/kg}$)		
		Afla B1	Afla B2	Afla G1
Caraway	24 (5)	7.1 ± 0.1	4.9 ± 0.08	2.4 ± 0.9
Mixed spices	29 (4)	3.4 ± 0.2	1.9 ± 0.04	1.2 ± 0.03
Cinnamon	22 (6)	6.4 ± 0.06	2.5 ± 0.03	3.1 ± 0.8
Black pepper	31 (4)	12.1 ± 0.7	7.8 ± 0.09	3.4 ± 0.08
Red pepper	27 (4)	5.2 ± 0.2	4.4 ± 0.08	2.2 ± 0.06
Cumin	21 (6)	10.2 ± 0.2	9.8 ± 0.1	2.1 ± 0.09

DISCUSSION

Aflatoxins occur in nature, but four aflatoxins B1, B2, G1 and G2 are dangerous to humans and animals as they have been found in all major food crops (WHO, 2018). Aflatoxins are considered the most carcinogenic, mutagenic and teratogenic substances found naturally in foods and feeds. Fungal toxins are highly toxic compounds cause many kinds of diseases including cancers and mutagens (Bircan, 2005). This paper studied the levels of aflatoxins in Libyan spices applying a HPLC method to evaluate the differences regarding co-occurrence and the level of contamination.

The results demonstrated that aflatoxins were present in various concentrations in the different kinds of spice samples as a result of the growth of the productive fungi and the availability of suitable moisture and temperature for fungal growth, which agrees with (A Zinedine et al., 2006; Abdallah Zinedine et al., 2007). The results in this survey showed that the concentration of aflatoxins is in the range of the

standard for aflatoxins as set by WHO. The concern about aflatoxins due to their important role as a source of disease outbreaks associated with food consumption is increasing and more studies should be carried out in Libya.

CONCLUSION

The contaminations of spices sold in Tripoli local markets with aflatoxins B1, B2, G1, and G2 were found in various concentrations. Therefore, regular monitoring of spices is strongly recommended. This study contributes to increasing the knowledge of Libyan public to ensure safety and quality of food.

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التوابل في السوق المحلي وتلوثها بسموم آفا، طرابلس، ليبيا

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المستخلص : تعتبر الأفلاتوكسين من أكثر المواد المسببة للسرطان والطفرة الموجودة طبيعياً في الأطعمة والأعلاف. هذه الأيضات تسبب تلف الكبد للبشر ومعظم أنواع حيوانات تجارب المختبرات، أجرت هذه الدراسة لتقييم مستوى تلوث عناصر التوابل بسموم الأفلاتوكسينات B1 و B2 و G1 و G2، والتي تباع في السوق المحلي بطرابلس في ليبيا، (كروية و التوابل المختلطة والقرفة والفلل الأسود والفلل الأحمر و الكمون) . نتائج الدراسة أظهرت أن أعلى تركيز للأفلاتوكسين B1 كان في عينات الفلفل الأسود بنسبة 12.4 ± 0.7 ميكروجرام / كجم وأن أقل مستوى للتلوث كان في عينات التوابل المختلطة بتركيز 3.4 ± 0.2 ميكروجرام / كجم. أعلى تركيز للتلوث بالأفلاتوكسين B1 كان في عينات الكمون بنسبة 10.2 ± 0.1 ميكروجرام / كجم. بينما أعلى تركيز للتلوث بالأفلاتوكسين G1 and G2 أيضا كان في عينات الكمون بنسبة 12.12 ± 0.09 و 0.17 ± 0.6 ميكروجرام / كجم على التوالي. نستنتج من الدراسة أن تلوث التوابل بالأفلاتوكسين B1 و B2 و G1 و G2 كان بتركيزات مختلفة.

الكلمات المفتاحية: سموم آفا، التوابل، طرابلس، ليبيا.



دراسة بعض المتغيرات المورفومترية باستخدام نموذج الارتفاع الرقمي (DEM) لوادي حيون - ليبيا

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المستخلص: يعتبر وادي حيون من أحواض الأودية بمنطقة الجبل الأخضر (ليبيا) ذات النشاط الزراعي الكثيف حيث أجريت هذه الدراسة بهدف تحديد بعض الخصائص المورفومترية للوادي، وكذلك بناء قاعدة معلومات مكانية - رقمية لمستجمع المياه لدعم وخدمة متخذي القرار باستخدام بيانات الارتفاعات الرقمية DEM و تم إجراء التحليل الطبوغرافي لمنطقة الدراسة وتحديد حدود مستجمع مياه وادي حيون وفصله عن بقية مستجمعات الأودية المحيطة به ، ثم أجرى التحليل المورفومتري للوادي ومستجمع مياهه لتحديد خصائصه المختلفة (المساحة، المحيط، اتجاه الميل السائد، طول المجرى المائي، ميل المجرى)، وقد أظهرت النتائج أن المساحة الكلية للمستجمع تبلغ 34.2792 كم² وأنه يحتوي على 37 تحت مستجمع (مستجمع جزئي) وأن مساحة هذه المستجمعات الجزئية تراوحت ما بين 0.0324 كم² إلى 2.65 كم² ويبلغ طول المستجمع حوالي 12.53 كيلو متر وعرضه 2.74 كم ومحيطه 43.74 كم، وأوضحت الخصائص الشكلية للمستجمع أنه يميل للاستطالة بصفة عامة ويظهر في شكل مثلث قمته في اتجاه البحر، بينما أوضحت خصائص التضاريس أنه مستجمع منبسط في جزئه الجنوبي حيث ينتشر النشاط الزراعي بينما شديد التضرس في الجزء الشمالي منه والذي يسود به غطاء نباتي طبيعي من غابات البحر المتوسط، و أظهر تحليل شبكة التعريف أنه يحتوي على 37 مجرى مائي وأن أطوالها الإجمالية قد بلغت 41.94 كم وأن طول المجرى الرئيسي يبلغ 15.91 كم ، كذلك أن مجاري الحوض مستقيمة وهذا يعني أن المياه تصل إلى المصبّ في فترة قصيرة، وأن تكرارية المجاري المائية منخفضة مما يقلل من فرص الجريان داخل مجاري الأودية.

الكلمات المفتاحية: نظم معلومات جغرافية، نموذج الارتفاع الرقمي، المورفومترية، وادي حيون، ليبيا.

لسطح الأرض الناتجة عن نظام التعرية النهريّة
(الغامدي، 2006).

المقدمة

أشار Chorley (1969) إلى أنه يمكن استخدام ستة عشر مقياساً مورفومترياً لدراسة أي مستجمع مياه، وأن هذه المقاييس تغطي أهم ثلاث خصائص في دراسة مستجمعات المياه، وهي امتداد مستجمع المياه وشكله واللذان يحددان مقدار الكمية المستقبلية من التساقط والإشعاع الشمسي، والتضاريس ومجمل الانحدار وهي في مجموعها تحدد سرعة الجريان، وكثافة شبكة المجاري والتي تحدد الفاعلية، وهذه الخصائص في مجملها تعكس التوازن بين نوع الصخر وبنيته والظروف المناخية.

يعتبر هورتون (Horton, 1945) المؤسس الحقيقي للدراسات المورفومترية لأحواض التصريف، وهو من أشهر الهيدرولوجيين في تلك الفترة ولا تزال قوانينه مفيدة ومطبقة حتى الآن على الرغم من التعديلات الكثيرة والطرق الأحدث التي تناولت مثل هذا النوع من الدراسات، أمثال ستريلر (Strahler, 1954, 1957; Stralher, 1964). تعد القياسات المورفومترية أحد أهم التطبيقات الجيومورفولوجية، ويعرف المورفومتري بأنه علم قياس الخصائص الهندسية

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Colombo, 2003; Wise, 2000; Selvan and Akawwi, 2013; Al-; العزاوي, 2008; Rashid, 2012; Radwan et al. husban and Makhamreh, 2015 (2017).

تكتسب الدراسات المورفومترية والهيدرولوجية للأودية الموسمية أهمية بالغة لارتباطها بمجالات تنمية المصادر المائية ومشروعات التنمية الزراعية والرعية خاصة في المناطق الجافة وشبه الجافة ذات المورد المائي المحدد والبيئة الحدية والهشة. تعتبر نظم المعلومات الجغرافية من التقنيات الحديثة التي يمكن توظيفها في الدراسات المورفومترية، وإن إدارة المياه داخل مستجمعات مياه الأودية الجافة من العمليات المهمة والضرورية للحفاظ على المياه والموارد الطبيعية الموجودة في هذه المستجمعات، حيث يكون الغرض منها استدامة النظام البيئي والمجتمع الإنساني.

تهدف الدراسة إلى تحديد بعض الخصائص المورفومترية لوادي حيون، وكذلك بناء قاعدة معلومات مكانية - رقمية لمستجمع المياه لدعم وخدمة متخذي القرار.

المواد وطرق البحث

تقع منطقة الدراسة في شمال قرية بطة (مستجمع مياه وادي حيون) بالجبل الأخضر شمال شرق ليبيا شكل (1) وتبلغ مساحتها 34.25 كم² وقد تم تحديد الإحداثيات الجغرافية لحدود منطقة الدراسة وكانت محصورة بين خطي عرض 32.654 و 32.754 درجة شمالاً وخطي طول 21.096 و 21.171 درجة شرقاً. تم الاستعانة بنموذج الارتفاع الرقمي (DEM) المتحصل عليه من وكالة الفضاء NASA بدقة أرضية 30 متراً <http://glcf.umd.edu/data/landsat/>. تم تصميم قاعدة البيانات ثم إدخال وتنقيح البيانات الشبكية والاتجاهية والوصفية، وتمت عملية معالجة وتحليل للبيانات بواسطة برنامج ArcGIS 10.1 وملحقاته التحليلية مثل Spatial ، Analysis tools، 3D Analyst tools ، Analyst tools.

وتعتمد الطرق الكمية لحساب الخصائص المورفومترية على طرائق القياس المباشر من الخرائط الكنتورية و باستخدام مجموعة من المعادلات الرياضية (Stralher, 1964) وحديثاً باستخدام برمجيات الحاسوب مثل Arc GIS, TOPAZ, El-Behiry, Shedid, Abu-Khadra, & El-)WMS (Huseiny, 2006؛ علاجي، 2010).

إن وسائل التحليل المورفومتري قد بدأت تأخذ مكاناً هاماً في الدراسات والبحوث الجيومورفولوجية المختلفة وتحل محل وسائل وأساليب التوصيف التقليدية خاصة فيما يختص بتحليل شبكات التصريف النهرية والسفوح والأحواض والأنهار أو أشكال الإرساب الرملية والأشكال الساحلية والعمليات المؤثرة فيها (محسوب، 1997).

تعتبر القياسات المورفومترية قاعدة بيانات كمية ضرورية لأي دراسة تهدف إلى تصميم النماذج الجيومورفولوجية الديناميكية لأنها توفر القياسات الضرورية للأشكال الأرضية التي تجعل تصميم النماذج الرياضية و المعملية مناسبة من الناحية التطبيقية، ونظراً للارتباط الكبير بين خصائص الشبكة المائية والخصائص الجيومورفولوجية والهيدرولوجية لأحواض التصريف فإن دقة التحليل المورفومتري تساعد كثيراً في استقصاء العديد من البيانات الجيومورفولوجية و الهيدرولوجية لأحواض التصريف كما دلت عليه الكثير من الدراسات المماثلة (بوروية، 2002).

