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Full length article

The effects of parity and lactation stages on udder and teats measurements in crossbred dairy cows

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ABSTRACT

The aim of the study was to evaluate the effect of parity, lactation on udder, teat traits and milk yield of crossbred cows at the educational farm field, University of Khartoum, Sudan. Twenty-eight lactating crossbred cows apparently healthy with different parties and ages were selected and investigated between January and November of 2022. The external udder and teat measurements were taken in centimeters(cm); while milk yield in liter (L) after fifteen days' post calving. The udder parameters measured were udder length (UL), udder circumference (UC), udder depth (UD), udder width (UW); whereas, the teat measurements were front teat length (FTL) and rear teat length (RTL), Front teat width (FTW), rear teat width (RTW) and the distance between teats (DBT). All investigated traits were measured in centimeters using measuring transparent ruler and tape meter. The result revealed that, there were significant differences ($p<0.05$) among udder and teat mean values measurements(cm) at different parities and lactation stages with exception the width of udder and distance between teats (front and rear sides) traits. Similarly, milk yield (liter) was also influenced by parity and lactation stages, in particular, at 1st lactation stage. In conclusion, parity and lactation stages have significant impact on parameters of udder, teats measurements; and milk yield in crossbred cows. These findings could be useful and ought to be taken in to account in dairy cows breeding. Similar studies should be carried out on other breed of cows in in study area and different geographical regions of the country.

INTRODCTION

The dairy industry plays a crucial role in the global economy, and understanding the factors influencing milk yield and udder morphology is essential for optimizing dairy production (FAO, 2017). Body measurements are phenotypic markers of the genetic makeup of an animal. Consequently, udder morphology traits are promising indicators of milk yield in dairy cattle (Achi et al., 2024). The size and shape of the udder are important conformation traits that could play a vital role in assessing a dairy animal's suitability for commercial milk production and should be considered in selection (Bhuiyan et al., 2004).

Variations in udder and teat characters are observed between breeds and individuals in the same herd with respect to parity and lactation stages. Hence, udder is the first site for judging the milking ability of

animals by local brokers and animal husbandry stakeholders. Therefore; it is more important to have knowledge of morphometry of udder and teats (Khatri *et al.,* 2017; Patel & Trivedi, 2018).

The udder and teat morphometric traits of cows include udder circumference, udder depth, udder width, fore teat length, hind teat length and their relationship to milk yield (Alphonsus et al., 2018). There are several factors which may affect udder traits and chemical composition of milk in dairy animals which include breed, parity, order and stage of lactation, weight, size, body condition, animal and udder sanitary state, breeding system and udder types (Rovai, 2001).

Inferior udder health can be a source of economic loss for both dairy farmers and milk processors. It can result in reduced milk yield and milk quality (Bartlett et al., 1991), changes in milk composition (Auldist et al., 1995), increased involuntary culling (Berry et al., 2005), and veterinary and treatment costs (Berry and Amer, 2005). The present study was undertaken with the aim to investigate the effect of location and parity on udder and teats measurements of crossbred cows.

MATERIALS AND METHODS

Study area

This cross-sectional study was conducted on crossbred cows at the educational farm field, University of Khartoum, Sudan between January and November of 2022. Khartoum is located between longitudes 31.5 to 34°E and latitudes 15 to 16°N. It is surrounded by River Nile State in the north-east, in the north-west by the Northern State, in the east and southeast by the states of Kassala, Qadarif, Gezira and White Nile State, and in the west by North Kurdufan (Anonymous, 2025). Khartoum, experiences a hot desert climate characterized by extremely high temperatures and very low precipitation. The city has two distinct seasons - a hot, dry season from October to April and a scorching hot season from May to September. During the summer months, temperatures can exceed 40°C (104°F) regularly. It receives minimal rainfall, with most of it occurring in the form of sporadic heavy showers between June and September (Anonymous, 2025).

Study animals and managements

Twenty-eight lactating crossbred cows apparently healthy with different parities (15 animals were multiparous and 13 animals were Primiparous**)** and ages ranged between 3-12 years old were selected and investigated in this study. The cows were raised by educational farm field, University of Khartoum, Sudan. The animals were appropriately marked with ear-tagged for ease of identification. The animals (cows) were kept under similar administrative management and nutrition conditions.

Morphometric traits of udder and teat measurements

The udder traits/parameters measured were Udder Length (UL), udder circumference (UC), udder depth (UD), udder width (UW); whereas, the teat measurements include front teat length (FTL) and rear teat length (RTL), Front teat width (FTW), rear teat width (RTW) and the distance between teats (DBT). All investigated traits were measured using measuring transparent ruler and tape. Centimeter is used as unit measurement. The parameters(traits) measurements were carried out according to the techniques described by (Kuczaj, 2003; Kul et al*.,* 2006).

Milk yield evaluation

Milk yield evaluation of the cows was commenced at day 15 post birth (postpartum). All cows were stimulated for milk ejection by manually massaging the udder after washing. Udders and teats were washed with clean water and wiped off with towels soaked in antiseptic solution and allowed to dry. Morning (12:00 AM) and evening (12:00 PM). Milk yields of individual cow were recorded to arrive at the total daily milk yield. The collected samples were transported to the laboratory immediately in a cool box with maintained temperature of < 4°C for process and further necessary action following the method described by Singhai et al. (2013).

Statistical Analysis

A completely randomized design (CRD) was employed to assess the impact of lactation stage and parity on udder morphology traits and milk yield. The data were analyzed using the following statistical model: $Yij = u + ai + bj + eij$

Where: Yij = examined dependent variables (UL, UW, UD, CU, TL, TW, and TDB), u = overall mean, ai = the impact of parity (i = primiparous and multiparous), bj = lactation stage (j = early, mid, and late), eij = random experimental error.

Duncan test was used to determine the associations between measurements, which was declared at $P < 0.05$; using the LSD test (SAS, 2012).

RESULTS AND DISCUSSION

Dairy cows' production is a significant sector of livestock production worldwide. The demand for milk in developing countries is projected to rise by 25 percent by 2025 (FAO, 2018). Unfortunately, the dairy sector in developing countries is challenged by poor yields from local breeds and high production costs on commercial

farms with exotic breeds. Dairy farmers are unaware of knowledge on udder morphometry and its relationship with milk production, parity and lactation stages. They are not maintaining proper production records of their animals in an organized manner (Sathiyabarathi and Kumar, 2020). Body measurements are phenotypic markers of the genetic makeup of an animal. Consequently, udder morphology traits are promising indicators of milk yield in dairy cattle and play a vital role in assessing a dairy animal's suitability for commercial production (Bhuiyan et al., 2005).

This study was carried out on crossbred cow at educational farm field, University of Khartoum with main objective to determine the effect of parity and lactation stage on udder and teat morphometric traits and milk yield of crossed cows. The results of the effect of parity and lactation stage on udder and teat morphometric traits and milk yield of crossed cows are presented in Table 1. As shown, the results revealed that parity have significant ($p<0.05$) effect on udder length, udder width, udder depth, udder circumference and milk yield. The mean values recorded were 53.20 ±0.76 & 66.67 ±0.73 cm; 30.80 ±0.59 & 36.56 ±0.69 cm; 36.47 ±0.55 & 44.11 ±0.48 cm; 90.22 ±1.11 & 110.25 ±1.22 cm; 7.59 ±0.10 & 10.73 ±0.13 (L) for Primiparous and Multiparous respectively. Furthermore, the result raveled that, the results indicate that multiparous cows have a significant ($P<0.005$) higher means values of udder measurement and milk yield compared to primiparous cows. These results are in agreement either completely or partially with previous studies (Achi et al., 2024; Sathiyabarathi; Kumar, 2020). The reason behind variations of udder morphological measurements could be explained in the view of Abdu et al, (2012) who suggested that progressive udder hypertrophy with respect to cow's age and parity.

The impact of lactation stages on udder morphological traits and milk yield crossbred cows are also depicted in Table 1.

.

Table 1. Effect of parity and lactation stage on udder measurements and milk yield in crossbred cows(n=28)

	Parameters (Traits)				
Variables	**MY (L)**	**UL (cm)**	**UW (cm)**	**UD (cm)**	**CU (cm)**
Parity					
Primiparous	7.59±0.10^{b}	53.20±0.76^{b}	30.80±0.59^{b}	36.47±0.55^{b}	90.22±1.11^{b}
Multiparous	10.73±0.13^{a}	66.67±0.73^{a}	36.56±0.69^{a}	44.11±0.48^{a}	110.25±1.22^{a}
Lactation Stage					
Early (1-3 M)	10.76±0.31^{a}	62.93±1.56^{a}	36.56±1.25^{a}	42.34±1.40^{a}	103.74±2.53^{a}
Mid(4-M)	9.62±0.22^{b}	58.33±1.61^{ab}	34.04±1.12^{a}	39.70±1.02^{ab}	100.24±2.16^{ab}
Late (7 M- drying)	8.83±0.17^{c}	56.93±1.58^{b}	30.25±1.70^{b}	36.87±1.40^{b}	94.65±2.34^{b}

^{a,b} means with different superscripts in the same column differ significantly ($P<0.05$); milk yield= MY, Udder Length= UL; Udder Width =UW; Udder Depth= UD; circumference Udder= CU, M=Month.

As shown, there are significant differences ($p>0.05$) between lactation stages and all morphological parameters studied which include udder length, udder width, udder depth, udder circumference. In the term of influencing of milk yield by lactation stage, results revealed that, the early stage had significantly ($p<0.05$) higher milk yield (10.76 ±0.31 liter) and lower mean value was recorded in late lactation stage (8.83 ±0.17 liter). The results are in line with findings of Milerski et al. (2006) who stated that lactation has effect on udder morphological traits and in contrast with findings of Achi et al., 2024. The contrary and consistent between the results of current study and findings of above workers could be attributed to variation in the age of the animals, genotype, stage of lactation and parity and environmental & management factors.

The Table 2. Displayed the results of the effect of parity on teats traits measurements in crossbred cows. As shown, the means values of fore and rear teat lengths were (7.97 ±0.59 & 7.09 ±0.65 cm) and (7.35 ±0.50 & 6.37 ±0.60 cm) for multiparous and Primiparous cows respectively. Similarly, the mean ±SE values of fore and rear teat width were (2.97 ±0.27& 2.81 ±0.22cm) and (2.91 ±0.18 & 2.83 ±0.15cm) for multiparous and Primiparous respectively. The mean valued of right and left Distance Between Teats were 7.15 ±0.22 & 4.70 ±0.20; 7.13 ±0.20 & 4.33 ±0.16 for Multiparous and Primiparous respectively.

The statistical analysis showed that significant differences($P<0.05$) observed among mean values of teat length and right & left distance between teats; while, none with width, front and rear sides of teats

measurements during different parities in experimental animals investigated. These results are in consistent either in complete or partially with findings of previous studies (Kuczaj, 2003; Singh et al*.,* 2010; Singhai et al*.,* 2013; Achi et al., 2024). However, these results are in contrast with findings of Alkhateeb et al. (2021) who studied the impact of parity on teats measurements of lactating buffaloes in Iraq. The contrary or consistent in the results among current study and previous studies could be attributed to breed of animals, management, genetically factors and the techniques of milking used.