يعد نموذج الارتفاع الرقمي Digital Elevation Models (DEM) أحد المكونات الأساسية لأنظمة المعلومات الجغرافية والقاعدة التي يعتمد عليها لاستنتاج الخواص المتعلقة بطبوغرافية الوديان واستقراء المعلومات عن تضاريسها وعملية المحاكاة الهيدرولوجية لجريان مياه الأمطار باستخدام مجموعة من الطرائق التحليلية المطبقة على المعطيات الرقمية لحساب قيم الارتفاعات و الميول والمعالم السطحية كحدود الأحواض المائية وشبكة التصريف (Burrough et al., 1996 ; Blaszczyński, 1997,

النتائج والمناقشة

بعض خصائص مستجمع وادي حيون:

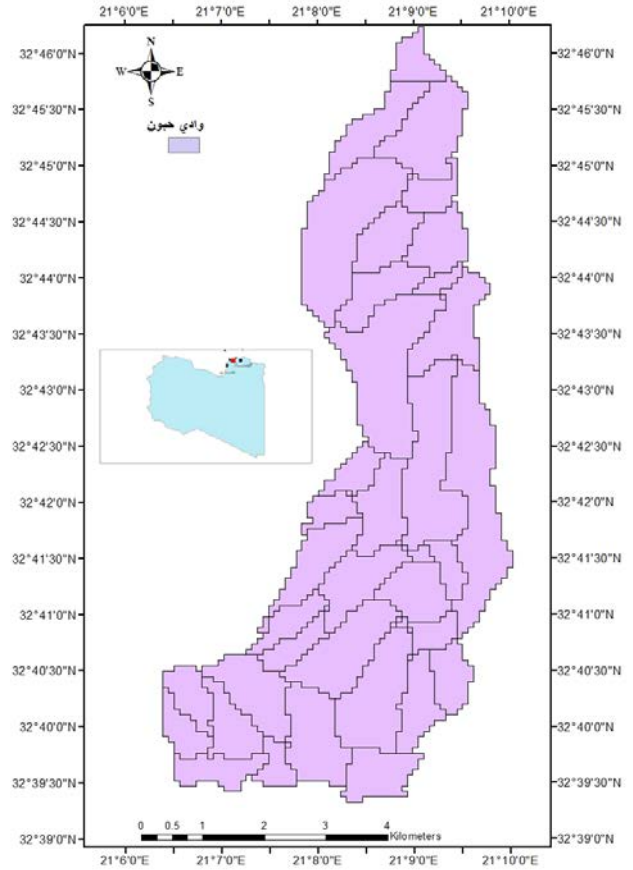
نموذج الارتفاع الرقمي (DEM): أمكن إنتاج خريطة الارتفاعات لمنطقة الدراسة من نموذج الارتفاع الرقمي (DEM) شكل (2) ويوضح جدول (1) مساحات مناطق الارتفاعات المختلفة في مستجمع مياه وادي حيون، حيث نجد أن القدر الأكبر من الوادي يقع على ارتفاع يتراوح بين (300-350) م ويمثل 29.91 % من إجمالي مساحة مستجمع مياه الوادي.

جدول (1) مناطق الارتفاعات داخل مستجمع مياه وادي حيون

الارتفاع (متر)	المساحة (كم ²)	النسبة المئوية (%)
50 - 0	0.1701	0.5
100 - 51	0.6226	1.82
150 - 101	1.4242	4.16
200 - 151	3.402	9.93
250 - 201	6.5043	18.99
300 - 251	8.9212	26.04
350 - 301	10.2460	29.91
378 - 351	2.9646	8.65

مصدر البيانات: من حساب الباحث اعتماداً على برنامج ArcGis

الميل Slope: تم استخراج الميل الشكل (3) من نموذج الارتفاع الرقمي DEM حيث وجد أن الميل السائد هو أقل من 10 % وبنسبة 66.68 % من إجمالي المساحة، ويتباين الميل بين تحت مستجمعات منطقة الدراسة حيث يتراوح ما بين 1.29 % في تحت مستجمع رقم (36) بينما تزداد القيمة بشدة في تحت مستجمع (1) لتصل إلى 12.39 % (جدول 2) وهذا التباين الشديد في شدة الميل يعزى إلى طبيعة منطقة الدراسة، ويساهم هذا الميل في تحديد نقاط خروج مياه الجريان السطحي من هذه المستجمعات.



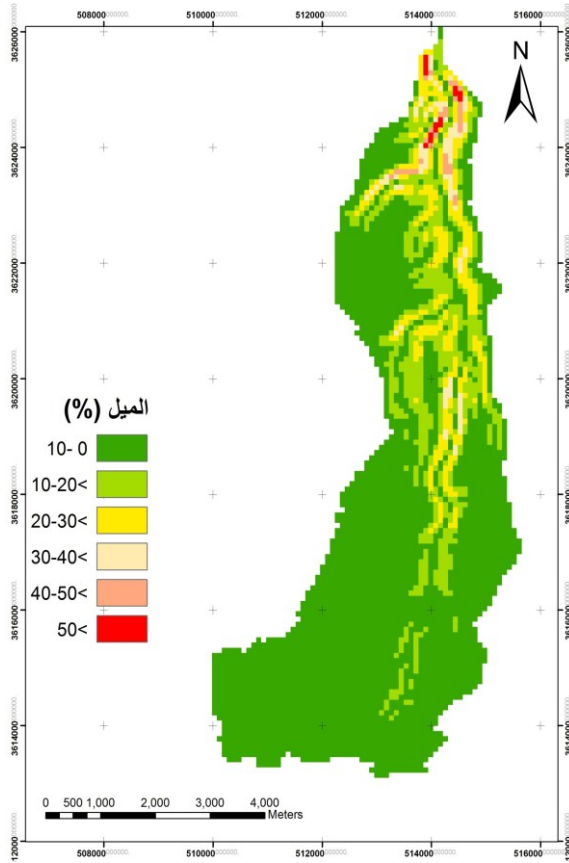
شكل (1). منطقة الدراسة.

لتحديد بعض الخصائص المورفومترية و تحديد اتجاهات سريان تصريف المياه تحديد اتجاهات تجمع مياه الجريان السطحي، تحديد خط جريان المياه داخل مستجمع المياه، تحديد أحواض الصرف الرئيسية وتحت الرئيسية، تحديد نقاط اتصال المستجمعات وارتباط تحت المستجمعات مع بعضها البعض، تحديد نقاط صرف المياه لكل حوض من الأحواض الصغيرة Sub-Basin و تحديد نقطة خروج المياه من المستجمع بالكامل بواسطة استخدام أداة Arc Hydro tools عبر عدة خطوات بالترتيب كما وردت بواسطة (Merwade, 2010)، كذلك بعض الصيغ الرياضية لمجموعة من الخصائص المورفومترية حيث تحصلنا على العديد من المخرجات الجدولية و الرسومية و الخرائط الرقمية ثم الورقية للعديد من المتغيرات المورفومترية لمنطقة الدراسة.

جدول (2) الميل بمستجمع مياه وادي حيون.

الميل (%)	المساحة (كم ²)	النسبة المئوية (%)
10 - 0	22.842	66.68
20 - 10 <	8.7231	25.47
30 - 20 <	2.2423	6.55
40 - 30 <	.43140	1.26
50 - 40 <	0.0081	0.02
50 <	0.0081	0.02

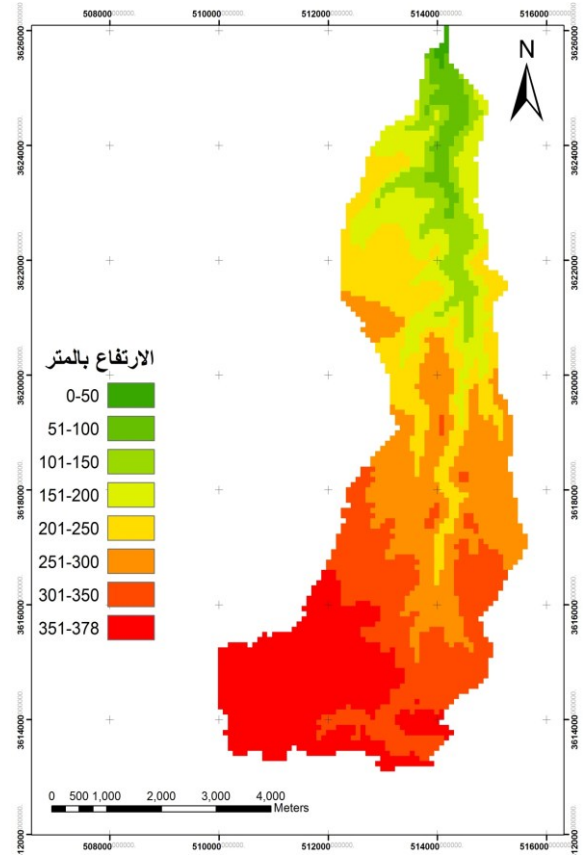
مصدر البيانات: من حساب الباحث اعتماداً على برنامج ArcGis



شكل (3) الميل بمستجمع مياه وادي حيون.

اتجاه الميل لسطح الأرض Aspect: تم استخلاص اتجاهات الميول لسطح الأرض من نموذج الارتفاعات الرقمية DEM ويوضح جدول (3) وشكل (4) اتجاهات الميول لسطح الأرض لمستجمع مياه وادي حيون، حيث يتضح أن اتجاهات الميول السائدة نحو الشمال بنسبة 29.16% وهذا يتفق مع اتجاه الميل العام لمنطقة الدراسة.

يوضح جدول (3) اتجاه الميل السائد أن معظم تحت المستجمعات في منطقة الدراسة تميل ناحية الشمال مباشرة أو الشمال الشرقي أو الشمال الغربي وهذا يعكس الاتجاه العام للميل في منطقة الدراسة والتي تميل بصفة عامة في اتجاه الشمال، إلا أن هناك بعض المناطق الجنوبية التي تميل تجاه الشرق وهذا يتفق مع اتجاه حركة المياه والتي يلتف فيها المجرى الرئيسي للوادي حيث تتحرك المياه من الغرب وفي



شكل (2) الارتفاع بمستجمع مياه وادي حيون.

من مساحة منطقة الدراسة، وهذا يتماشى مع الاتجاه العام لطبوغرافية المنطقة حيث يوجد مصب الوادي في اتجاه البحر شمالاً. إن معظم أراضي منطقة الدراسة نشطة في تجمع المياه حيث تبلغ مساحة مستجمعات حركة المياه 31.9207 كم² وبنسبة 93.19 % من مساحة المستجمع.