Table. 2. Effect of parity on teats measurements of crossbred cows(n=28)

	Parity	
Parameters	Multiparous(n=15)	Primiparous(n=13)
Teat's length		
Front	7.97±0.59[a]	7.09±0.65[b]
Rear	7.35±0.50[a]	6.37±0.60[b]
Teat's width		
Front	2.97±0.27	2.81±0.22
Rear	2.91±0.18	2.83±0.15
Distance Between Teats		
Right	7.15 ±0.22[a]	4.70±0.20[b]
Left	7.13 ±0.20[a]	4.15±0.33[b]
Front	11.99±0.35	10.63±0.23
Rear	4.43±0.13	3.84±0.14

[a,b]: means in the same row with different superscripts differ significantly (P < 0.05); n= number cows

The effect of lactation stages on teats measurement and milk yield in crossbreed cows are presented in Table 3. As shown, there are steadily increase in mean values of teat traits/parameters in different lactation stages, namely, length (TL) and teats width (TW). The means values are 7.38 ±0.29 - 7.90 ± 0.27; 2.56 ±0.12 - 2.95 ±0.12 for front teats; while 6.69 ±0.27; 04 ±0.25; 2.87 ±0.10-2.89 ±0.07 for rear teat. Significant differences (P<0.05) were observed among mean values of length rear teat and lactation stages; while, none with length front teat. The mean values of Distance Between Teats (DBT) parameters were not significant different(P<0.05) with exception rear side parameter. These results are in complete or partial in agreement with findings of previous studies (Tiki et al., 2005; Zwertvaegher et al., 2012; Sathiyabarath and Kumar, 2022). The contrary and harmony among results of this study and above worker's findings may be due to the breed of cows, shape & size of teats, and different measuring methods used.

Considering the effect of lactation stages on milk yield, the results revealed that the higher means values was recorded at 1st lactation stage, followed by mid and late stages. Significant differences were observed between the means values of milk yield and 1st lactation stage only. These results are in parallel with findings of other researchers (Ahmad et al., 2011; Ceyhan et al., 2015; Achi et al., 2024). The reason for reduction in milk yield with advanced stages of lactation may be due to morphological changes on dimensions of udder and teats and hormonal factors.

Table 3. Effect of lactation stage on teats measurements and milk yield in crossbreed cows (n=28)

	Lactation stages		
Traits	**Early (1-3 M)**	**Mid (4 -6 M)**	**Late (7 M –raying)**
Milk yield (MY)	10.76±0.31[a]	9.62±0.22[b]	8.83±0.17[c]
Teat's length			
Front	7.38±0.29	7.45±0.31	7.90±0.27
Rear	6.69±0.27[b]	6.50±0.27[c]	7.04±0.25[a]
Teat's width			
Front	2.56±0.12	2.84±0.13	2.95±0.12
Rear	2.87±0.10	2.84±0.10	2.89±0.07
Distance Between Teats			
Right	6.09±0.56	5.58±0.48	5.29±0.48
Left	6.09±0.53	5.50±0.45	5.20±0.43
Front	11.6±0.64	11.12±0.73	10.84±0.51
Rear	4.24±0.25[a]	3.54±0.27[b]	3.49±0.19[b]

[a,b] Means in same row within a factor carrying different superscripts, differ significantly (P < 0.05); Milk yield=MY; Month=M

CONCLUSIONS

It could be concluded from this study, that parity and lactation stages have significant impact on parameters of udder, teats measurements; and milk yield in crossbred cow. The knowledge of such data is required for selection and breeding of dairy cows. further studies should be carried out on other breed of cows in different geographical regions of the countries.

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AUTHOR CONTRIBUTIONS:

Hayani A.A, **Tayib T.A.A.** and Nikhaila. A.M. authors equally contributed on protocol proposal, collection, processing, analyzed, interpretation of data and wrote first & final version of Manuscript. All Authors have approved this version of the manuscript.

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CONFLICT OF INTEREST

The authors have declared no conflict of interest.

ETHICAL STANDARDS

The Faculty of Animal Production, University of Khartoum, Sudan, approved the study.

DATA AVAILABILITY:

All data generated and analysed during this study are included in this published article.

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تأثير عدد الولادات ومراحل الرضاعة على قياسات الضرع والحلمات في الأبقار الحلوب المهجنة

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الملخص

هدفت الدراسة إلى تقييم تأثير عدد الولادات ومرحلة الرضاعة على صفات الضرع والحلمات وإنتاج الحليب للأبقار المهجنة في حقل المزرعة التعليمية بجامعة الخرطوم بالسودان. تم اختيار ثمانية وعشرين بقرة هجينة حلوب مرضعة تبدو سليمة متعددة الولادات والأعمار وتم فحصها في الفترة من يناير إلى نوفمبر من عام 2022. تم أخذ قياسات الضرع الخارجي والحلمة بالسنتيمتر (سم)؛ بينما تم قياس إنتاج الحليب باللتر (لتر) بعد خمسة عشر يومًا من الولادة. كانت معلمات الضرع التي تم قياسها هي طول الضرع (UL) ومحيط الضرع (UC) وعمق الضرع (UD) وعرض الضرع(UW) ؛ بينما كانت قياسات الحلمة هى طول الحلمة الأمامية (FTL) وطول الحلمة الخلفية (RTL) وعرض الحلمة الأمامية (FTW) وعرض الحلمة الخلفية (RTW) والمسافة بين الحلمات .(DBT) تم قياس جميع الصفات التي تم فحصها بالسنتيمتر باستخدام المسطرة والشريط القماشي. أظهرت النتيجة وجود فروق ($p<0.05$) معنوية ذو دلالة احصائية بين متوسط قيم قياسات الضرع والحلمة (سم) وعدد الولادات ومراحل الرضعة المختلفة باستثناء عرض الضرع والمسافة بين الحلمات (الجانبين الأمامي والخلفي). وبالمثل، تأثر إنتاج الحليب (لتر) ($p<0.05$)أيضًا بعدد الولادات ومرحلة الرضاعة، ولا سيما في مرحلة الإرضاع الأولى. خلصت الدراسة الى ان عدد الولادات ومرحلة الرضاعة لها تأثيرًا كبيرًا على قياسات الضرع والحلمات وإنتاج الحليب في الأبقار المهجنة. يمكن الاستفادة من نتائج هذه الدراسة واخذها بعين الاعتبار عند اختيار وتربية الأبقار الحلوب. كما يوصي أيضا بإجراء مزيدا من دراسات مماثلة على سلالات أخرى من الأبقار في منطقة الدراسة ومناطق جغرافية مختلفة من البلاد.

الكلمات المفتاحية: الأبقار المهجنة، مراحل الرضاعة، إنتاج الحليب، الحلمة، عدد الولادات، الضرع

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Full length article

Gross anatomical features of the air sacs of the common kingfisher *(Alcedo atthis)*

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ABSTRACT
This research was conducted with the main aim to investigate the morphology of air sacs system in kingfisher. Eight healthy, adult kingfishers were used to explore the morphological characteristics of the air sacs, which were examined grossly and with latex and cast preparations. In general, the morphological features of the kingfisher air sacs are similar to other avian species. We observed nine air sacs; four paired sacs (cervical, cranial thoracic, caudal thoracic and abdominal air sacs) and one unpaired sac; the clavicular air sac. The cervical air sac communicated to the lung by the medioventral bronchus and gave off intermuscular, subscapular and subcutaneous diverticula. The clavicular air sac communicated with bronchial tree through the medioventral bronchus and had subscapular, axillary, humeral, subpectoral and sternal diverticula. The cranial and caudal thoracic air sacs were communicated with the lung through the lateroventral bronchi. Each cranial thoracic air sac gives diverticulum which fused medially forming one large diverticulum; while, there were no diverticula extending from the caudal thoracic air sacs. The left abdominal sac was the largest air sac. The right and left abdominal sacs gave off branches to diverticula that pneumatized synsacrum. The abdominal air sacs gave off femoral diverticula caudal to the hip joint in addition to the perirenal diverticula. In conclusion, the present study provided detailed and comprehensive data about the morphology of air sacs system in kingfisher. In general, the air sacs of kingfisher are almost similar to other bird species with few variations. These findings could be enhancing anatomical knowledge of respiratory system of kingfisher bird.

INTRODCTION

Birds have a total of nine air sacs, which are connected to their lungs and trachea. The air sacs are divided into four groups: cervical, cranial thoracic, caudal thoracic, and abdominal. Each group of air sacs has a specific function in the respiratory process, and they work together to allow birds to efficiently extract oxygen from the air (Casteleyn et al., 2018). Birds do not possess a diaphragm, so they do not present any differentiation between thoracic and abdominal cavities. The respiratory system of birds is divided into lower and upper respiratory tract. The upper respiratory system is formed by the nasal cavity, larynx and trachea; whereas, the

lower respiratory tract is formed by the lungs and air sacs (Baume et al., 1993; Çevik-Demirkan et al., 2006; Dyce et al., 2010; Al-Mamoori and Al-Abdula, 2016; Viegas et al., 2024).

Air sacs are one of the unique structures of the avian respiratory system that aid in the sustain continuous airflow and ventilation of the lung during the breathing cycle (Powell &Mitchell, 2000). Air sacs also have an significant role in the regulation of body temperature (Dawson & Whittow, 2000). Avian air sacs are important in flight and swimming by decreasing the density of the body (Kent & Carr, 2008; Dyce et al., 2010). Because air sacs are extensions of the bronchial system that are closely arranged between the internal body organs and even pierce some of the skeletal bones via diverticula (Duncker, 2004; Sawad & Udah, 2012). Morphological features of air sacs have been reported for several species of birds (Bezuidenhout et al., 1999; El-Mahdy, 2005; Cevik-Demirkan et al., 2006; Demirkan et al., 2006; Sawad & Udah, 2012; El-sayed & Hassan, 2019). However, there is no information about air sac structure in the kingfisher.

The kingfisher is a carnivorous flight bird (Fry et al., 1999). It is distributed over Europe, Asia, and North Africa. In temperate regions, it lives in clear, slow-flowing streams and rivers, and lakes with vegetated banks. Tropical populations habit the slow-flowing rivers, mangrove creeks and swamps *(*Fry et al., 1999).

Kingfisher catches fish from 1–2 m above the water, on a branch, river bank. when food is detected, it bobs its head to gauge the distance and plunges steeply down to seize the prey usually not deeper than 25 cm below the surface. Its wings are opened underwater and the open eyes are protected by the transparent third eyelid. it then raises beak-first from the surface and flies back to its perch. The fish is adjusted until it is held near its tail and beaten against the perch several times. Once dead, the fish is positioned lengthways and swallowed head first. A few times each day, a small greyish pellet of fish bones and other indigestible remains is regurgitated *(*Fry et al., 1999).

Despite a wealth of books and studies devoted to avian anatomy, very little attention has been paid to the respiratory system (air sacs) of kingfisher. The present study was conducted to examine the gross morphological structures of air sacs of the kingfisher in the Damietta governorate, Egypt.

MATERIALS AND METHODS

Study area and study birds

Eight mature healthy kingfisher's birds of both sexes and weight of 34–46 g were collected from wild bird hunters in the Damietta governorate, Egypt to study the macroscopic anatomy of the air sacs and their connections to the bronchial tree. This study was carried out under the approval of scientific research ethics committee, Faculty of Veterinary Medicine, Suez Canal University, Ismailia, Egypt during the period between 2021-2023. All birds were transferred to Department of Anatomy, histology & embryology, where a detailed morphological examination of the air sacs has to be performed. The birds were anesthetized intramuscularly with 2% xylazine HCl at the dose of 3 mg/kg (Farouk et al., 2017; El-sayed & Hassan, 2019). The studied birds were then decapitated and kept for other studies.

Gross examination

For examination the gross morphology of the air sacs and their relationship to the surrounding organs, three euthanized birds were gently massaged to evacuate the pulmonary system and to avoid rupture of air sacs (O'Connor, 2004). Then the abdominal wall was incised from the cloaca to sternum, then a transverse incision caudal to the keel bone was made. The incised abdominal wall, peritoneal fat and the internal viscera were reflected to expose the air sacs and their related visceral organs and bones according to technique described by Al-Mamoori (2016) and Viegas et al. (2024) with some modification.

Latex and cast preparations

Gum milk latex colored with red ink was injected via the trachea then a tight ligation was made and the three specimens were immersed in 10% formalin for 3–4 days. Subsequently, the injected birds were dissected to examine the lungs, air sacs and their related organs using the technique as described by EL-BABLY et al. (2014) with some modifications.

The remaining two birds were injected through trachea with a (2:1) mixture of Kem-Apoxy 150 and its catalyst then the trachea was tightly ligated. The injected birds were left to harden at room temperature for 3–4 days. Next, the hardened specimens were immersed in 100% water solution of potassium hydroxide (KOH) for 2–3 days at room temperature to macerate the soft tissues. The macerated specimens were gently washed in running tap water leaving the cast which was then left to dry at room temperature according to technique described by El-Sayed and Hassan (2019). On these specimens we determined the position, shape and size of the air sacs and their diverticula. For proper Latin terminology we used the *Nomina Anatomica Avium* (Baumel et al., 1993).

All photographs were taken with Canon digital camera 10 MP.

RESULTS

The results revealed that, the kingfisher has nine air sacs; four paired air sacs; cervical, cranial thoracic, caudal thoracic, and abdominal air sacs and one unpaired sac, the clavicular air sac. The air sacs were deeply situated among the visceral organs in the body cavity, in addition to their several diverticula inside most bones of the of the trunk, pectoral and pelvic girdles.

The cervical air sacs, *Saccus Cervicalis*, were positioned at the base of the neck ventral to the first thoracic and last two cervical vertebrae (Figs. 1, 2 &3), in front of the lung and communicated with lung via the medioventral bronchus (Fig. 2). The two sacs were connected medially and related dorsally to the neck musculature and ventrally to the trachea, oesophagus and clavicular sac. Each cervical air sac possessed vertebral, subcutaneous and intermuscular diverticula. The vertebral diverticulum passed along each side of the vertebral column from the 2nd thoracic vertebra to the 1st cervical vertebra (Fig.2). Each vertebral diverticulum had two tubular extensions; one inside the vertebral canal and the other inside the transverse canal. These two tubular extensions were connected through the intervertebral foramina. The subcutaneous diverticulum (Fig.2) fused with that of other side to surround the trachea. The intermuscular diverticulum (Figs. 2 and 3), which about 2 cm in length and was situated between the cervical vertebrae and shoulder girdle muscles.

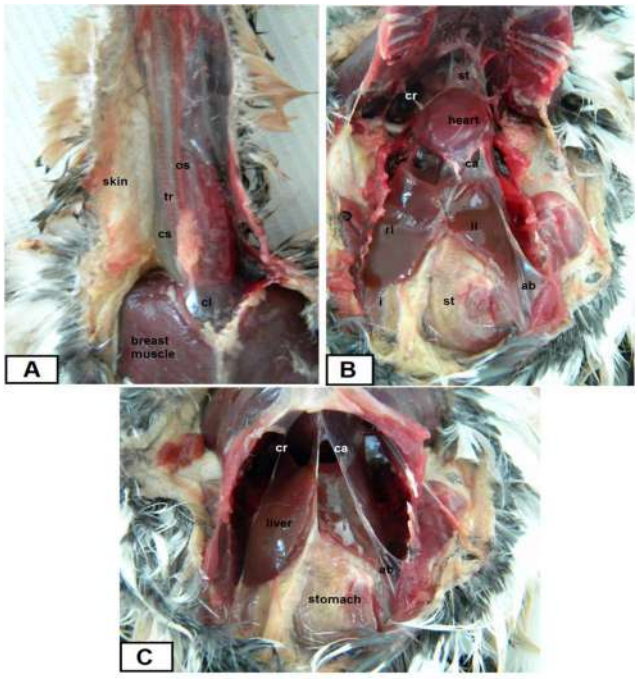
The clavicular air sac, *Saccus Clavicularis*, was a large, unpaired sac, that was formed by the union of the right and left sacs. The clavicular air sac fills the thoracic inlet and was entirely delimited by the pectoral girdle and sternum (Figs.1, 2 & 3). The trachea and oesophagus are coursed between the clavicular and cervical air sacs. The clavicular air sac enclosed the syrinx and expanded around the heart base extending ventral to the cranial half of each lung to communicate with it by the medioventral bronchus. The clavicular air sac extended from the level of last three cervical vertebrae to the 3rd thoracic vertebrae (Figs. 1, 2 and 3). The clavicular air sac possessed extra-thoracic and intra-thoracic diverticula. The extra-thoracic diverticula include subscapular, humeral and subpectoral, that were situated around the muscles and bones of the shoulder girdle. The subscapular diverticulum (Figs. 2 and 3) was situated between the scapula, the cervical air sac and the first two ribs. The subpectoral diverticulum was placed under the pectoral muscles (Figs. 2 and 3). The humeral diverticulum was sited dorsal to the subpectoral diverticulum (Figure-). Only one intrathoracic diverticulum of the clavicular sac; sternal diverticulum, which was located ventromedial to the cranial thoracic air sacs and was located between the sternum, base of the heart and cranial part of the lung, and invaded the sternum (Figs. 2 and 3).

The paired cranial thoracic air sacs, *Saccus thoracicus cranialis*, were roughly triangular. They were the smallest air sacs and placed underneath the lateral body wall ventral to each lung, caudolateral to the clavicular air sac, cranioventral to the caudal thoracic air sacs and cranial to the abdominal air sacs (Figs. 1, 2 & 3). The cranial thoracic air sac showed costal impressions as they extended from the level of the 3rd rib to the posterior end of the sternum. Each cranial thoracic air sac fused cranially with the clavicular air sac and communicated together with the ventral surface of each lung through the medioventral bronchus (Fig. 2). Medially, the visceral surfaces of both sacs were enclosed between the proventriculus, heart and the cranial part of the right hepatic lobe. Each cranial thoracic air sac gives diverticulum which fused medially form one large diverticulum related to right abdominal wall externally and to the right lobe of liver, gizzered and intestine internally

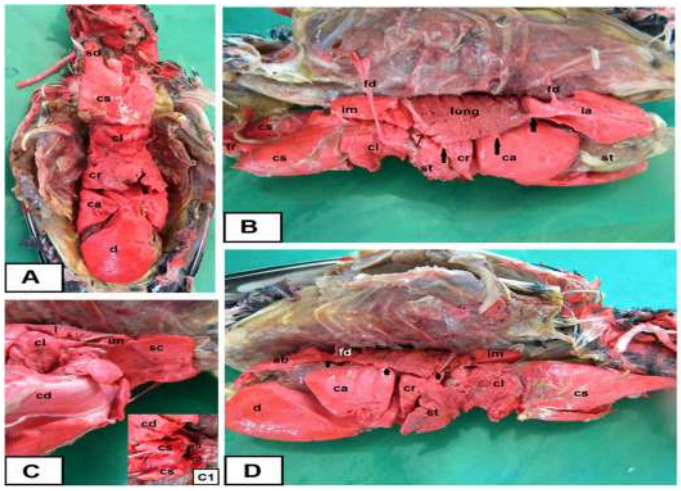
The paired caudal thoracic air sacs, *Saccus thoracicus caudalis*, were symmetrical sacs situated craniolateral to the abdominal sacs, at the rear of the caudal border of the corresponding cranial thoracic sacs and caudoventral to the corresponding lung (Figs. 1, 2 & 3), to which they communicated through a lateroventral bronchus (Fig. 2). These air sacs were larger than the cranial thoracic sacs. Laterally, the caudal thoracic air sacs were related to the lateral abdominal wall and this lateral surface showed the costal impressions of the last three ribs (Figs. 1 & 2). Medially, the left caudal thoracic sac was related to the left lobe of liver; while the right one was related to the parietal surface of the right hepatic lobe, and right abdominal air sac (Figs. 1, 2 & 3). There were no diverticula coming from the caudal thoracic air sacs.

The paired abdominal air sacs, *Saccus abdominalis*, were asymmetrically placed and located behind the caudal thoracic air sacs. The left abdominal air sac was smaller than the caudal thoracic sac and located above the gizzard. The left air sac was placed caudo-dorsal to the caudal thoracic sacs; while, the right air sac was located caudoventral to the caudal thoracic air sac (Figs. 1, 2 & 3). The visceral side of the right abdominal air sac was related to the gizzard, intestine, liver and ovary in female birds (or testis in male birds); while, the left air sac

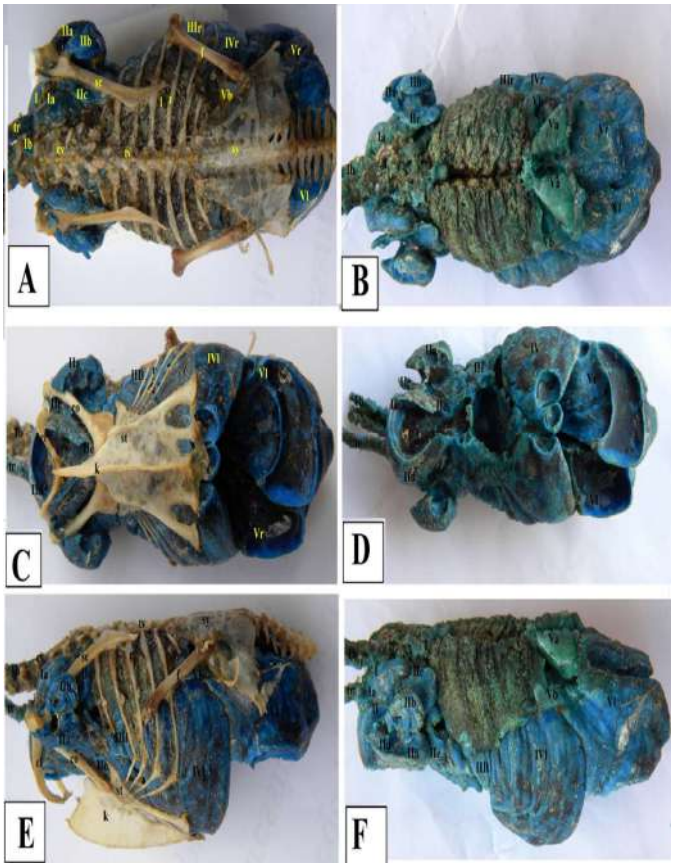
was related to the gizzard. The parietal surface of the right and left abdominal air sacs was against to the synsacrum (Fig. 2). The abdominal air sacs communicate the lung through the lateroventral bronchi (Fig. 2). The right and left abdominal sacs detach branches to diverticula that pneumatized the synsacrum. The caudal-most portion of each sac was narrower and gave off a femoral diverticulum (Fig. 3) that was located behind the hip joint (Figs. 2 and 3).