جدول (4) اتجاه سريان المياه داخل مستجمع مياه وادي حيون

النسبة المئوية (%)	المساحة (كم ²)	اتجاه السريان
18.65	6.3884	شمال
15.17	5.196	شمال شرق
21.75	7.4495	الشرق
9.07	3.1081	جنوب شرق
5.97	2.0441	جنوب
5.17	1.7704	جنوب غرب
13.77	4.7172	غرب
10.45	3.5813	شمال غرب

مصدر البيانات: من حساب الباحث اعتماداً على برنامج ArcGis

تجمع السريان للمياه Flow Accumulation

يوضح جدول (5) وشكل (6) تجمع سريان للمياه والمساحات لكل قيمة ويتضح من الجدول أن معظم المنطقة تتميز بقيمة تجمع أقل من 3947 بيكسل (Pixels) حيث تمثل 93.19 % من المساحة الكلية لمستجمع مياه الأمطار بوادي حيون.

جدول (5) تجمع السريان للمياه داخل مستجمع مياه وادي حيون

النسبة المئوية (%)	المساحة (كم ²)	مجمع السريان
93.19	31.9207	3947
3.12	1.0692	132
1.11	0.3807	47
0.33	0.1134	14
1.11	0.3807	47
1.14	0.3903	49

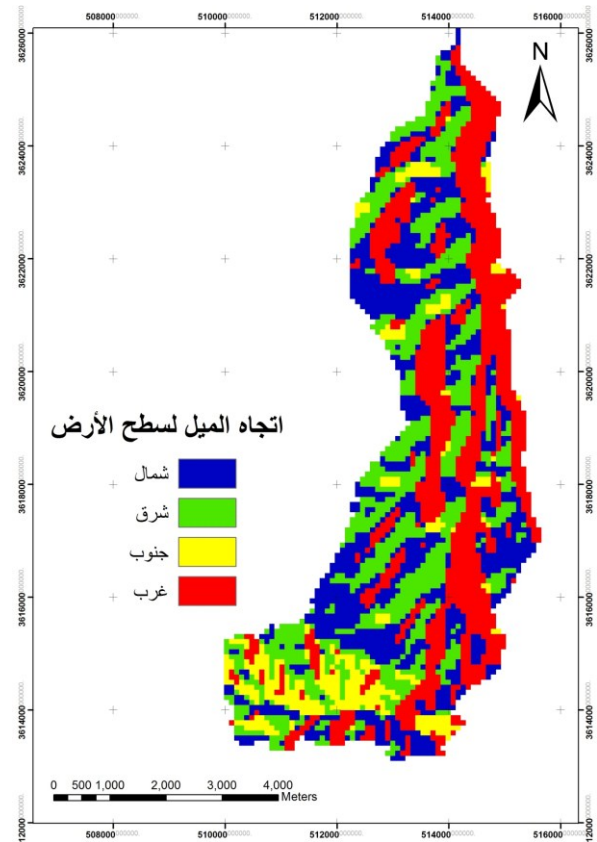
مصدر البيانات: من حساب الباحث اعتماداً على برنامج ArcGis

اتجاه الشرق ويرتبط طول المجرى المائي بطول تحت المستجمع بصفة عامة.

جدول (3) اتجاهات الميول لسطح الأرض داخل مستجمع وادي حيون

النسبة المئوية (%)	المساحة (كم ²)	اتجاه الميل
29.16	9.9904	الشمال
26.31	9.0123	الشرق
22.77	7.8003	الجنوب
21.76	7.4520	الغرب

مصدر البيانات: من حساب الباحث اعتماداً على برنامج ArcGis



شكل (4) اتجاهات الميول لسطح الأرض داخل مستجمع وادي حيون.

اتجاه سريان المياه Flow Direction: أوضحت نتائج

اتجاه سريان المياه حسب الجدول (4) والشكل (5) أن اتجاه حركة المياه الرئيسي هو إلى الشمال بصفة عامة (شمال شرقي - شمال - شمال غربي) وبنسبة تصل إلى 44.27 %

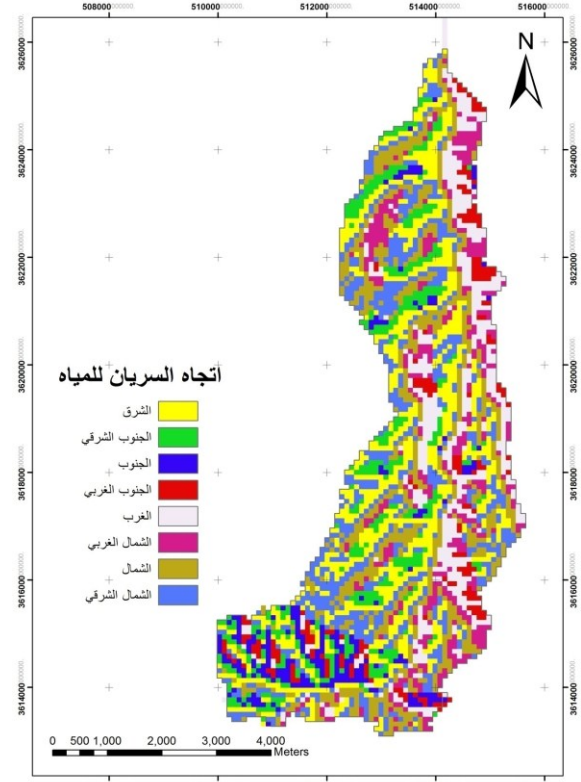
الخصائص المورفومترية لحوض وادي حيون:

الخصائص المساحية:

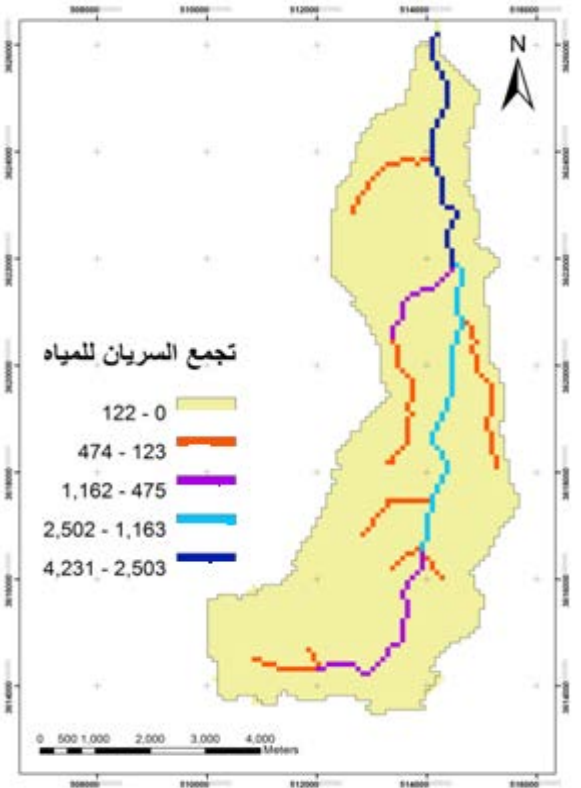
مساحة مستجمع المياه: تعتبر مساحة مستجمع المياه من أهم الخواص المساحية المستخدمة كثيراً في النماذج الهيدرولوجية وتستخدم في حساب الكثير من المقاييس المهمة مثل كثافة التصريف للمساحة وغير ذلك وهي تعد العامل الرئيسي المحدد لكمية المياه المنصرفة في مستجمع المياه إذا كانت جميع العوامل الأخرى ثابتة مثل خصائص الصخور والبنية الجيولوجية والغطاء النباتي والظروف المناخية وهذا يعني زيادة كمية الأمطار.

أظهرت النتائج أن المساحة الكلية للمستجمع تبلغ 34.2792 كم² وأنه يحتوي على 37 تحت مستجمع (مستجمع جزئي) وأن مساحة هذه المستجمعات الجزئية تراوحت ما بين 0.0324 كم² إلى 2.6568 كم² كما يتضح في جدول (6) و شكل (7) وقد تراوحت مساحات المستجمعات الجزئية ما بين 2.6568 كم² لتحت مستجمع رقم (12) الذي يقع في الجزء الشمال الغربي للمستجمع الرئيسي، لحوض رقم (25) الواقع في منتصف المستجمع الرئيسي، وبهذا يعتبر مستجمع مياه وادي حيون من المستجمعات ذات المساحة الكبيرة نسبياً، وكبر المساحة يعني زيادة ما يتلقاه من مياه الأمطار.

طول المستجمع: يبلغ طول المستجمع حوالي 12.53 كيلو متر و قد تراوحت ما بين أقصى طول والذي تمثل في مستجمع مياه رقم (19) و الذي بلغ طوله 4.00 كم، وأقل طول بين المستجمعات الجزئية مستجمع رقم (24) 0.18 كم، وأوضحت نتائج الخصائص الشكلية للمستجمع أنه يميل للاستطالة بصفة عامة ويظهر في شكل مثلث قمته إلى اتجاه ساحل البحر. ويؤثر طول المستجمع على زمن التركيز في المستجمع إذ إن المياه التي يستقبلها المستجمع تأخذ وقتاً طويلاً للوصول إلى نقطة المصبّ بسبب ضياع جزء منها



شكل (5) اتجاهات السريان لمستجمع مياه وادي حيون.



شكل (6) تجمع السريان للمياه والمساحات لمستجمع مياه وادي حيون.

إلى الدائرة عندما تقترب (1) وانخفاض النسبة يدل على سيادة المجرى الرئيسي والترتبة التالية ذات التعرية التراجعية (الوادي في مرحلة الشباب)، ووصلت هذه النسبة في وادي حيون إلى (0.22) وتعتبر هذه نسبة قليلة جداً وتدل على بعد مستجمع المياه عن الاستدارة وقربه من الاستطالة أكثر، والسبب في ذلك سيادة عمليات التعرية التراجعية وتعميق المجرى.

معامل الشكل: تم تحديد أشكال مستجمعات المياه من خلال المعادلة التالية:

(Gregory and Walling, 1976):

$$Rf = A / L^2$$

حيث: A مساحة مستجمع المياه، L طول مستجمع المياه. يصف معامل الشكل مدى انتظام عرض مستجمع المياه على امتداد طولها من المنبع إلى المصب، وهي تصل في وادي حيون إلى 0.22 وهي نسبة منخفضة، وتدل على صغر المساحة مقابل الطول، مما يجعل الحوض يقترب من شكل المثلث ويتيح فرصة جيدة لتجمع المياه عند قاعدة المثلث وانخفاض احتمالية حدوث الفيضان.

معامل التفلطح (الانبعاج): يعالج هذا المعامل بعض السلبيات التي تظهر في معدل الاستدارة وذلك لعدم امكانية وجود أحواض تتخذ الشكل الدائري تماماً أو تكون تامة الاستدارة ولكن معظم الأحواض تأخذ عادة القطع الناقص أو الشكل الكمثرى أو الشكل الإهليجي، ويستخرج من المعادلة الآتية:

$$\text{معامل التفلطح (الانبعاج)} =$$

$$\text{مربع طول الحوض (كم)} / (4 * \text{مساحة الحوض (كم}^2))$$

تدل القيم المنخفضة على تفلطح الحوض وزيادة أعداد مجاريه الأولية وأطولها في مكان ما منه دون سواه، في حين تشير القيم المرتفعة إلى عكس ذلك، حيث وجد أنه لوادي حيون يبلغ 1.15 وهو يعتبر من القيم المنخفضة.