F i g u r e 1. *A photograph of the gross dissection of the air sacs of the kingfisher, neck (A), thoracoabdomen (B), and abdomen (C). Saccus cervicalis (cs), Saccus clavicularis (cl), Saccus thoracicus cranialis (cr), Saccus thoracicus caudalis (ca), and Saccus abdominalis (ab), Diverticula sternalia (st), traches (tr), oesophagus (os), right lbe of liver (rl), left lobe of liver (ll).*



F i g u r e 2 A photograph of *Anatomical description of gum milk latex injected air sacs of king fisher; ventral view (A), left view (B), reflected cervical diverticulum (C) and reflected cervical air sac (C1), showing. Saccus cervicalis (cs), Saccus clavicularis (cl), Saccus thoracicus cranialis (cr), Saccus thoracicus caudalis (ca), and Saccus abdominalis dextra (ab), Saccus abdominalis senstra (la), Diverticula vertebralis, Diverticula sternalia (st), Diverticula subcutanea (ss), Diverticula femoralis (fd), lung (L), lateroventral*



F i g u r e 3. *A photograph of a colored cast injected air sacs of the king fisher. The figure showed the air sacs from different approaches as the dorsal view (A&B), ventral view (C&D), and lateral right view (E&F). kingfisher has five air sacs; Saccus cervicalis (I), Saccus clavicularis (II), Saccus thoracicus cranialis (III), Saccus thoracicus caudalis (IV), and Saccus abdominalis (V). There are several extensions from these sacs; Diverticula vertebralia (Ib), Diverticula interrnuscularia (Ia), Diverticulum subscapulare (IIc), Diverticulum axillare (IIb), Diverticulum subpectorle (IId), Diverticulum humerale (IIa), Diverticula sternalia (IIe), Diverticula perirenalia (Va), and Diverticula femoralia (Vb)*

DISCUSSION

The respiratory system of birds differs significantly from that of mammals and has an important role in making a sound, thermoregulation and gas purification (Dewangan, 2011**).** It includes specific organs which are unique to the birds i.e., the syrinx and air sacs (Dyce et al., 2010). Research indicated that the number, size and shape of the air sacs and their diverticula are quite different among bird's species. Depending on the species, it has been found that birds have from six to

eleven air sacs (Bejdić et al., 2021). Considering the scarcity of anatomical studies in the kingfisher, the present study aimed to evaluate the anatomy of the air sacs in the kingfisher at Damietta governorate, Egypt**.**

The results of current work research revealed that, the air sacs observed in kingfisher were similar to that reported in other avian species (Cevik-Demirkan et al., 2006; Samah at al., 2014; El-sayed & Hassan, 2019). However, the interpulmonary diverticulum of the cervical air sacs recorded in rock partridge (Kurtul et al., 2004) were not observed in the kingfisher.

The current work documented that the cervical sacs of the kingfisher consisted of a pair of chambers and diverticula like that observed in most birds (King, 1966). On the other hand, in some birds such as the turkey (Meleagris) and goose, the cervical air sac fused with the lateral part of the clavicular sac to form the cervicoclavicular air sac (King & Atherton, 1970; Onuk et al., 2009). We observed in the kingfisher that the vertebral diverticula of the cervical air sacs pass cranially and caudally along the vertebral column and similar findings recorded in domestic birds (El-sayed & Hassan, 2019). Bejdic et al. (2021) reported partial fusion of the cervical air sac in Crimson Rosella.

The intermuscular diverticula in the kingfisher did not penetrate between the cervical muscles, but in some birds, they do penetrate these muscles and accompany some branches of the brachial plexus (Duncker, 1971). In accordance with findings of King, (1966) in Pelecaniformes, Akester et al., (1973) in *Leptoptilos*, Samah et al. (2014) in golden Pekin duck and El-sayed & Hassan (2019) in hooded crow. The current work observed extensive subcutaneous diverticula of the cervical air sacs.

The kingfisher has a single clavicular air sac in the thoracic inlet like that recorded in most avian species (El-sayed & Hassan, 2019). Moreover, Bejdic et al. (2021), studied the clavicular air sac in Crimson Rosella and researched to similar results. However, the findings of Bezuidenhout et al. (1999) in contrast with current results, who studied the respiratory air sacs in ostriches and reported that the left and right medial clavicular air sacs fuse with each other ventrally to the trachea to form a single. median compartment.

The present work recorded only the sternal diverticulum inside the thoracoabdomen. but, in most birds, the intrathoracic diverticula of the clavicular air sac are the cardiac and sternal diverticula (Duncker, 1971; El-sayed & Hassan, 2019). The cardiac diverticulum was reported in ducks and the albatross (Murray &Fisher, 1967; Cevik-Demirkan et al., 2006), but in contrast to the findings of current study in kingfisher. In most birds the ex-trathoracic diverticula include a subscapular diverticulum (between the scapula and the thoracic cage), an axillary diverticulum (between the muscles around the shoulder region), a humeral diverticulum (invading the humerus), a subpectoral diverticulum (under the pectoral muscles) and a supra-humeral diverticulum (covering the head of the humerus (Baumel et al., 1993; Bejdić et al.,1999; Onuk et al., 2009). In the present research, the supra-humeral diverticulum was not observed in the kingfisher. Furthermore, the extensive subcutaneous diverticula that have been reported in Pelecaniforms, Ciconiiforms, and Coraciiforms (King, 1966) were not observed in the current study. The axillary diverticulum was not observed in the kingfisher. The cranial thoracic air sacs of kingfisher were larger than the caudal thoracic, and similar to that reported in domestic birds (Taşbaş et al., 1994; El-syaed and Hassan, 2019). These results are in contrary to findings observed in Passeriformes (Duncker, 1971) and the long-legged buzzard (Orhan et al., 2009).

We noticed that the cranial thoracic air sacs in kingfisher have one large diverticulumin which is in contrast to observations in domestic fowl (Getty, 1975; Taşbaş et al., 1994), in mallard ducks (Cevik-Demirkan et al., 2006) and in hooded crow (El-syaed and Hassan, 2019) which they have no diverticula. Orhan et al. (2009) observed that in the long-legged buzzard the thoracic air sacs aerated most of the sternal ribs except the last two, as well as extending a cardiac diverticulum under the heart. Moreover, another diverticulum of each thoracic air sac is an extension along the oesophagus of phalacrocoracids (Duncker, 1971). On the other hand, the caudal thoracic sac is absent in *Meleagris* (King& Atherton, 1970)

In the current study, the abdominal sac was located in the dorso-caudal region of the coelom, which is similar to findings previously reported in the birds (Çevik-Demirkan et al., 2006; ONUK et al., 2009). In crow, El-syaed and Hassan, (2019) reported that the abdominal air sac was the largest sac in respiratory system of bird compared to others sacs investigated, this finding is in contrast with our findings.

The current work revealed that the abdominal airs sacs in the kingfisher did not gave off perirenal diverticula unlike many birds (Duncker, 1971; & El-syaed and Hassan, 2019).

The contrary or consistent among the findings of previous studies and current study in kingfisher air sacs morphological features and their diverticula could be attributed to difference description of researchers to

these organs (sacs) during their studies, the asymmetry of the abdominal viscera of birds (Mclelland, 1989). Moreover, Maina 2015) cited that, the anatomy of the lower part of the respiratory system is quite variable among the avian taxa and these variations come as results of bird's adaptation to the flight and different habitats.

CONCLUSIONS

Based on the anatomical features obtained in the current study, we concluded that the gross anatomy of the air sacs of kingfisher is almost similar to other birds with few variations. It is thought that the findings will make important contributions to the anatomy literature. However, more studies should be carried out for deeper understanding anatomical structures of other parts and diseases of respiratory of kingfisher bird.

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CONTRIBUTORS OF UTHORS

All authors AAM, WB, and HAS have equally contributed in the designing, carried out, extracted the data, writing the first draft and final of the manuscript. All authors have reviewed and approved the last submitted version.

COMPETING INTERESTS

Authors declare that there is no conflict of interest.

ETHICS APPROVAL

This study was performed in line with the principles of the Declaration of Helsinki 19. The study was approved by scientific research ethics committee, Faculty of Veterinary Medicine, Suez Canal University, Ismailia, Egypt.

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DATA AVAILABILITY STATEMENT

The data are available within the article

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الصفات التشريحية المظهرية للأكياس الهوائية لطائر الرفراف

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الملخص

أجريت هذه الدراسة بهدف التعرف على الصفات التشريحية المظهرية للأكياس (الحويصلات) الهوائية في طائر الرفراف. شملت الدراسة ثمانية طيور رفراف بالغة سليمة، تم فُحص الطيور بالعين وباستخدام مستحضرات اللاتكس والجبس. كشفت النتائج وبشكل عام، ان الصفات التشريحية المظهرية للأكياس الهوائية لطائر الرفراف تتشابه مع الاكياس الهوائية للأنواع الأخرى من الطيور. تم ملاحظة تسعة أكياس هوائية؛ أربعة أكياس هوائية مزدوجة (أكياس هوائية عنقية، وأكياس هوائية قحفية صدرية، وأكياس هوائية صدرية سفلية، وأكياس هوائية بطنية) وكيسًا واحدًا غير مزدوج؛ وهو الكيس الهوائي الترقوي. يتصل الكيس الهوائي العنقي بالرئة عبر القصبة الهوائية الوسطى البطنية، وينتج عنه رتوج بين العضلات وتحت الكتف وتحت الجلد. يتواصل الكيس الهوائي الترقوي مع القصبات الهوائية من خلال القصبة الهوائية الوسطى البطنية وله رتوج تحت الكتف وإبط وعضدي وتحت صدري وقصي. تتواصل الأكياس الهوائية الصدرية القحفية والذيلية مع الرئة من خلال القصبات الهوائية البطنية الجانبية. يكون كل كيس هوائي صدري قحفي رتوجًا يندمج في المنتصف مكونًا رتوجًا كبيرًا واحدًا؛ بينما لا توجد رتوج ممتدة من الأكياس الهوائية الصدرية الذيلية. كان الكيس الهوائي البطني الأيسر هو أكبر من بين الاكياس الهوائية المدروسة. كونت الأكياس البطنية اليمنى واليسرى فروعًا إلى رتوج تعمل على نفخ المفصل العجزي. كونت الأكياس الهوائية البطنية رتوجًا فخذيًا ذنبيًا لمفصل الورك بالإضافة إلى الرتوج حول الكلى. خلصت هذه الدراسة الى ان الحويصلات الهوائية لدى طائر الرفراف تتشابه تقريبًا مع أنواع الطيور الأخرى، مع اختلافات طفيفة، ربما تُعزز هذه النتائج المعرفة التشريحية للجهاز التنفسي لدى طائر الرفراف.

الكلمات المفتاحية: الاكياس الهوائية، الصفات التشريحية، طائر الرفراف.

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Full length article

Protective effect of adsorbing and bio-transforming antimycotoxin agents on growth performance, carcass traits, blood parameters of broiler chickens exposed to mycotoxin- contaminated feed

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ABSTRACT

Mycotoxin contamination in feed a common problem in broiler chickens' industry worldwide. This experimental study was performed at the Faculty of Veterinary Medicine, Thamar University with the aim to assess the impact of adsorbing and bio-transforming antimycotoxin agents on reducing toxic of aflatoxin B1 (AFB1) in broilers feed by examining the growth performance, carcass trait, serum parameters. 126 one-day old broiler chicks (Ross) were purchased from market and randomly allocated into 6 treatments and control groups containing 3 replicates with 7 birds in each replicate. The experimental groups were as following: (1) basal diet (clean or positive control), (2) mycotoxin-contaminated basal diet (negative control), (3) mycotoxin- contaminated basal diet and biolan in drinking water at 1%, (4) mycotoxin-contaminated basal diet and 2% zeolite, (5) mycotoxin- contaminated basal diet and 2% enzymes; and (6) mycotoxin- contaminated basal diet and mycofix 1%. In the starter period (0-3weeks), the birds in negative control, biolan, zeolite and enzymes groups showed better feed intakes, but not significant ($P<0.05$) comparing to other groups. The best feed conversion ratio (FCR) was recorded in the positive control and mycofix groups, and the worst FCR was recorded in the negative control group. In the grower period (3-6 weeks), the birds in biolan group showed higher feed intake, but the best weight gains and FCR were showed by the zeolite, positive control, enzymes and mycofix groups compared to the other groups. In the period of 6-7 weeks, enzymes and mycofix groups showed the best FCR indices compared to the negative control. Considering the weights of carcass yields and internal organs in broilers, the results revealed that, there were significant differences ($P<0.05$) in the dressing percentages of carcass at the end of experiment and none in the relative weight of the heart, liver, gizzard. Biochemistry analysis of blood demonstrated that there were no significant differences($P<0.05$) in total protein, Albumin, Globulin serum concentrations of treated and negative control groups with exception in enzyme and mycofix groups. There were no significant differences ($P<0.05$) among mean values of serum cholesterol and triglycerides in treated and control group, in spite, higher mean values concentration of cholesterol and triglycerides was recorded in treated groups. The results also displayed that, the serum urea and creatinine were lower in the negative control group compared to treated and the positive control groups. In conclusion, the present results showed that there is positive effect by adding the adsorbenting and biotransforming antimycotoxins agents to broiler diets in terms of growth performance, carcass traits and blood parameters. Further research work should be carried on other additives diet of broilers.

INTRODCTION

The poultry industry is one of the main sources of meat production worldwide. It is an important source of human proteins and of income for many breeders and workers in the poultry farming sector (Obaid et al., 2023). Poultry farming profitability significantly depends on feed costs, with them accounting for 60–70% of the total production cost (Makkar, 2018), for this reason, the efficient use of feed is extremely important in broiler production.

Mycotoxins are secondary metabolites of fungi mainly belonging to the genera Aspergillus, Alternaria, Fusarium, Cladosporium, Claviceps, and Penicillium (Peng et al., 2018). Feed ingredients have been shown to be prone to contaminated with mycotoxins, resulting in contamination of final poultry feed commodities (Njobeh et al. 2012; Akinmusire et al., 2018). The occurrence of mycotoxin contamination is global challenge, accompanied by rising animal and human health hazards and huge financial losses in the food and feed production industries (EFSA, 2011; Pinotti et al., 2016).

Feed additives are used in chicken nutrition to increase feed safety, improve growth and carcass quality, and raise immunity. The commonly used feed additives in poultry diets include antimycotoxins (Olivera et al., 2015). Antimycotoxins are feed additives that protect animal health by deactivating mycotoxins found in contaminated feed. These substances can bind to mycotoxins and prevent them from being absorbed through the gut and into the body. The addition of antimycotoxins to poultry diets has been considered the most promising dietary approach to reduce the effects of mycotoxins (Galvano et al., 2001).

Mycotoxin binders are nutritionally inert adsorbents that reduce mycotoxin absorption from the gastrointestinal tract by integrating them into contaminated feed, thereby preventing and decreasing mycotoxicosis and transportation of mycotoxins into animal products (Boudergue et al., 2009). Another way of reducing the negative effects of mycotoxins already ingested and present in the gastrointestinal tract of animals involves the use of mycotoxin modifiers such as enzymes, yeast, and bacteria, to degrade the mycotoxins into less toxic metabolites. Recently, the inclusion of *Lactobacillus spp*. in broiler chickens' diets was shown to alleviate the toxic effects of Aflatoxin B1(AFB1) and Zearalenone, ZEN, (Chang et al. 2020), as well as Deoxynivalenol, DON, (De Souza et al., 2020).

Depending on their mode action, antimycotoxins may act by reducing the bioavailability of the mycotoxins i.e., adsorbing agent or by degrading mycotoxins or transforming them into less toxic metabolites i.e., bio-transforming agents. A little data available on the effect of adsorbing and bio-transforming antimycotoxins agents in broiler diets. Therefore, the aim of this study was to investigate the effect of adsorbing and bio-transforming antimycotoxins agents on the performance, carcass traits and blood parameters of broilers exposed to mycotoxin- contaminated feed.

MATERIALS AND METHODS

Study area

The current experiment study was conducted during the year of 2023 in the Department of Veterinary Medicine, Faculty of Agriculture and Veterinary Medicine, Thamar University.

Chemical, biological materials and feed

The zeolite used in this experiment was obtained from Yemen zeolite company, Sana`a, Yemen. zeolite contains clinoptilolite as the active substance. The biolan was purchased from market and consist of a complex of non-starch polysaccharides obtained from yeast cell wall (YCW) purification. MP-zyme a commercial enzyme composed of: Amylase, cellulose, xylase, phytase, protease, β-glucans and pectinase. Mycofix plus 3.0 is the product of Biomin® GTI GmbH. Herzogenbeurg, Austria. Mycofix®Plus originally contained the components: Synergistic blend of minerals, biological constituent, BBSH 797, phytogenic substances, and Phycophytic constituents. Adsorbic antimycotoxin used was Zeolite, the biotransformic antimycotoxin was MP zyme and the combination formulated product was mycofix plus 3.0.

The basal diet was prepared for starter and growth periods. The composition of the diets prepared according to the requirements prescribed in Ross strain. Metabolizable energy (ME) and crude protein (CP) number of diets were 3200 kcal/kg and 23% respectively, and for the rest of the experimental period from 4 to 7 weeks of age, The grower–finisher experimental diets were contained 20% CP, and 3200 kcal/kg ME satisfying the needs recommended by NRC. (1994).

The concentration of aflatoxin B1 used in treated and negative groups was at dose of 0.1 mg/kg according to guidance keys given by Ramandani et al. (2020). The level of aflatoxin that is still safe in feed ingredients is no more than 50 pbb or 0.05 mg/kg (Jannah et al., 2024).

Birds and experimental design

A total of 126 one-day old broiler chicks (Ross) were purchase from market. The birds were randomly

allocated into six treatments and control groups containing 3 replicates with 7 birds in each replicate. The experimental bird groups were as the following: (1) basal diet (clean or positive control), (2) mycotoxin-contaminated basal diet (negative control), (3) mycotoxin-contaminated basal diet and biolan in drinking water at 1%, (4) mycotoxin-contaminated basal diet and 2% zeolite, (5) mycotoxin- contaminated basal diet and 2% enzymes; and (6) mycotoxin- contaminated basal diet and mycofix 1% as presented in Table 1. All bird groups were reared under standard managemental condition. The prophylactic measures were taken to control diseases and to increase the viability of the birds. The experimental room of the birds` was properly prepared, it was previously disinfected with 4% formalin and divided into separated compartments of equal size each of (1.5 x 2m) 3 m^2 floor area and bedded by a layer of chaffed sawdust. Experimental compartments were equipped with cylindrical hanging feeders, water founts and gas brooders, and maintained room temperature and air flow. Along the experimental period, all the bird groups were subjected to 24 hours lighting during the first three days and gradually decreased by 5 minutes daily till it reaches 23 hours which extended to the age of 7 weeks. Room temperature maintained by gas brooders at 34˚C during the first three days and gradually decreased by 0.5˚C daily till it reaches 25˚C at the end of the third week, then it maintained at 24˚C thereafter till the end of the experiment.

Table 1. Summarizes the experimental group design

Treatments	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
	Control (+ve)	Control (-Ve)	Biolan	Zeolite	Enzymes	Mycofix
Com. diet	+	+	+	+	+	+
Mycotoxins	-	+	+	+	+	+
Biolan	-	-	+	-	-	-
Zeolite	-	-	-	+	-	-
Enzymes	-	-	-	-	+	-
Mycofix	-	-	-	-	-	+

SAMPLING AND MEASUREMENTS

Growth performance and feed conversion

Birds were checked twice daily and the weight of birds was used to adjust the average feed consumption and body weights. The average initial body weight of the chicks at the beginning of the starter period was nearly same. Chicks were weighed weekly, live body weight (LBW) and feed consumption was recorded to calculate the body weight gain (BWG) and feed conversion ratio (FCR). The amount of feed consumed was weekly recorded in each of the different experimental groups. The average amount of feed intake (FI) by each bird was calculated by dividing the weekly consumed feed by its respective number of living birds in each group at this week. Regarding the development of the body weight and weight gain, the birds were individually weighed every week and the live weight changes were taken as the criteria of the effect of the different treatments, and as a measure for growth, the amount of feed consumed was divided by the body weight gain of the bird in order to calculate the rate of feed conversion.

Carcass traits and Blood biochemistry

At the end of the experimental period (49 day of age), five birds from each group were randomly selected and slaughtered for measurement of carcass traits and blood biochemistry, water was removed from the birds 12 hours before the expected time of slaughtering. The birds were dressed for calculation of dressing carcass percentage, after removal of feathers, head and feet. The relative weights of some internal organs of birds, including gizzard, liver and heart were recorded at the end of the experiment.

A blood specimen was collected from each of the slaughtered bird of all groups at the end of the experiment for biochemistry analysis. Blood specimens were gathered from the brachial vein in suitable vacuum tube. The blood samples were allotted to clot at ambient temperature, centrifuged for 10 minutes at 3000 rpm, and serum from each sample was extracted. The serum samples (1ml/vial) were kept at -20°C until used. Blood parameters investigated and determined were total serum protein and its fractions (albumin and globulin), total cholesterol, triglycerides, urea and creatinine using standard test kits supplied by SGM (Roma / Italia).

Statistical analysis

The crude data obtained from current experimental study were subjected to statistical analyses using the SPSS Version 20 (IBM Corp., NY, USA). The results were expressed as means and standard deviations. Differences between means were tested for significance by the two-way analysis of variance using the general linear model procedure and Ducan's test with a significance level *P* at 5%.

RESULTS AND DISCUSSION

Growth performance

The results effects of adsorbenting and biotransforming antimycotoxin agents on the performance of broiler chickens exposed to mycotoxin-contaminated feed are summarized in Table 2**.** As shown, in the starter period (0-3 weeks), the birds in negative control, biolan, zeolite and enzymes group

showed better feed intakes, but not significant (P<0.05) comparing to other groups. The weight gains of birds were significantly (P<0.05) better in the groups of zeolite and Enzymes followed by the positive control groups. The best FCR was observed in the positive control and mycofix groups whereas; the worst FCR in the negative control group. The reasons behind different results obtained on performance of birds may be due to the effects of the mycotoxins which reduce the effectiveness of digestive enzymes of protein, lipids and starch which leads to reduction in the weight gain of the chicks and dietary conversion efficiency.