الخصائص التضاريسية:

نسبة التضرس: وهو يرتبط بمناخ وجيولوجية ونوعية الصخور في حوض التصريف لمستجمع المياه وتدل درجة التضرس

بالتبخر والتسرب، ويتيح فرصة كبيرة لتغذية الخزان الجوفي في المستجمع، وهذا يعني أن احتمال حدوث الفيضان قليل.

عرض مستجمع المياه: يؤثر عرض المستجمع على كمية التلقي من التساقط والجريان والتسرب وكلما زاد عرض الحوض زاد ما يتلقاه من التساقط وبالتالي يزداد الجريان السطحي، يصل عرض مستجمع مياه حيون نحو 2.74 كم، وبلغت نسبة الطول إلى العرض 4.57 أي أكثر من أربعة أضعاف وهذا يعني استطالة الحوض وبالتالي زيادة زمن التركيز Time of Concentration أي وصول المياه إلى المجرى الرئيسي في أوقات مختلفة ويزداد عرض مستجمع حيون في أعلاه بسبب عمليات التعرية التراجعية والجانبية لشدة الانحدار وزيادة كمية الأمطار على هذه المنطقة لأنها منطقة ذات ارتفاعات عالية وتصل إلى 378 م.

محيط مستجمع المياه: يبلغ محيط مستجمع مياه وادي حيون حوالي 43.74 كم، وهذا الطول لمستجمع مياه يوضح مدى تعرج خط تقسيم المياه المحيط بالمستجمع بالإضافة إلى أنه يعكس مساحته الكبيرة. وتباينت محيطات المستجمعات الجزئية ما بين أقصى طول محيط في تحت مستجمع رقم (12) والذي بلغ طول محيطه 13.14 كم، وأقل طول محيط في مستجمع رقم (25) إذ بلغ 1.08 كم.

الخصائص الشكلية:

نسبة الاستطالة: تعبر عن امتداد مستجمع المياه مقارنة مع الشكل المستطيل وتتراوح ما بين (0 - 1) ويكون الشكل أقرب للمستطيل عند الاقتراب من الصفر، وتصل في وادي حيون (0.53) أي أن مستجمع المياه يميل للاستطالة إلى حد ما، ويرجع ذلك لطبيعة الصدع أو الانكسار الطولي في صخور المنطقة ولذلك فإن مجرى الوادي ينطبق مع الصدع الجيولوجي في منطقة الدراسة.

نسبة الاستدارة: توضح مدى اقتراب وابتعاد شكل مستجمع المياه عن الدائرة، ويتراوح ما بين (0-1) ويكون الشكل أقرب

جدول (6) بعض خصائص تحت مستجمعات وادي حيون.

رقم تحت المستجمع	المساحة (كم ²)	المحيط (km)	طول المجرى المائي (km)
1	0.4698	3.60	0.97
2	0.9558	6.66	1.53
3	1.4661	7.02	1.68
4	2.5596	9.18	0.70
5	0.4779	3.96	0.84
6	0.7938	4.68	1.23
7	0.8343	4.68	3.05
8	0.8424	5.40	0.99
9	0.2106	3.06	0.40
10	1.1826	7.20	1.28
11	2.5839	10.08	3.40
12	2.6568	13.14	0.45
13	2.2113	9.54	0.28
14	0.4698	4.14	1.36
15	0.9720	6.12	3.47
16	0.3888	3.60	0.28
17	0.9801	7.20	1.08
18	0.3726	3.42	0.37
19	0.0972	2.16	4.00
20	1.0206	6.30	1.75
21	0.8829	5.22	0.28
22	0.5103	4.86	0.97
23	0.4617	4.68	0.57
24	1.4580	7.20	0.18
25	0.0324	1.08	0.56
26	0.3645	3.42	1.57
27	1.6281	6.84	0.66
28	0.7776	5.22	0.98
29	0.6075	3.96	0.41
30	1.1340	6.30	0.88
31	0.5589	4.14	2.44
32	0.4779	3.96	0.88
33	0.7290	5.22	0.36
34	1.3041	5.94	1.44
35	0.3402	3.24	1.27
36	0.8262	4.68	0.79
37	0.6399	5.04	0.79

المنخفضة على انبساط مستجمع المياه (Maidment, 1993)، وقد وصلت في وادي حيون 29.37 م/كم وهي قيمة منخفضة وذلك لكبير مساحة المستجمع وتدل على أن المستجمع المائي قد سُوي جزء من حوضه وغالباً هذا الجزء الذي يستخدم في الزراعة. حُسبت من معادلة (1976،

(Gergory and Willing

$$Rh = Hm / L$$

حيث Hm التضرس الكلي، L طول مستجمع المياه

التضاريس النسبية: بلغت التضاريس النسبية للمستجمع 8.345 ويشير الارتفاع النسبي إلى نشاط عمليات التعرية خلال الأزمنة الجيولوجية السابقة والتي ساهمت في تشكيل سطح مستجمع وادي حيون.

قيمة الوعورة: وجد أنه بتطبيق قيمة الوعورة على كامل مستجمع مياه وادي حيون بلغت 1.92 وهي قيمة مرتفعة تدل على وعورة سطح مستجمع المياه خاصة في الجزء الشمالي منه مما يقلل من فرص الاستخدام الزراعي بها وتركز النشاط الزراعي في الجزء الجنوبي. حُسبت من المعادلة التالية:

$$HD = (Hm. D) / L$$

حيث Hm التضرس الكلي، D كثافة التصريف، L طول مستجمع المياه

نسبة النسيج: وهو يشير إلى معدل تقطع مستجمع المياه وحُسب من معادلة (1971) Chorley and Kennedy

$$Rt = \sum Nu / P$$

حيث Nu عدد الروافد في الرتبة، P محيط مستجمع المياه.

بلغت نسبة النسيج في مستجمع مياه وادي حيون 0.84 وهي نسبة منخفضة تدل على إن النسيج خشن، ويشير إلى مقاومة الصخور لعمليات التعرية بالرغم من أنها من الصخور الجيرية وقد يلعب الغطاء النباتي الكثيف خاصة في الجزء الشمالي من مستجمع المياه دوراً هاماً في تنظيم حركة الماء فيقلل من عمليات التعرية في الوقت الحالي بالرغم من نشاطها في المراحل الأولية لتكوين مستجمع المياه والأودية التي تجري فيه.

رتب وأطوال مجاري الوادي: تتكون شبكة تصريف الوادي من 37 مجرى كما في شكل (8)، ومن نتائج تحليل الرتب والأطوال في شبكة تصريف وادي حيون تبعاً لطريقة (Strahler, 1957) نجد أن مستجمع المياه يصنف على أنه من الرتبة الثالثة جدول (7) (شكل 8)، وهذا يشير إلى عدم تطور شبكة التصريف المائي بمستجمع المياه، حيث إن طول المجرى الرئيسي لمستجمع حيون 15.91 كم، وطول المجاري لجميع رتب المستجمع 44.14 كم حيث تتكون الرتبة الأولى من 740 مجرى وتشكل ما نسبته 56.40% من رتب المستجمع، جدول (7) وهي في معظمها أودية قصيرة جداً ولا يعبر عددها عن مدى فاعليتها في نشاط شبكة التصريف المائي.

جدول (7) رتب وأطوال الأودية لشبكة تصريف وادي حيون

الرتبة	عدد المجاري	النسبة المئوية %
1	740	56.40
2	252	19.21
3	157	11.97
4	64	4.88
5	99	7.54

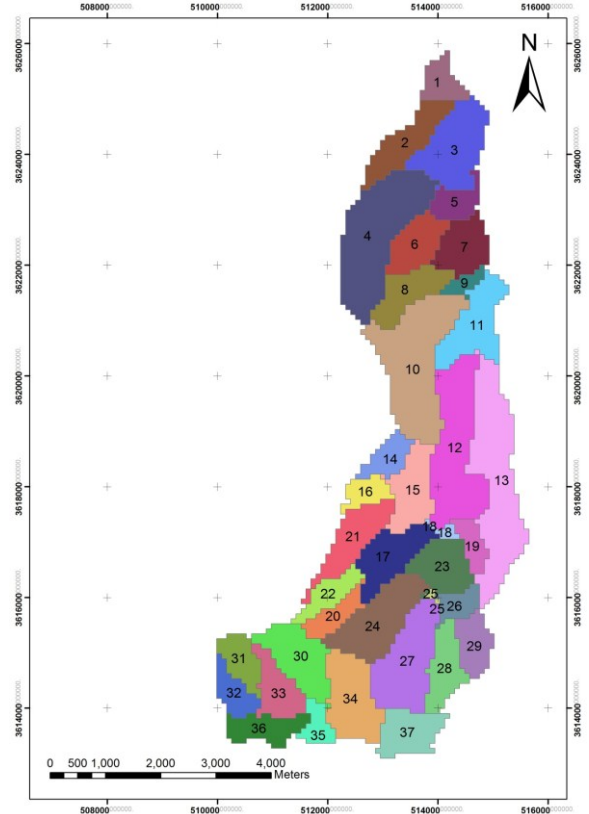
مصدر البيانات: من حساب الباحث اعتماداً على برنامج ArcGis

تكرارية المجاري المائية: تصل تكرارية المجاري المائية في وادي حيون إلى 1.08 وهي قيمة منخفضة تدل على قلة أعداد المجاري في مستجمع المياه بالنسبة لمساحته وبالتالي قلة أطوالها، وتشير التكرارية المنخفضة إلى انخفاض فرص الجريان داخل مجاري الأودية وأن معظم الماء في مجاري الأودية يختزن في التربة أو يتسرب خلال الشقوق إلى المياه الجوفية وأن الوادي مازال في مرحلة مبكرة من النضج.

نسبة التشعب: وهي تعبر عن العلاقة بين عدد المجاري المائية في رتبتين متتاليتين، وتم حسابها تبعاً للمعادلة التالية:

$$Rb = Nu / Nu+1$$

حيث Nu عدد الروافد في الرتبة، Nu +1 عدد الروافد في الرتبة التالية.



شكل (7) مستجمع المياه الرئيسي لوادي حيون والتحت المستجمعات الجزئية.

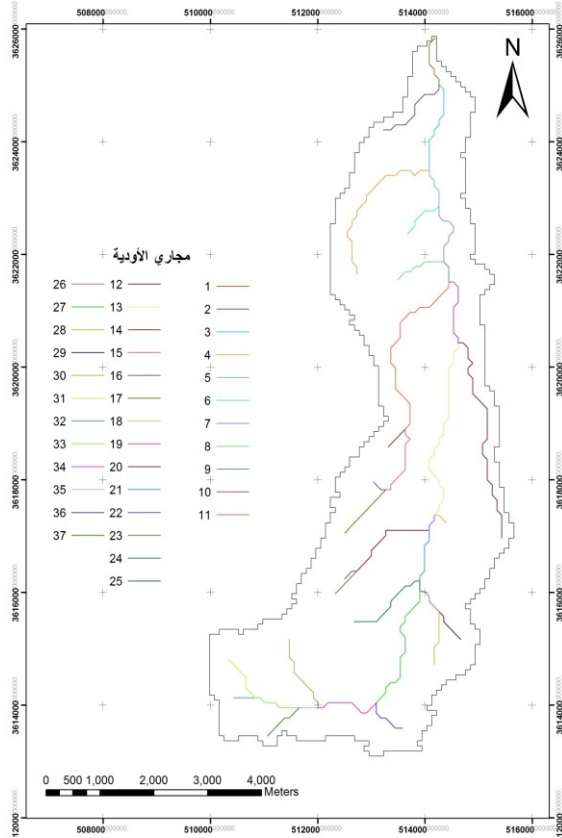
التكامل الهبسومتري: يعد التكامل الهبسومتري من المعاملات المستخدمة لتمثيل الفترة الزمنية التي قطعها الدور التحاتية في الأحواض النهرية ومن خلال تكامل العلاقة بين المساحة الحوضية وتضاريس الحوض، إذ إن الزيادة في المساحة يرافقها زيادة في كثافة الصرف وانخفاض في تضاريس الحوض.

يمكن الحصول على معدل التكامل الهبسومتري من خلال المعادلة الآتية:

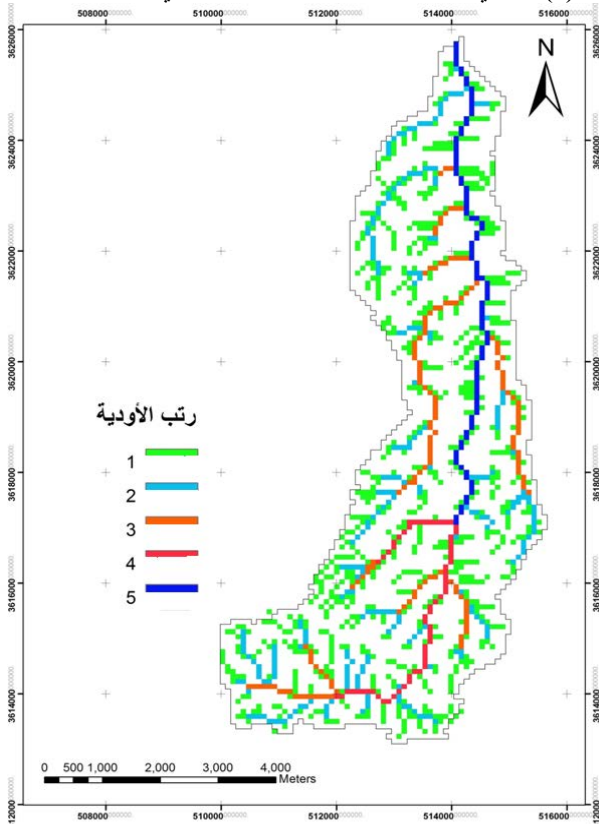
التكامل الهبسومتري = مساحة الحوض (كم²) / تضاريس الحوض (م)

وبعد أن طبقت معادلة التكامل الهبسومتري على منطقة الدراسة اتضح أن النتائج كانت منخفضة إذ بلغت 0.0907، مما يعني صغر عمر ومساحة الحوض وزيادة الانحدار وأنه لا يزال في بداية دورته التحاتية.

الخصائص الخطية لشبكة التصريف:



شكل (8) مجاري الأودية الرئيسية لشبكة تصريف وادي حبون.



شكل (9) رتب الأودية لشبكة تصريف وادي حبون.

وجد أن نسبة التشعب لمستجمع مياه وادي حبون قد بلغت 1.9 وهي تدل على قلة تقطع الحوض وزيادة كمية التصريف التي تصل مباشرة إلى المجرى الرئيسي لمستجمع المياه، ويعزى ذلك لقصر طول الأودية الفرعية وعدم تشعبها واتصال معظمها بطريقة مباشرة بالمجرى الرئيسي.

كثافة التصريف: تم حسابها من معادلة Horton (1945) التالية:

$$kD = \sum_{i=1}^k Lu/A$$

حيث Lu الطول الكلي للمجاري المائية في كل الرتب المختلفة

Ak المساحة الكلية لمستجمع المياه.

وجد أن كثافة التصريف في وادي حبون 1.22 كم²/كم² وهي نسبة منخفضة نظراً لقصر طول مجاري الأودية وأن الحوض لم يصل بعد إلى مرحلة النضج الطبوغرافي وأن المستجمع مازال يعمق ويوسع حوضه، وهذا ما يتفق مع بقية الخصائص الخطية لشبكة التصريف.

معامل التعرج الطبوغرافي: يصل معامل التعرج لمستجمع مياه وادي حبون 1.32 وبناءً على تصنيف شوم Schamm فإن مستجمع مياه حبون يصنف بأنه ذو مجاري انتقالية Transitional أي إنه سينتقل إلى المجاري المنتظمة والتي يبلغ مؤشر تعرجها (1.5)، أي إن مجاري الحوض أقرب إلى الاستقامة من التعرج، وهذا يعني أن المياه تصل إلى المصبّ في فترة قصيرة إلا أن هناك عوامل تقلل من احتمالية حدوث الفيضان في الحوض مثل طول الحوض وشكله وقلة كثافة التصريف والاستخدام الزراعي المكثف في الجزء الجنوبي منه والغابات الطبيعية الكثيفة في الجزء الشمالي، بالإضافة إلى الطبيعة الصخرية الجيرية المتشققة السائدة في منطقة الدراسة، والتي تساهم في فقد جزء من مياه الجريان السطحي داخل مجاري الأودية إلى المياه الجوفية عبر الشقوق والفواصل.

الاستنتاج

نستنتج أن مستجمع وادي حيون يميل للاستطالة بصفة عامة على شكل مثلث قمته في اتجاه ساحل البحر وينبسط في جزئه الجنوبي، بينما يكون شديد التضرس في الجزء الشمالي وبالرغم من الطول الإجمالي للمجاري المائية إلا أنها تعتبر قليلة بالنسبة للمساحة الإجمالية للمستجمع مما يجعل الوادي غير ناضج ومازال يعمق مجراه ويوسع حوضه، كذلك أن مجاري الحوض أقرب إلى الاستقامة من التّعرج وهذا يعني أن المياه تصل إلى المصبّ في فترة قصيرة، وأن تكرارية المجاري المائية منخفضة مما يقلل من فرص الجريان.

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الخصائص الهيدرولوجية لمستجمع مياه وادي حيون:

زمن التركيز: المعادلة المعدلة لجاتون Jaton كما يلي:

$$TC = 76.3 \sqrt{S} \sqrt{i}$$

حيث TC زمن التركيز، S مساحة المستجمع المائي، معدل الانحدار (i).

بلغ زمن التركيز على حوض وادي حيون 6.79 ساعات وهو وقت طويل لطول الحوض إذ بلغ طوله 44.14 كم وبلغت نسبة الاستطالة في الحوض 0.53 وهي نسبة عالية تدل على الشكل المستطيل للحوض.

سرعة الجريان السطحي: بلغت سرعة الجريان على وادي حيون 0.142 م/ث وهي قيمة عالية حيث إن سرعة الجريان تزيد بزيادة الانحدار وطول المستجمع إذ بلغ 12.53 كم

بالإضافة إلى درجة تّعرج المجاري حيث كانت أقرب للاستقامة، كل هذه العوامل تؤدي لزيادة سرعة وصول المياه للمصبّ.

معامل الفيضان: وبتطبيق معادلة جاتون (Jaton, 1980) بلغ

معامل الفيضان في وادي حيون 23.18 وهذا يعني احتمالية حدوث جريان سريع في المجرى الرئيسي للوادي ويعود ذلك لارتفاع تكرارية مجاري الرتبة الأولى في المستجمع.

قمة التدفق: يتم حسابها باستخدام طريقة تالبوت

$$Q = K C A^n R_f F_f$$

حيث Q قمة التدفق أو التصريف م³/ث، K ثابت.

C معامل التصريف ويحسب من مجموع C1+C2+C3

حيث C1 معامل لتحديد طبيعة المنطقة.

C2 معامل انحدار منطقة التصريف.

C3 معامل الشكل لمنطقة التصريف.

حيث يصل التدفق في مستجمع وادي حيون 443.26 م³/ث، وهذا يشير إلى أن الحوض يصرف كميات كبيرة من المياه عند نقطة المصب، وذلك كلما زادت مساحة الحوضية للحوض زاد كمية ما يستقبله من مياه الأمطار وبالتالي زيادة ما يصرفه من المياه.

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Study of Some Morphometric Variables Using of Digital Elevation Models (DEM) of Wadi Habboun - Libya

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Abstract: The Habboun Valley is considered one of the valleys in Al-Jabal Al-Akhdar area, Libya, with an intensive agricultural activity. This study was carried out with the aim of identifying some of the morphometric properties of the valley, as well as building a spatial-digital database of the watershed to support and serve decision makers using DEM data. The topographic analysis was carried out for the study area and the boundaries of the Wadi Habboun watershed were determined and separated from the rest of the surrounding catchments. The morphometric analysis of the valley and its watershed was conducted to determine its different characteristics (area, Perimeter, the length of the watercourse, the slope of the stream). It showed that the total area of the catchment is 34.2792 km² and that it contains 37 Sub-catchment. The area of these catchments ranged between 0.0324 to 2.65 km². The length of the catchment is about 12.53 Km and its width is 2.74 Km and its perimeter is 43.74 Km. It tends to elongate in general and appears in the shape of triangle summit in the direction of the sea, while characteristics of the topography showed that it is a flat plank in its southern part, where agricultural activity is widespread, while it is highly concentrated in the northern part which occupied mostly with Mediterranean forests. The results of the analysis of the identification network showed that it contains 37 waterways and their total length reached 41.94 km and the length of the main stream of the 15.91 Km, as well as the streams of the basin straight and this means that the water reaches downstream in a short period of time and the frequency of the waterways is low and thus, reduces the chances of runoff within the valleys.

Keywords: GIS; Digital Elevation Model; Morphometric; Wadi Habboun; Libya.

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محددات الطلب على العمالة في القطاع الزراعي في ليبيا للفترة 1975-2014 (دراسة تطبيقية باستخدام طريقة المربعات الصغرى الديناميكية (DOLS))

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المستخلص: إستهدفت الدراسة تقدير أهم العوامل المؤثرة على العمالة في القطاع الزراعي في ليبيا للفترة 1975-2014، ولتحقيق هدف الدراسة اعتمد البحث منهجية Gregory Hansen للتأكد من وجود علاقة تكامل مشترك بين متغيرات الدراسة، وتقدير نموذج مقدرات التكامل المترامن للعلاقة في المدى الطويل، بوساطة تطبيق طريقة المربعات الصغرى الديناميكية (DOLS) كونها أحد طرق إنحدار التكامل المشترك، وأشارت نتائج الدراسة إلى وجود علاقة موجبة ذات دلالة إحصائية بين مستوى التكوين الرأسمالي الثابت والإستخدام في قطاع الزراعة، وتأثير عكسي لمستوى متوسط الأجور الحقيقية على الطلب على العمالة الزراعية، كما أوضحت قيم المتغير الصوري في النموذج التأثير الإيجابي له والذي يشير إلى القرارات الصادرة والتي تقضي بخفض عدد العاملين في الجهاز الإداري وتشجيع العمالة الزائدة إلى العمل في القطاعات الإنتاجية كالزراعة والصناعة، وأوصت الدراسة في ضوء النتائج المستخلصة ضرورة التوسع في الإستثمارات الحالية، وخلق إستثمارات جديدة لاستيعاب الطلب الإضافي من العمالة، ووضع سياسة للأجور يكون من شأنها زيادة الطلب على العمل.