In the grower period (3-6 weeks), the birds in groups of zeolites, biolan and enzymes showed better feed intakes, whereas; the best weight gains were observed in birds of zeolite, enzymes and positive control groups followed by the mycofix and biolan groups. FCR was the best in the zeolite and the positive control groups followed by the enzymes and mycofix groups, whereas; the worst FCR rate was observed in birds of the biolan and negative control groups.

In the period of 6-7 weeks, the birds in the biolan group recoded the higher feed intake values, however; the best values weight gains and FCR were recorded in the zeolite, positive control, enzymes and mycofix groups compared to the other groups. it`s confirmed that the adding antimycotoxins to diet of birds are reduced the effect of the mycotoxins and significantly increased the weight of birds.

The addition of biolan which contains yeast cell wall (YCW) to the chicken feed stimulated feed intake from one to 21 days of age (Dos Santos et al., 2021). The increase in feed intake with treatments groups with YCW may be related to the trophic effect caused by YCW polysaccharides on the digestive mucosa, which increases the villus height, especially during the first seven days of life in chickens (Santin et al., 2001).

Concerning the whole experimental period (0-7 weeks) feed intake was the highest in the biolan group followed by the zeolite groups compared to the other groups. the birds in zeolite and enzymes groups showed better values of weight gain followed by the positive control group compared to the other groups. Regarding to FCR, the best indices was observed in birds of the positive control, zeolite, enzymes and mycofix groups compared to the negative control and Biolan groups (Table 2). The results of present study are in agreement with findings of previous studies (Garcia et al. 2007, Levic et al. 2008, Abaş et al., 2011 and Suresh et al., 2018; Kolawole et al., 2020). The reasons could be attributed to that supplying the diet of birds with antimycotoxins agents possess chemical and bioactive ingredients act to reduce the toxic effects of mycotoxins and contamination of intestine or have high absorption capacity. Furthermore, zeolite contained minerals (macro- and microelements) in an ionic state which is beneficial for birds' growth and amelioration of the intestinal status (Amad & Al-ansi, 2018; VasiljevI et al., 2021).

Carcass traits

The results revealed that, there were significant differences (P<0.05) in the dressing percentages of carcass at the end of this experiment, the bird in mycofix group had the best carcass dressing percentage followed by the zeolite and the enzymes groups compared to negative group. An improvement quality of carcass by supply birds' diet with adsorbenting and biotransforming antimycotoxin agents may be due to decreased the carcass fat percentage. These results are in line with findings of El-Katcha et al. (2017) who reported that chemical or biological mycotoxin-binders supplementation significantly improved dressing percentage of broiler chicken.

The impact of dietary treatments on the relative weight of heart, liver, gizzard and kidney yield of birds(broilers) are summarized in Table 3. As shown, no significant differences (p>0.05) were detected in the relative weight of the heart, liver, gizzard among the treatment groups compared to the negative control group. These results are in parallel with findings obtained by Chen et al. (2019), and in contrast to findings reported previously by many workers (Tessari, et al, 2006, Shannon et al., 2017, Saminathan, et al., 2018 and Aikore, et al., 2019), who found that increase in weights of the liver, heart, and kidneys in broilers fed with contaminated diets treated with antimycotoxin agents.

Table 2. Effect of adsorbing and biotransforming antimycotoxins on feed intake, body weight gain and feed conversion ratio in broilers exposed to mycotoxin- contaminated feed

Trait		Treatments and control groups					
Feed intake	Period	Control +ve	Control -Ve	Biolan	Zeolite	Enzymes	Mycofix
	0-3w	793.63 ^{b}	805.89^{ab}	812.45 ^{ab}	821.03 ^{a}	820.63 ^{a}	788.67 ^{b}
	3-6 w	2482.59^{bc}	2419.31^{c}	2544.54^{ab}	2609.33 ^{a}	2508.97 ^{b}	2486.08 ^{bc}
	6-7 w	1405.2 ^{ab}	1417.9^{ab}	1486.3 ^{a}	1389.6 ^{b}	1400.6 ^{ab}	1412.7 ^{ab}
	0-7 w	4681.43^{bc}	4643.09^{c}	4843.25 ^{a}	4819.92 ^{a}	4730.17 ^{b}	4687.49 ^{bc}
Body weight gain	0-3 w	470.44 ^{a}	446.78 ^{b}	468.72 ^{ab}	476.45 ^{a}	474.72 ^{a}	467.75 ^{ab}
	3-6 w	1449.27 ^{ab}	1264.14^{b}	1404.4 ^{ab}	1511.58 ^{a}	1440.4 ^{ab}	1411 ^{ab}
	6-7w	888.59 ^{b}	892.08 ^{ab}	904.62 ^{a}	889.59 ^{b}	905.62 ^{a}	900.61 ^{ab}
	0-7	2808.3 ^{ab}	2603 ^{c}	2777.74^{b}	2877.62 ^{a}	2820.74 ^{ab}	2779.36 ^{b}
FCR	0-3 w	1.69 ^{b}	1.8 ^{a}	1.73 ^{ab}	1.72 ^{ab}	1.72 ^{ab}	1.69 ^{b}
	3-6 w	1.71 ^{c}	1.91 ^{a}	1.81 ^{b}	1.73 ^{bc}	1.74 ^{bc}	1.76 ^{bc}
	6-7 w	1.63 ^{ab}	1.63 ^{ab}	1.69 ^{a}	1.61 ^{ab}	1.59 ^{b}	1.61 ^{ab}
	0-7 w	1.67 ^{b}	1.78 ^{a}	1.74 ^{ab}	1.67 ^{b}	1.68 ^{ab}	1.69 ^{ab}

**Figures in the same row having the same superscripts are not significantly different (P< 0.05). W=week*

Table.3. Effect of adsorbing and bio-transforming antimycotoxin agents on relative weights (% of pre-slaughter weight) of carcass yields and internal organs of broilers exposed to mycotoxin- contaminated feed

Organs	Treatments and control groups					
	Control +ve	Control -ve	Biolan	Zeolite	Enzymes	Mycofix
Dressed Carcass	72.56± 1.02^{ab}	71.26± 0.93^{b}	72.27±0.91^{ab}	72.8±1.11^{a}	72.67± 0.91^{ab}	72.94±1.02^{a}
Heart	0.507± 0.04^{ab}	0.527± 0.04a	0.490±0.02^{b}	0.478±0.04^{c}	0.511± 0.04^{ab}	0.510± 0.04^{ab}
Liver	2.29± 0.08^{ab}	2.43± 0.09^{a}	2.32±0.06^{ab}	2.27±0.08^{b}	2.34± 0.06^{ab}	2.29± 0.07^{ab}
Spleen	0.166± 0.03^{ab}	0.158± 0.01b	0.168±0.03^{a}	0.173±0.01^{a}	0.168± 0.03^{a}	0.166± 0.03^{ab}
Gizzard	1.620± 0.04^{ab}	1.630± 0.05a	1.630±0.05^{a}	1.480± 0.05^{b}	1.490±0.08^{b}	1.620± 0.04^{ab}
kidney	0.421±0.02^{b}	0.606± 0.01^{a}	0.430±0.01^{ab}	0.420±0.01^{ab}	0.428± 0.01^{ab}	0.421± 0.02^{b}

**Figures in the same row having the same superscripts are not significantly different (P< 0.05).*

Table. 4. Effect of adsorbing and bio-transforming antimycotoxin agents to mycotoxin contaminated diets on blood serum parameters of broilers exposed to mycotoxin- contaminated feed

Parameter	Experimental treatments					
	Control +Ve	Control -Ve	Biolan	Zeolite	Enzymes	Mycofix
Total protein (g / dl)	4.57±0.17^{ab}	4.32±0.18^{b}	4.51±0.12^{ab}	4.55±0.15^{ab}	4.64± 0.19^{a}	4.64± 0.20^{a}
Albumin (g/ dl)	2.32± 0.07^{ab}	2.18± 0.07^{b}	2.30± 0.08^{ab}	2.32± 0.08^{ab}	2.38± 0.04^{a}	2.37± 0.08^{a}
Globulin (g / dl)	2.25± 0.10^{ab}	2.14± 0.11^{b}	2.21± 0.03^{ab}	2.23± 0.07^{ab}	2.26± 0.15^{a}	2.27± 0.12^{a}
Cholesterol (mg /dl)	114.13±0.69^{a}	101.13±0.74^{b}	108.24±0.62 ^{ab}	109.34±0.65^{ab}	107.06±0.92^{ab}	106.12± 0.68^{ab}
Triglycerides (mg /dl)	68.44±0.65^{a}	59.98±0.96^{b}	65.44±0.41^{ab}	64.44±0.41^{ab}	67.44±0.55^{a}	62.65± 0.18^{ab}
Urea (mg/dl)	2.14± 0.04^{a}	1.84± 0.04^{b}	1.92± 0.05^{ab}	1.92± 0.05^{ab}	1.98± 0.07^{ab}	1.97± 0.03^{ab}
Creatinine (mg/dl)	0.19± 0.02^{a}	0.14± 0.02^{b}	0.17± 0.04^{ab}	0.18± 0.06^{a}	0.17± 0.01^{ab}	0.19± 0.02^{a}

**Letters in the same row having the same superscripts are not significantly different (P< 0.05*).

Biochemistry analysis of blood

The results of biochemistry analysis of blood samples are presented in Table 4. The results revealed that, there was no significant differences($P<0.05$) in total protein, Albumin, Globulin serum concentrations of treated groups and negative control groups with exception of enzyme and mycofix groups which were have higher mean values concentrations. Putra et al. (2024) studied and reviewed the protective effects of various feed additives on broiler chickens exposed to mycotoxin-contaminated feed and reached to similar results. The blood parameter changes impaired protein synthesis and have been shown to be marked by decreased blood total protein, globulin, and albumin levels that have been linked to mycotoxicosis. The biochemical parameters change of blood observed in the different studies could be attributed to age, sex, metabolic state, breed, and levels of mycotoxins and duration of exposure. The toxicity of mycotoxins has been demonstrated to trigger the suppression of hepatic protein, carbohydrate, and lipid metabolism, and might therefore lead to liver dysfunction and serum biochemical changes (Aviagen, 2019; Zabiulla et al., 2021). In current study, there were no significant differences ($P<0.05$) among mean values of serum cholesterol and triglycerides in treated and control group, in spite, higher mean values concentration of cholesterol and triglycerides recorded in treated groups. Blood analysis also displayed that, the serum urea and creatinine were lower in the negative control group compared to treated and the positive control groups (Table 4). These results are agreed with findings of Tapia and Seawright (1985). The higher mean values of serum urea and creatinine in treated group compared to negative groups may be due damage caused in liver and kidney by mycotoxins.

The mortality rate was influenced by the mycotoxins contaminated groups, especially the negative control group which recorded the highest mortality rate (8%) than the other groups (which recorded mortality rate between 3 to 4%) which prove that there was favorable effect of the antimycotoxins on birds (broiler chickens) health. An immunosuppressive effect of mycotoxins has been shown to cause reduced disease resistance, reduced drug efficacy, and vaccine failures, making the animal more susceptible to diseases and increasing mortalities (Antonissen, et al 2014, Monson, et al, 2015, Murugesan, et al, 2015 and Kemboi, et al 2020).