الكلمات المفتاحية: العمالة الزراعية، الناتج الزراعي، الأجور، التكوين الرأسمالي الثابت، التكامل المشترك.

المقدمة

القطاع الزراعي الليبي (الأرياح، 1996)، إن عدد العمالة الزراعية في ليبيا في انخفاض مستمر؛ حيث كان أكثر من 70٪ من السكان الليبيين يعملون في الزراعة وتربية الحيوانات وفقاً لتقرير أعدته البعثة إلى ليبيا في عام 1952 (الأمم المتحدة، 1952؛ Al-chukhucka، 2003). كما أكد Metz (2004) أنه قبل عام 1958، أسهمت الزراعة بنسبة 30٪ من الناتج المحلي الإجمالي، ووفرت المواد الخام للقطاع الصناعي والتجارة والصادرات، على الرغم من أن الأراضي الزراعية في ليبيا لا تتعدى 4٪ من مساحتها الكلية 1.76 مليون كيلومتر مربع.

لقد انخفض عدد القوى العاملة في الزراعة بشكل كبير من 50٪ من إجمالي العمالة في عام 1963 إلى 30٪ في عام

تناولت النظرية الاقتصادية المحاور الاقتصادية المتعلقة بتقديرات العرض والطلب على العمالة، بهدف إحداث توازن بين جانبي العرض والطلب على القوى العاملة، والطلب على العمالة الزراعية هو طلب مشتق من الطلب على منتجات الأراضي الزراعية، وتعد العمالة الزراعية من أهم عناصر الإنتاج اللازمة لزيادة الناتج الزراعي (محمد وآخرون 2016). ونظراً إلى التغيرات الاقتصادية والاجتماعية التي مرت بها ليبيا خلال العقود السابقة، وعلى الرغم من تطبيق سياسة التنمية الزراعية فإن هناك عدم توازن في هيكل سوق العمل، فضلاً عن انخفاض كفاءة استخدام عنصر العمل البشري في

عدد السكان، والتوسع في التعليم الجامعي على حساب التعليم التقني، قد ألفت تلك المتغيرات آثارًا سلبية على توازن سوق العمل، وأدى إلى ارتفاع معدلات البطالة

هدف البحث: تقدير دالة الطلب على العمالة الزراعية في القطاع الزراعي، ومن ثم تحديد العوامل المؤثرة عليها.

منهجية الدراسة

اشتملت منهجية الدراسة على اختبار استقرارية البيانات باستخدام اختبار فيليب بيرون وديكي فولر الموسع، وتحليل التكامل المشترك باستخدام منهجية Gregory Hansen كما اعتمد طريقة المربعات الصغرى الديناميكية (Dynamic Ordinary Least Square Method) (DOLS).

الدراسات السابقة

تتسم الدراسات في مجال الموارد البشرية الزراعية في ليبيا بالندرة مما يعطي أهمية بحثية وتطبيقية للدراسات الحالية في هذا المجال (الشباح، 2018). وبشكل عام هناك العديد من الدراسات التي تناولت العوامل المؤثرة على الطلب على العمالة الزراعية، وقد أدرجت متغيرات مختلفة، وهذه المتغيرات تختلف من دولة إلى أخرى. ونذكر من هذه الدراسات على سبيل المثال: دراسة Kandilov (2017) و Kandilov لتقدير دالة الطلب على العمالة الزراعية في الولايات المتحدة الأمريكية لتقييم تأثير الحد الأدنى للأجور، والمكاسب، والأجر بالساعة، والساعات الأسبوعية على العمالة الزراعية، وبينت نتائج الدراسة ان مرونة الطلب بالنسبة للحد الأدنى للأجور كانت سالبة. وهذه الدراسة أكدت دراسة قام بها ليانوس (1972) للتحقيق في تأثير الحد الأدنى للأجور للعمال الزراعيين في الولايات الجنوبية الأمريكية من 1950 إلى 1969 حيث أثبتت النتائج ان إدخال الحد الأدنى للأجور للعمال الزراعيين تعمل على تقليل من فرص العمل في الزراعة. وأكدت دراسة (Devi وأخرون، 2013) على ان النتائج الزراعية من المحددات المهمة للطلب على العمالة

1969، ويعزى ذلك بشكل أساسي إلى هجرة المزارعين المحليين والقوى العاملة إلى المناطق الساحلية للبحث عن وظائف في القطاع العام (Allan، 1981). وبحلول عام 1968، لم يكن بالإمكان الحفاظ على الإنتاج الزراعي الليبي بدون العمالة الخارجية، وبخاصة من تونس ومصر، وعلى سبيل المثال اعتمد الإنتاج الزراعي الليبي في الشمال الغربي بشكل كبير على العمالة المهاجرة التونسية، في حين أن الإنتاج الزراعي في شمال شرق ليبيا كان يعتمد إلى حد كبير على العمال المصريين المهاجرين (Allan، 1983). وأوضح الصادق (2007) أن ليبيا تعاني من نقص كبير في القوى العاملة الزراعية، هذا فضلاً عن النقص الواضح في الكفاءة الإنتاجية والمهارة في استخدام عناصر الإنتاج الحديثة، والطلب على القوى العاملة يزداد بمعدل أقل من معدل النمو السكاني، ومعدل العمالة في الميادين الأخرى وعليه انخفض نصيب الزراعة من المجموع الكلي للقوى العاملة، وتصل نسبة العمالة الأجنبية إلى حوالي 86% من إجمالي العمالة الزراعية.

كما أن هناك العديد من العوامل التي تؤثر على الطلب على العمالة الزراعية، من أهمها: الأجور، ومساحة الأراضي المزروعة، والاستثمارات الكلية، وتشير بعض الدراسات الى أن نسبة مساهمة العمالة الزراعية في العمالة الكلية الليبية قد انخفضت خلال الفترة الأخيرة (محمد وآخرون 2016).

إن من المهم جداً دراسة محددات العمالة الزراعية؛ لمعرفة حركة العمالة الزراعية، ولوضع إستراتيجيات مناسبة لتعزيز نمو العمالة (Devi وآخرون، 2013) وسوف تستهدف هذه الدراسة تحديد العوامل المحددة للطلب على العمالة الزراعية في ليبيا خلال الفترة (1975-2014).

مشكلة الدراسة: يشهد القطاع الزراعي في ليبيا تراجع الأهمية النسبية لمساهمة العمالة الزراعية في سوق العمل، ولقد كان لاكتشاف النفط دورٌ كبيرٌ في التأثير على هيكل سوق العمل في ليبيا، فضلاً عن التغيرات الاجتماعية والمتمثلة في زيادة

تقدير الطلب على عنصر العمل البشري في الزراعة المصرية طبقاً للمنهج الثنائي وذلك بتقدير نماذج الريح والتكاليف من نوع كوب-دجلاس واللوغاريتمية المتسامية وتبين وجود علاقة عكسية بين أجر العامل الزراعي وعدد العمال، كما تبين وجود علاقة إحصائية بين رأس المال والعمل لصالح العمل.

إما على صعيد الدراسات المحلية فهناك دراستين : الأولى دراسة الصادق ومحمد (2007) بعنوان (دور العمالة الزراعية في خطط التنمية الاقتصادية في الجماهيرية الليبية) والتي هدفت إلى دراسة تأثير المتغيرات الاقتصادية على الطلب على العمالة الزراعية خلال الفترة 1981-2007 ، من خلال تقدير نموذج قياسي ، وتبين من نتائج البحث أن زيادة إنتاجية العامل الزراعي بمقدار دينار واحد تؤدي إلى زيادة الطلب على العمالة الزراعية بحوالي عامل زراعي واحد وأن زيادة قيمة الإنتاج الزراعي بمقدار مليون دينار تؤدي إلى زيادة الطلب على العمالة الزراعية بمقدار ألفي عامل، وأثبتت الدراسة أن إنتاجية العامل تحتل المرتبة الأولى من حيث التأثير على الطلب على العمالة الزراعية، ويليه المستوى التكنولوجي من حيث التأثير على أجر العامل الزراعي. والثانية دراسة محمد وآخرون (2016) لتقدير دالة الطلب على العمالة الزراعية في ليبيا للفترة (1981-2011)، بينت نتائج الدراسة التأثير السلبي لكل من إنتاجية العامل الزراعي والأجور على الطلب على العمالة، والتأثير الإيجابي للناتج الزراعي عليها كما تبين من معاملات الانحدار الجزئي ان متغير الناتج الزراعي يأتي في المرتبة الأولى من حيث الأهمية النسبية في التأثير على الطلب في العمالة الزراعية يليه في المرتبة الثانية أجر العامل ويأتي في المرتبة الثالثة والأخيرة إنتاجية العامل .

ولئن اشتركت معظم الدراسات في تركيزها على أهمية الأجور وعلاقتها العكسية بمستوى الطلب على العمالة الزراعية ، إلا أن هذه الدراسات لم تكن مجمعة على دور الناتج الزراعي والذي كان معنوي في بعض الدراسات وغير معنوي في

الزراعية في منطقة البنجاب الواقعة بين الهند وباكستان حيث يؤثر بشكل ايجابي. تناولت دراسة (عيسى، 2011) الطلب على العمل في قطاع الزراعة في الجزائر للفترة 1970-2005 باستخدام طريقة المربعات الصغرى، وقد أكدت النتائج التأثير الإيجابي لكل من زيادة الناتج الزراعي والمتغير الوهمي المتمثل في البرنامج الوطني للتنمية الريفية على حجم العمالة، والعلاقة العكسية بين الأجور والطلب على العمل. وأجرى (النعمي و محسن، 2012) دراسة قياسية للطلب على العمالة الزراعية في ثلاث دول عربية ، هدفت إلى قياس أثر نصيب الفرد من الناتج المحلي الإجمالي وحجم السكان على القوى العاملة الزراعية في كل من اليمن ، سوريا والسعودية ، وقد بينت نتائج الدراسة التي استخدمت طريقة المربعات الصغرى العلاقة السالبة بين نصيب الفرد من الناتج المحلي الإجمالي والطلب على القوى العاملة في اليمن مما يدل على الاتجاه المستمر في تناقص حصة القطاع من القوى العاملة وعدم معنوية حجم السكان، اما في المملكة العربية السعودية فقد أشارت النتائج إلى عدم معنوية نصيب الفرد من الناتج المحلي الإجمالي وأكدت وجود علاقة عكسية ذات معنوية إحصائية بين حجم السكان والطلب على العمالة الزراعية في السعودية وقد تم تفسير ذلك بأنه عند إدخال الأساليب الحديثة في الإنتاج الزراعي فان ذلك يقلل من الطلب على العمالة.

وبالنسبة إلى سوريا فقد أكدت النتائج وجود علاقة طردية وذات معنوية إحصائية بين كل من نصيب الفرد من الناتج المحلي الإجمالي وحجم السكان على الطلب على العمالة الزراعية. وقامت (زبيحة، 2016) بتقدير الطلب على عنصر العمل الزراعي في الجزائر للفترة 1990-2015 من خلال نموذج لدالة القيمة المضافة الخطية وغير الخطية وذلك باستخدام طريقة المربعات الصغرى بهدف تحديد أهم المتغيرات المؤثرة في القوى العاملة، وتوصلت الدراسة إلى انه توجد علاقة عكسية بين الناتج الزراعي ممثلاً بالقيمة المضافة والطلب على العمالة الزراعية، بينما العلاقة طردية بين عنصر الزمن والعمالة. وفي دراسة لشحاتة وعطا (2002) تم

وهو ذو أثر موجب، والثاني أثره سالب؛ حيث إن ارتفاع الأجور يؤدي إلى ارتفاع الأسعار، وهذا يترتب عليه نقص الطلب على الإنتاج، ومن ثم نقص الكمية المطلوبة من العمل (أي إن تأثير الأجور يكون بمجمله سالباً).

3- حجم التكوين الرأسمالي: إن زيادة التكوين الرأسمالي يعد المحرك الأساسي للتنمية الزراعية، ومن ثم فإن زيادته تعني مزيداً من الاستثمارات، وزيادة الإنتاج، وخلق فرص العمل، إلا أن أثر التكوين الرأسمالي على الاستخدام يعتمد على ما إذا كانت طبيعة العلاقة بين العمل ورأس المال علاقة تبادلية أو تكاملية، كما أن هناك جزءاً من الاستثمار مولد للنمو الاقتصادي، ولكنه غير قادر على خلق فرص عمل (المصباح، 2014).

النموذج القياسي وطريقة التقدير توصيف نموذج الدراسة

من خلال النظرية الاقتصادية والدراسات السابقة فإنه تم توصيف النموذج الرياضي لمحددات الطلب على العمالة الزراعية في ليبيا كالاتي:

$$LNL_t = f(LNGDP_t, LNW_t, LNK_t, D)$$

حيث ان

LNL_t : تمثل صيغة اللوغاريتم الطبيعي

LNL_t : عدد العاملين في قطاع الزراعة

$LNGDP_t$: الناتج المحلي الإجمالي الحقيقي في قطاع

الزراعة (بأسعار عام 2010)

LNW_t : متوسط الأجر الحقيقي للفرد في قطاع الزراعة

(بأسعار عام 2010)

LNK_t : التكوين الرأسمالي الثابت (بأسعار عام 2010)

D : المتغير الوهمي الذي يشير إلى القرارات التي تقضي بخفض عدد العاملين في الجهاز الإداري وتشجيع العمالة الزائدة إلى العمل في القطاعات الإنتاجية كالزراعة والصناعة.

بعضها الآخر، وقد يعود السبب في ذلك إلى عوامل متعددة منها طبيعة الاختلالات الاقتصادية الهيكلية، والتغيرات التي تحدث في الطلب الكلي. إن الورقة البحثية أدناه تختلف باستخدامها للنماذج الحديثة في تقدير العلاقة بين المتغيرات حيث إن معظم الدراسات السابقة استخدمت طريقة المربعات الصغرى (OLS) دون إجراء اختبار الاستقرارية (Stationarity)، وان غياب الاستقرارية يجعل من (OLS) غير مناسبة للتقدير.

الإطار النظري ونموذج الدراسة

تبين النظرية الاقتصادية أن الطلب على العمل طلب مشتق derived demand من الطلب على السلعة التي يسهم العامل في إنتاجها، وأشارت العديد من الدراسات إلى أن هناك مجموعة من العوامل ذات التأثير السلبي والإيجابي على هذا الطلب. ومن أهم هذه العوامل:

1- حجم الإنتاج: وفقاً لقانون أوكن فإن هناك علاقة طردية بين الناتج المحلي الإجمالي ومعدل الاستخدام، فزيادة الطلب المحلي والخارجي على السلع والخدمات المنتجة داخل الاقتصاد تؤدي إلى ارتفاع الأسعار، وعليه ارتفاع الأرباح الكلية للمنشأة، وهذا يؤدي إلى ارتفاع مستويات الإنتاج من السلع والخدمات، وينعكس ذلك على ارتفاع الطلب على العمالة (الشرع وآخرون، 1994)، إلا أنه لا يوجد اتجاه عام ثابت يؤكد هذه العلاقة الطردية بين زيادة الناتج المحلي الإجمالي والاستخدام بشكل آلي.

2- الأجور الحقيقية تشير النظرية الاقتصادية إلى أن التغير في مستويات الأجور الحقيقية يؤثر سلباً على الاستخدام وذلك من خلال أثرين (طاقة وحسن، 2008): أثر الإحلال (Substitution Effect) وأثر التوسع (Scale Effect) فزيادة الأجور الحقيقية مع ثبات الإنتاج والأسعار تؤدي إلى ارتفاع تكاليف العمل، وهذا يدفع المنتج إلى إحلال عنصر رأس المال محل العمل، أما أثر التوسع فيتكون من أثرين: الأول هو زيادة الكمية المطلوبة من العمل بسبب زيادة الإنتاج

فرضية العدم عندها تأخذ الفروق حتى يتم الوصول إلى سلسلة مستقرة. ويضاف إلى الأختبار السابق اختبار فيليب بيرون (Philips and Perron) وهو اختبار غير معلمي يأخذ بنظر الاعتبار التباين الشرطي للأخطاء، حيث اعتمد على التوزيعات المحدودة نفسها لاختباري ADF و DF، ويتطلب اختبار PP تقدير المعادلة التالية: $\Delta Y_t = \mu_0 + \mu Y_{t-1} + \varepsilon_t$ ويستخدم اختبار PP نفس القيم الحرجة التي يستخدمها اختبار ADF. ولتطبيق اختبار Gregory Hansen للتكامل المشترك للمتغيرات محل الدراسة ينبغي أولاً تحديد رتبة التكامل المشترك لهذه المتغيرات؛ وذلك للتأكد من أن جميع المتغيرات متكاملة من الرتبة $I(1)$ ، ولتحديد رتبة التكامل للمتغيرات سوف نستخدم اختبار فيليب بيرون (PP) وديكي فولر المعدل (ADF)

ومن خلال نتائج اختبار الاستقرار والمتحصل عليها بالاعتماد على اختبار فيليب بيرون (PP) وديكي فولر المعدل (ADF) يتضح أن جميع المتغيرات غير مستقرة في المستوى وقد استقرت عند الفروق الأولى، وقد كانت نتائج الاختبارين متماثلة، وذلك كما هو واضح في الجدول رقم (1).

اختبار استقرار السلاسل الزمنية Time Series Stationary Test

تعد دراسة الاستقرارية أحد الشروط المهمة عند دراسة التكامل المشترك وغياها يسبب عدة مشاكل قياسية، وتكمن أهميتها في التحقق من استقرار أو عدم استقرار السلسلة الزمنية، وتحديد رتبة التكامل المشترك للمتغيرات ومن الاختبارات المهمة في هذا المجال اختبار ديكي فولر الموسع، "Augmented Dickey-fuller"، وتأخذ معادلة التقدير الشكل التالي (Gujarati, 1995):

$$\Delta Y_t = a + \beta_t + \gamma Y_{t-1} + \sum_{j=1}^m \phi_j \Delta Y_{t-j} + e_t$$

وتشير Δ إلى الفرق الأول، و a إلى الثابت، و t إلى عامل الاتجاه الزمني، و m تمثل عدد فترات التباطؤ والتي يتم تحديدها وفقاً لأحد معايير المعلومات وأهمها Akaike و Schwarz (Herman, 2003) ويجري اختبار فرضية العدم القائلة بوجود جذر الوحدة (أي عدم استقرار السلسلة الزمنية) بإيجاد (ADF) المحسوبة للمعلمة δ ومقارنتها بقيمة (ADF) الحرجة عند مستوى معنوية معين، فإذا كانت القيمة المحسوبة أقل من القيمة الحرجة ترفض الفرضية العدمية أي ان السلسلة الزمنية مستقرة، أما إذا لم ترفض جدول (1). نتائج اختبار جذر الوحدة

TEST	درجة تكامل السلسلة	Exogenous	الفرق الأول	Exogenous	المستوى	Variable
PP	(1)I	Constan	-5.92595 (0.0000)	NON	-0.95074 0.2990(((LNL _t
ADF	(1)I	Constan	-5.929793 (0.0000)	NON	-0.961836)0.2945(
PP	(1)I	Constan	-5.24668 (0.0001)	NON	-0.49077 (0.4970)	LNGDP _t
ADF	(1)I	Constan	5.162215- (00001)	NON	0.546643- (0.4738)	
PP	(1)I	Constan	-9.84543 (0.0000)	Constant, Linear Trend	-3.04391 (0.1339)	LNW _t
ADF	(1)I	Constan	-9.553869 (0.0000)	NON	0.945288 (0.9052)	
PP	(1)I	Constan	-6.441619 (0.0000)	NON	-1.395702 (0.1489)	LNK _t
ADF	-3.196411	Constan	-6.700519 (0.0000)	NON	-1.302655 (0.1747)	

النحو التالي (Gregory & Hansen, 1996):

$$y_t = \mu_0 + \mu_1 \varphi_{t\tau} + \mu_2 X_t + \varepsilon_t$$

$$y_t = \mu_0 + \mu_1 \varphi_{t\tau} + \mu_2 t + \mu_3 X_t + \varepsilon_t$$

$$y_t = \mu_0 + \mu_1 \varphi_{t\tau} + \mu_2 X_t + \mu_3 X_t \varphi_{t\tau} + \varepsilon_t$$

$$y_t = \mu_0 + \mu_1 \varphi_{t\tau} + \mu_2 t + \mu_3 t \varphi_{t\tau} + \mu_4 X_t + \mu_5 X_t \varphi_{t\tau} + \varepsilon_t$$

حيث: إن y_t يمثل العامل التابع وهو في دراستنا العمالة و X_t المتجه الذي يتضمن العوامل المستقلة، و ε_t الخطأ الأبيض، $\varphi_{t\tau}$ المتغير الصوري كما أن $\varphi_{t,\tau}$ تمثل المتغير الوهمي حيث يأخذ القيمة واحد أو صفر وفقاً للآتي:

$$\text{If } t \leq \tau \text{ and } \varphi_{t,\tau} = 1 \text{ if } t > \tau \varphi_{t,\tau} = 0$$

وفي هذه الدراسة تم تقدير النموذج الأكثر شيوعاً وهو النموذج الرابع، وتم استخدام ثلاثة اختبارات للتأكد من استقراره بواقى التقدير وهي (Miyazaki, 2014 & Hamori):

$$Z_t, Z_a, ADF$$

من خلال النتائج الواردة في جدول رقم (2) ووفقاً لاختبار Gregory Hansen للتكامل المشترك فإن فرضية العدم مرفوضة؛ لعدم وجود تكامل مشترك؛ حيث يوجد اختباران (ADF, Z_t) من أصل ثلاثة اختبارات تؤكد وجود تكامل بين المتغيرات مع مقطع هيكلي واحد وهو سنة 1980 وهي قريبة من سنة 1984 التي صدرت فيها مجموعة من القرارات تقضي بخفض عد العاملين في الجهاز الإداري، وتشجيع العمالة الزائدة إلى العمل في القطاعات الإنتاجية كالزراعة والصناعة.