CONCLUSION

The present results showed that there is a positive effect of supply broiler diets with adsorbenting and biotransforming antimycotoxins agents on birds (broiler chickens) in terms of growth performance, carcass traits and blood parameters. Further study should be carried with other additives to diet of birds (broiler chickens).

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CONTRIBUTION OF AUTHORS

SA author contributed to the study conception, design, written 1st draft and final version of the manuscript. Material preparation and data collection were performed by ASA, HG, AA authors, data analysis and visualization were performed by AA, FB and AA authors. All authors read and approved the final version of manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest. The funders had no role on conducting of the study.

ETHICS CONSIDERATIONS

Birds were handled humanely throughout the study, and the experimental design and protocol for the use of the birds for research were approved by the faculty board of the Faculty of Veterinary Medicine, Thamar University.

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الفعالية الوقائية لمضادات السموم الفطرية الرابطة والمحولة الحيوية على النمو، وصفات الذبيحة ومؤشرات الدم في الدجاج اللاحم التي غذيت على أعلاف ملوثة بالسموم الفطرية

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الملخص

يعد التلوث بالسموم الفطرية في الأعلاف مشكلة شائعة في قطاع تربية الدجاج اللاحم في جميع أنحاء العالم. أُجريت هذه الدراسة التجريبية في كلية الطب البيطري، جامعة ذمار، بهدف تقييم تأثير مضادات السموم الفطرية الرابطة والمحولة الحيوية على خفض سمية الأفلاتوكسين ب 1 (AFB1) في الدجاج اللاحم من خلال تقييم النمو، وسمات الذبيحة، والمعايير المصلية. تم شراء 126 كتكوتًا من دجاج اللاحم (روس) بعمر يوم واحد من السوق، ووُزّعت عشوائيًا على 6 مجموعات (مجموعات معاملات ومجموعات ضابطة)، تحتوي كل منها على 3 مكررات، بواقع 7 طيور في كل مكرر. قسمت المجموعات التجريبية على النحو التالي: (1) غذاء أساسي (مجموعة ضابطة النظيفة أو الموجبة)، (2) غذاء أساسي ملوث بالسموم الفطرية (مجموعة ضابطة سالبة)، (3) بيولان في ماء الشرب بنسبة 1% وغذاء أساسي ملوث بالسموم الفطرية (4) ٢% زيوليت وغذاء أساسي ملوث بالسموم الفطرية، (5) 2% إنزيمات MP وغذاء أساسي ملوث بالسموم الفطرية، (6) 1% مايكوفكس وغذاء أساسي ملوث بالسموم الفطرية. في فترة البدء (0-3 أسابيع)، أظهرت الطيور في المجموعة الضابطة السلبية، ومجموعات البيولان والزيوليت والإنزيمات، استهلاكًا أفضل للعلف، ولكن ليس ذو دلالة معنوية إحصائية ($P<0.05$) مقارنةً بالمجموعات الأخرى. سُجِّلت أفضل نسبة تحويل غذائي (FCR) في مجموعتي الضابطة الموجبة والمايكوفكس، بينما سُجِّلت أسوأ نسبة تحويل غذائي في المجموعة الضابط ة السالبة. في فترة النمو (3-6 أسابيع)، أظهرت طيور مجموعة البيولان استهلاكًا غذائيًا أعلى، ولكن الزيادة في الوزن وأ نسبة التحويل الغذائي كانت الافضل في مجموعات الزيوليت والضابطة الموجبة والإنزيمات والمايكوفكس مقارنةً بالمجموعات الأخرى. في فترة 6-7 أسابيع، أظهرت مجموعتا الإنزيمات والمايكوفكس أفضل مؤشرات التحويل الغذائي مقارنةً بالمجموعة الضابطة السالبة. وفيما يتعلق بالأوزان النسبية لتصافي الذبيحة والأعضاء الداخلية في دجاج اللحم، أظهرت النتائج وجود فروق معنوية إحصائية ($P<0.05$) في نسب التصافي للذبيحة في نهاية التجربة، وعدم وجود فروق معنوية في الاوزان النسبية للقلب والكبد والقوانص. أظهر التحليل الكيميائي الحيوي للدم عدم وجود فروق معنوية ($P<0.05$) في تركيزات البروتين الكلي، والألبومين، والغلوبيولين في مصل الدم بين المجموعات المعالجة والمجموعة الضابطة السلبية، باستثناء مجموعتي الإنزيم والمايكوفكس. كما لم يلاحظ أي فروق معنوية احصائية ($P<0.05$) بين متوسطات قيم الكوليسترول والدهون الثلاثية في مصل الدم بين المجموعات المعالجة والمجموعات الضابطة، على الرغم من تسجيل متوسطات أعلى لتركيز الكوليسترول والدهون الثلاثية في المجموعات المعالجة. كما أظهرت النتائج انخفاض في مستويات اليوريا والكرياتينين في مصل الذبيحة في المجموعة الضابطة السالبة مقارنةً بالمجموعات المعالجة والضابطة الموجبة. خلصت النتائج الحالية الى ان هناك تأثيرًا إيجابيًا لمضادات السموم الفطرية الرابطة والمحولة الحيوية المضافة إلى علائق دجاج اللاحم على النمو الطير، وصفات الذبيحة، ومعايير الدم. وينبغي إجراء المزيد من الأبحاث على مضادات السموم الفطرية الأخرى المضافة الى عليقة الدجاج اللاحم.

الكلمات المفتاحية: مضادات السموم الفطرية الرابطة والمحولة الحيوية، افلاتوكسين ب1، معايير الدم، دجاج اللحم، الأداء

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Full length article

Leishmaniasis among patients visiting medical centers at Dhamar district, Dhamar Governorate, Yemen: A 3-Year retrospective study

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ABSTRACT

Leishmaniasis is an important vector-borne disease that represents a serious public health problem. A 3-year retrospective study was conducted at medical centers, Dhamar district, Dhamar Governorate using patient`s records with leishmaniasis from 2021-2023. Demographic, clinical and spatiotemporal data such as age, gender, place of residence, occupation, clinical signs, treatment, month variation(season) were collected and reviewed. Collected data were summarized and analyzed using Microsoft Excel and SPSS software respectively. The results revealed that, the overall prevalence rate of leishmaniasis was 88.54% (181 out of 323), and 87.00% and 1.55 % for Cutaneous leishmaniasis (CL) and Visceral leishmaniasis (VL)respectively. The higher number of cases was recorded in year of 2022(33.44%); whereas, the lower in 2021(21.98%). Significant differences($P<0.05$) were observed among prevalence rates of leishmaniasis forms. The higher prevalence rate was in age groups of 11-20 years old, males, rural residents, those visiting G. Dhamar hospital, those with skin lesion, and those treated with Meglumine drug as 30.65, 44.58, 76.78, 26.63, 64.40, 50.46, 45.51% respectively; whereas the lower rate was recorded in age group of 31-40 years (8.36%), females (43.96%), urban residents (11.76%), those visiting General laboratory (0.64%), in lower& upper limbs of patients(1.24%), patients had hepatosplenomegaly (1.55%), and treated Stipogluconate Sodium drug (4.66%). The higher rate of disease was recorded in month of February (11.15%) and the lower in the month of November (4.33%). Statistical analysis revealed that there were significant differences between the prevalence rate and variables of age, medical center, anatomical site, clinical signs, treatment. In conclusion, the leishmaniasis is prevent among the patients' visiting medical centers at Dhamar district areas. An effective control measures should be implemented to reduce and control of leishmaniasis in the study area.

INTRODCTION

Leishmaniasis is disease caused by obligate intracellular protozoan parasites of the genus *Leishmania*. It is transmitted to humans by the bite of infected female sandflies (Akhlagh et al., 2019; Bruno et al., 2022). The

World Health Organization (WHO) classified the disease as a neglected tropical disease (Elaagip et al., 2020, WHO, 2021; Abukhattab et al., 2024). There are several forms of human leishmaniasis, and the most common forms are cutaneous leishmaniasis (CL), which is characterized with skin sores; and visceral leishmaniasis (VL), which affects several internal organs usually the spleen, liver and bone marrow (WHO, 2021; Geto et al., 2024). All forms of the disease have been strongly associated with poor socioeconomic status, population displacement, a weak immune system and climate change (Alvar and Bern, 2006; Diro et al., 2014). Leishmaniasis cases have been reported in about 89 countries of the world, with an estimated 700000 to 1 million new cases occurring annually. Most cases occur in East Africa, Southeast Asia and South America (Alvar et al., 2012; WHO, 2021).

Over the last few years, a lot of activities have been performed in the prevention and control of leishmaniasis. The strategies for the prevention and control of the disease include management of the environment, sandfly control, avoiding contact with the reservoir, and early detection and treatment of the infected individuals (Lemma et al., 2015; Kassahun et al., 2015). Clinically, *Leishmania* species can infect all human ages and present multiple manifestations (CDC, 2022), depending on the immune and nutritional statuses of the individuals, in cutaneous leishmaniasis (CL), the clinical signs of the diseases ranging from multiple papular, nodular, ulcerative skin lesions to destructive mucocutaneous ulceration; whereas, in visceral (VL), the clinical signs of VL include hectic fever, weight loss, hepatosplenomegaly, and anemia. CL and VL could be diagnosed by serological, hematological and molecular techniques in laboratory (Amro et al., 2009; Nasereddin et al., 2009; Hamarsheh et al., 2012; Handler et al., 2015; Burza et al., 2018; Amro, 2020).

Despite of considerable studies have been conducted on leishmaniasis in Yemen (Alharazi et al. (2016) in Taiz; Asmaa et al., 2017 in Taiz; Alkulaibi et al., 2019 in Western Highlands of Yemen; Nassar et al., 2021 in Hajjah; Ibrahim et al., 2023 in Ibb; Sami et al., 2024 in Yemen), still there is lack of empirical evidences on status of leishmaniasis in the study area. Therefore, this study aimed to investigate the leishmaniasis status on patients attending to Dhamar medical centers for 3 years period from 2021 to 2023

This study will help to understand the geographical distribution and the determinant factors. Such information is vital to develop evidence-based and area-specific interventions.

MATERIALS AND METHODS

Study areas

Dhamar district, Governorate of Dhamar is located approximately 100 km south to Sana`a, the capital of Yemen. In general, the Governorate weather is highly variable as a result of elevation the Governorate from the sea level (2425 meter). The winter of Governorate is cold; whereas, the summer is moderate. The trend of weather change in recent years has leading to change in the Meteorological data values, for example, the average minimum and maximum temperature been have increased; while, rainfall has been reduced. The majority of population work in agriculture.

Study design and collection the Data

The present study is a retrospective study carried out on leishmaniasis`s patients visiting Dhamar medical centers for 3 years past, namely, General Dhamar hospital, Taibah hospital, A. B. Sad clinic, Adel Ajarfi, Central laboratory. A total of 330 records of patients diagnosed with leishmaniasis in these medical centers from 2021 to 2023 were selected and reviewed. leishmaniasis diagnosis in these medical centers was performed according to the WHO guidelines and following standard operating procedures (Khabsa et al., 2022). Data related to the demographic characteristics, clinical signs and spatia-temporal information such as age, gender, the location of the lesion, the month variation, and treatment for each individual were collected. The data were collected by experienced medical laboratory technologists and students using a data collection sheet (Debash et al., 2022).