الجدول رقم (2). نتائج اختبار Gregory Hansen لتكامل المشترك المتغير التابع (العمالة)

الاختبار	القيمة الإحصائية	المقطع الهيكلي	القيم الجدولية		
			10%	5%	1%
ADF	-5.09	1980	-5.77	-5.28	-5.02
Zt	-5.16	1980	-5.77	-5.28	-5.02
Za	-32.29	1980	63.64	53.58	48.65

Notes: The order of lag length is selected by using the AIC. ** indicates statistical significance at the 10% level. The critical values are from Gregory and Hansen (1996a).

اختبار التكامل المشترك ذي العتبات Gregory Hansen

عند تقدير علاقة انحدار بين عدد من المتغيرات في صور سلاسل زمنية غير مستقرة، فمن الممكن أن تكون علاقة الانحدار المقدر بينهما عبارة عن علاقة زائفة؛ بسبب أن التغير في المتغيرات قد يكون بسبب الزمن، وأن تكون العلاقة بين المتغيرات علاقة اقتران أو ارتباط، وليست علاقة سببية، وإجراء الانحدار في صورة فروق لكل واحد قد يؤدي إلى فقدان خصائص المدى الطويل، ولذلك ظهرت فكرة التكامل المشترك الذي يشير إلى علاقة طويلة المدى بين المتغيرات غير مستقرة، أو أنها تعني وجود طريقة تعديل تمنع الزيادة في خطأ علاقة المدى الطويل.

توجد العديد من الاختبارات للكشف عن علاقة التكامل المشترك بين السلاسل الزمنية من أهمها: اختبار انجل -جرانجر Granger & Engle لسنة 1978، جوهانسن -جيسلس Johansen-Juselius لسنة 1990، نموذج ARDL لسنة 1995 والذي طُوّر في سنتي 2001 و 2005، واختبار Gregory Hansen (المستخدم في هذه الدراسة) حيث اقترح كل من (Gregory and 1996) Hansen, استخدام أسلوب متطور لاختبارات (ADF, Z_t, Z_a) في حالة اختبار التكامل والتي تكون صالحة في

حالة الفرضيات البديلة التي قد تحوي أحد الانحرافات في متجه التكامل.

الاختبارات المقترحة هي توسعة لاستخدام اختبار ADF، و اختبارات (Z_a, t) لاختبار التكامل وذلك بدون أي قيود على الزمن الذي قد يحدث عنده هذا النوع من الانحراف، وهذه الاختبارات مبنية على فكرة الفرضية البديلة في حالة اختبار التكامل والتي مفادها (No Cointegration) ومن ميزة اختبار Gregory Hansen أنه يكشف عن المقاطع الهيكلية والتي فشلت اختبارات التكامل الأخرى في كشفها. وقد اقترح كل من Gregory و Hansen سنة 1996 وبالاعتماد على منهجية واختبار ديكي فولار الموسع أربعة نماذج وهي على

على الاستخدام في القطاع الزراعي، بمعنى أن زيادة الأجور الحقيقية بنسبة 100% تؤدي إلى تخفيض الاستخدام في القطاع الزراعي بنسبة 657%. ويتضح كذلك أن المتغير الوهمي ذو دلالة إحصائية وله أثر إيجابي، وهذا يعني أن القرارات الصادرة والتي تقضي بخفض عدد العاملين في الجهاز الإداري كان لها أثر إيجابي على الاستخدام في القطاع الزراعي، أما الناتج الزراعي فلم تثبت معنويته، ولكن هذا لا يعني عدم أهميته وإنما هذا المتغير قد لا يؤثر بمفرده ولكن يؤثر في النموذج مع بقية المتغيرات مجتمعة.

كما تؤكد نتائج اختبار جذر الوحدة للبقايا والواردة في الجدول رقم (5) أنها مستقرة بمستوى دلالة 0.01 مما يعني ان الانحدار ليس زائف.

جدول رقم (5). نتائج اختبار جذر الوحدة لبقايا معادلة DOLS

ADF	PP	Cointegration regression method	DOLS		
				Constant, Linear Trend	Constant, Linear Trend
5.503986 (0.0001)	5.418779 (0.0005)	Level	5.414059 (0.0005)	5.514725 (0.0001)	5.414059 (0.0005)

النتائج والتوصيات

توصلت الدراسة إلى أن العوامل المؤثرة في الاستخدام في القطاع الزراعي هي الأجور الحقيقية والتكوين الرأسمالي الثابت، كما أن الاستخدام في القطاع الزراعي يكون أكثر حساسية تجاه التغير في الأجور من التغير في رأس المال المستخدم، وعليه ينبغي وضع سياسة للأجور يكون من شأنها زيادة الطلب على العمل وتخفيض البطالة، وضرورة التوسع في الاستثمارات الحالية وخلق استثمارات جديدة لاستيعاب الطلب الإضافي من العمالة.

3- تقدير العلاقة في المدى الطويل باستخدام طريقة المربعات الصغرى الديناميكية (DOLS):

لقد اقترح (2003, Watson and Stock) ما أسماه بمنهجية المربعات الصغرى الديناميكية (DOLS OLS Dynamic) في عملية التقدير وتتضمن المنهجية إضافة تغيرات حالية وماضية ومستقبلية للمتغيرات (المتكاملة تكامل مشترك) إلى معادلة التكامل المشترك وهي طريقة معلمية تعد من أحدث الطرق و الأكثر قوة بسبب أدائها في العينات صغيرة الحجم، إذ تستعمل هذه الطريقة لتقدير العلاقة التوازنية طويلة المدى للنظام الذي يحوي متغيرات متكاملة من درجات مختلفة لكنها مازالت متكاملة تكاملاً مشتركاً، حيث تعتمد هذه الطريقة على قيم الإزاحات والتباطؤات (Lags and Leads) عبد الرزاق و الجبوري (2012).

ويبين الجدول رقم (3) نتائج اختبارات انحدار التكامل المشترك سالفة الذكر والتي تشير إلى أهم النقاط الآتية:

الجدول رقم (3). نتائج تقدير نموذج انحدار التكامل المشترك

المتغيرات	DOLS	
	المعامل	الاحتمال
$LNGDP_t$	0.073160	0.3040
LNK_t	0.152096	0.0000
LNW_t	-0.657522	0.0000
D	0.590518	0.0000
C	9.943428	0.0000
Adjusted R-squared	0.969688	

وتظهر نتائج التقدير وجود علاقة ذات دلالة إحصائية بين مستوى التكوين الرأسمالي الثابت والتشغيل في قطاع الزراعة، إذ بلغت المرونة 0.152 أي إن زيادة التكوين الرأسمالي الثابت بنسبة 100% تؤدي إلى زيادة استخدام القوى العاملة في القطاع الزراعي بنسبة 152%.

كما يتبين أن لمستوى متوسط الأجور الحقيقية تأثيراً عكسياً

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Determinants of demand for agricultural labor in Libya (1975-2014) an Empirical Study by using Dynamic Ordinary Least Square Method DOLS

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Abstract: The aim of the study is to estimate the important factors affecting the workforce in the agriculture sector in Libya between 1975 to 2014 and to achieve the aim of the study, the Gregory Hansen methodology was used to ensure that there is a cointegration relationship between the study variables and also to estimate the model of the capabilities of the simultaneous integration of the relationship in the long term by applying the squares method (DOLS) because it's one of the ways of regression joint integration. The results of the study indicate that there is a statistically significant relationship between the level of fixed capital formation and the use of labor in the agriculture sector, and the reverse effect of the average real wages on demand labor. The values of the dummy variable in the model showed positive effect. The study recommends the necessity to expand the current investments and create new investments to accommodate the additional demand for labor, as well as the development of a wage policy that would increase the demand for labor.

Keywords: Agricultural labor, agricultural output, wages, fixed capital formation, joint integration.

الملاحق

جدول البيانات المستخدمة في التحليل القياسي

	L_t	$LGDP_t$	K_t	LW_t^*	D
1975	4.892845	6.597239	5.034018	8.02088	0
1976	4.949664	6.730318	5.261597	7.988707	0
1977	4.975528	6.550317	5.328893	7.985822	0
1978	4.996018	6.632788	5.371534	8.075449	0
1979	5.010782	6.692659	5.315342	8.242834	0
1980	5.032527	6.832611	5.317211	8.558789	1
1981	5.089535	6.960182	5.416523	8.67756	1
1982	5.120452	6.984417	4.884258	8.651907	1
1983	5.152757	7.121522	4.735279	8.576438	1
1984	5.222513	7.081859	4.6297	8.453765	1
1985	5.175613	7.121522	4.161805	8.475685	1
1986	5.184051	7.001101	3.72275	8.153498	1
1987	5.192418	6.842425	3.859948	8.239908	1
1988	5.230031	6.914549	3.832135	8.185248	1
1989	5.254865	6.9849	4.254504	8.179609	1
1990	5.240674	7.022558	4.79951	8.250602	1
1991	5.244373	7.16324	3.268388	8.243872	1
1992	5.276036	7.141859	4.247503	8.226464	1
1993	5.303749	7.105531	5.539589	8.149778	1
1994	5.328294	7.102129	5.265385	8.238933	1
1995	5.359327	7.118338	4.969001	8.11828	1
1996	5.390793	7.129421	5.065386	8.225747	1
1997	5.389426	7.193296	5.305512	8.233526	1
1998	5.415983	7.198806	4.433391	8.167074	1
1999	5.446173	7.169253	4.070612	8.14687	1
2000	5.476314	7.199042	4.456804	7.891317	1
2001	4.728666	7.241823	4.088793	9.172101	1
2002	4.678864	7.278183	3.009792	8.55859	1
2003	4.625473	7.313017	2.528823	8.65939	1
2004	4.692694	7.358798	2.448623	8.603265	1
2005	4.76168	7.432451	2.952252	8.577402	1
2006	4.834192	7.526251	2.950668	8.62217	1
2007	4.343355	7.565253	1.24521	9.003904	1
2008	4.303619	7.589197	0.929514	8.994202	1
2009	4.262238	7.613375	1.326691	9.092527	1
2010	4.204257	7.605007	1.147822	9.164162	1
2011	4.158452	6.433192	0.482353	9.152904	1
2012	4.09392	6.303071	0.672771	9.178498	1
2013	4.042632	6.135402	-0.14273	9.242563	1
2014	3.98857	5.924574	-0.22707	8.949922	1

المصدر: مركز البحوث الاقتصادية بنغازي، تقرير مصرف ليبيا المركزي، أعداد مختلفة، البنك الدولي UNCTAD.

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