Data analysis

Microsoft Excel was used to summarize data extracted from patients` records. SPSS version 21 software package, wase used for analyzing the data. Descriptive statistics were employed to calculate frequencies and percentages of overall leishmaniasis prevalence and trends of leishmaniasis in terms of seasons, years, sex, age, and patient place of residence. A chi-square test was applied to compare the proportions between the study groups. A *P*-value ≤ 0.05 was considered statistically significant. Finally, the findings were summarized using Tables. Any incomplete data, were excluded from the analysis.

RESULTS AND DISCUSSION

Prevalence of Leishmaniasis

Leishmaniasis is an emerging tropical infectious disease. It is caused by the protozoan parasite of the Leishmania genus, which is endemic in many regions of the world, including the Middle East (Abukhattab et al., 2024).

According to the WHO, different forms of leishmaniasis have been reported from 89 countries and over 350 million people are at risk. Based on clinical symptoms, leishmaniasis is divided into cutaneous, mucocutaneous, diffuse cutaneous, and visceral forms. The number of people who suffer from leishmaniasis is estimated to be 12–15 million. Annually, 2 million new cases of leishmaniasis occur, of which approximately 0.5 million cases are visceral leishmaniasis and 1.5 million cases are cutaneous leishmaniasis CL (Torres-Guerrero et al., 2017). This retrospective study was carried out with main objective to investigate status of leishmaniases and associated factors in patients visiting medical centers at Dhamar district for 3- years past form 2021-2023.

Out of 330 records of patients, 323 were reviewed and analyzed, 7 records were excluded due to poor quality of the data or lack of data required. The results of this study revealed that, 286 cases were positive for leishmaniases with overall prevalence rate of 88.54%, furthermore, 87.00% and 1.55% of cases were positive for cutaneous (CL) and visceral (VL) leishmaniases respectively as presented in Table 1. These results are in line with previous studies (Amin et a., 2000; Hamid and Gobah, 2009; Sarkari et al., 2012; Al-Kamel, 2016; Picón-Jaimes et al., 2018; Akhlagh et al., 2019; Mann et al., 2021; Amro, 2020; Hatami, et al., 2022; Abdulslam et al., 2022; Bruno et al., 2022; Hassanein et a., 2023; Alkurbi and Hassanein, 2023), the prevalence rates reported by above studies are ranging from 4.39% to 81.8% for CL and 3.3% to 29% for VL. The differences and consistency between the results of current study and findings of the above studies could be attributed to differences in study location, study duration, laboratory personnel performance in parasite detection, sample size, availability of medical care, relative abundance and dynamic of sandflies (Debash et al., 2022).

Table 1. Overall prevalence of leishmaniasis in patients visiting Dhamar medical centers between 2021-2023(n= 323)

Leishmaniasis form	No. subjects infected	Prevalence %	95% CI	*P* value
Cutaneous	281	87.00		0.000
Visceral	5.0	1.55		
Overall	286	88.54	85.1-91.9	

Table 2. Trends of Leishmaniasis in patients at Dhamar Medical Centers between 2021-2023(n=323)

Year	No of subjects infected	Prevalence %	*P* value
2021	71	21.98	0.448
2022	108	33.44	
2023	107	33.13	

The annual prevalence rate of leishmaniases among patients visited medical centers of Dhamar during the past 3 years are displayed in Table 2. As shown. The lower (21. 98%) and higher (33. 444%) prevalence rate was seen in the years of 2021 and 2022 respectively; the data show, there is an increase trend in the prevalence rates of leishmaniases from 2021 to 2022 and decrease in year of 2023. Significant differences (P<0.05) were not observed among the prevalence rates of disease among patients in different years. These results are similar to findings of Akhlagh et al. (2019) in Iran and Tegegne et al. (2022) in Ethiopia, who carried out retrospective studies on leishmaniasis of human. and reported that there is increase and decrease in the number of suspected and confirmed cases of disease with different years of study. The declined in cases or prevalence rate might be due to effective management control used against vectors and improved of medical care adapted in study areas.

The results of leishmaniasis distribution cases according to sociodemographic characteristics, clinical signs, and treatment are presented in Table 3. As shown, the results demonstrated that, the most infected group of patients was in the age group of 11–20 years old (30.65%); whereas, the lower rate in age group of 31-40 years and above (8.36%). Significant differences (P < 0.05) were observed among prevalence rates of age groups (P<0.05). These findings were supported by the works of other researchers (Iddawela et al. 2018; Akhlagh et al., 2019). The higher prevalence rate of leishmaniasis recorded in age group of 11-20 may be attributed to that, the individuals in this group are more active in community and more exposed to infection compare to rest groups of age.

On the basis of sex, the results revealed that males (44.58%) were more prone to infection compared to females (43.96%). However; the statistical analysis showed no significant differences (P < 0.05) in the number of leishmaniasis cases among men and women. These results are in contrary with findings of Alebie et al., (2019) who reported females were more infected with leishmaniasis compared to males in Eastern Ethiopia. The higher cases of infection in males in this study could be explained that, in Yemen, men are more vulnerable to infection because they have family responsibilities that need more moving from one place to another subsequently expose themselves more to risk of infection. Furthermore, majority of them are from rural areas and work in agricultural activities that are frequently done outside, making them more vulnerable to sand fly bites (Debash et al., 2022).

Patients residing rural areas (76.78%) were more infected with leishmaniosis compared to patient living in Urban (11.76%) areas. AL-Hassani et al. (2022) carried out epidemiological and histological study on cutaneous

leishmaniasis in humans at Al-Najaf Governorate, Iraq and reached to similar results; however, in contrast with findings of Hatami et al. (2022) who reported more cases of infection among residents in urban areas. The contrary and consistent in prevalence rates among patients residing rural and urban areas might be due to the availability of a suitable environment for causative agent`s reservoir & insect vectors, low level of cultural and health awareness about leishmaniasis (Al-Hassani et al., 2022). The higher prevalence rate of disease was recorded in patient visiting General Dhamar Hospital Authority (26.63%); whereas, the lower in general Laboratory of Dhamar (0.62%). Significant differences (P<0.05) were observed among prevalence rates of different medical centers. This may be due to managemental factor, diagnosis equipment and health staff worker's availability and their experience.

Table 3. Distribution of leishmaniasis in patients at Dhamar medical centers according to sociodemographic characteristics, clinical signs and treatment between 2021-2023(n=323)

Variable	Categories	No. of infected subjects	Prevalence %	P value
Age	10<	84	26.01	0.007
	11.20 Yrs	99	30.65	
	21-30 Yrs	36	11.15	
	31-40 Yrs	27	8.36	
	41-60 & above	40	12.38	
Sex	Males	144	44.58	0.176
	Females	142	43.96	
Residency	Urban	38	11.76	0.352
	Rural	248	76.78	
Medical center	A. B. Sad Clinic	84	26.01	0.000
	Adel Ajarfi	55	17.03	
	G. Dhamar hospital	86	26.63	
	Taibah Hospital	59	18.27	
	Central Laboratory	2.0	0.62	
Anatomical sites	Face	208	64.40	0.000
	Upper limbs	30	9.29	
	Lower limbs	14	4.33	
	Trunk	6.0	1.86	
	Face &Upper limbs	12	3.72	
	Upper &lower limbs	4.0	1.24	
	Viscera	5.0	1.55	
Clinical signs	Skin lesion	163	50.46	0.000
	Skin lesion &Fever	118	36.53	
	Hepatospleenmegaly	5.0	1.55	
	Other	11	3.41	
Treatment	Fluconazole	49	15.17	0.000
	Itraconazol	46	14.24	
	Stipogluconat Sodium	15	4.64	
	Meglumine	147	45.51	
	Doxtcycline	29	8.98	

On the basis of anatomical sites of diseases, the higher number of lesions was observed in the face area (64.40%); whereas, the lower number in upper & lower limbs (1.24%); Significant differences (P<0.05) were observed between the prevalence rate and anatomical site of disease. The higher of lesions of leishmaniasis in face could be explained as that, usually all parts the body are covered with cloths; whereas, face unveiled, subsequently, expose face more to a sandfly insect bite.

The common clinical signs appeared in the patients infected with leishmaniasis are skin lesion (50.46%) followed by skin lesion & fever in combination (36.53%) for CL and hepatosplenomegaly (1.55%) for VL. Significant differences (P<0.05) were observed between prevalence rate and clinical signs of the disease. Previously, several studied have been carried out to identify the clinical signs of leishmaniasis in patients and

reported similar findings or more (Alharazi et al., 2016; Bruno et al., 2022). The higher rate of skin lesion recorded may be due to causative agent species, anatomical location of bites, immuno-reaction factors and nature of disease form.

Regarding treatment of leishmaniasis, the most common drug prescribed was Meglumine (45.51%) followed by Fluconazole (15.17%), others drugs were prescribed also with variety percentages. The reason for prescribing Meglumine more might be due to its efficacy against the leishmaniasis and less toxicity.

The results revealed that the higher prevalence rate was recorded in February (11.15%) which concurred with commencement of winter season; whereas, the lower rate in November (4.33%) which coincided with commencement of Autumn season as depicted in Table 4. Abu Al -Dawanij (2014) and Al- Hassani et al. (2022) reported similar results; whereas, in contrary with findings of Al-Moussawi (2015).

Table 4. Distribution of leishmaniasis in patients according to the month variation (Season) n=323

Season	Month	No. of infected Subjects	Prevalence %	*P* value
	Dec	35	10.84	0.609
	Jan	27	8.36	
Winter	Feb	36	11.15	
	Mar	27	8.36	
	Apr	22	6.81	
Spring	May	14	4.33	
	Jun	29	8.98	
	Jul	21	6.50	
Summer	Aug	24	7.43	
	Sep	21	6.50	
	Oct	16	4.95	
Autumn	Nov	14	4.33	

These discrepancies in the percentages and number of infections cases in different month or season may be attributed to the fact that the incubation period of disease is varies from person to person, immune system of the host, as well as changes and fluctuations in climate in the country as well (Al-Hassani et al., 2022).

CONCLUSIONS

It could be concluded from this study: The leishmaniasis is prevent among the patients visiting Dhamar medical centers. Distribution of leishmaniasis influenced by some sociodemographic and clinical factors. An effective control measures should be implemented in the study area. Early surveillance system should be adapted to monitor the disease and its vectors in study areas.

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CONTRIBUTION OF AUTHORS

IRMSA author contributed to the study conception, design, written 1st draft and final version of the manuscript. Materials preparation and data collection were performed by AAMA, MAWA, SNA, AMA, AFBA. Data analysis and visualization were performed by AHAAand FAMA. All authors read and approved the final version of manuscript.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS STATEMENT

Informed consent was not needed because of the retrospective nature of the study, which included accessed patient record only. All patient records data were anonymized and handled confidentially. The study protocol was approved by a competent Authority at Al-Hikma University.

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داء الليشمانيا بين المرضى الذين يرتادون المراكز الطبية في مديرية ذمار، اليمن: دراسة استعادية لمدة ثلاث سنوات

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الملخص

داء الليشمانيا هو مرض طفيلي مهم ينقله ذباب الرمل ويمثل مشكلة صحية عامة وخطيرة على مستوى العالم. تم إجراء هذه دراسة بأثر رجعي مدتها 3 سنوات في بعض مستشفيات ومراكز مديرية ذمار الطبية بهدف تحدد نسبة الإصابة وعوامل الخطورة المصاحبة لحدوث داء اللشمانيا باستخدام سجلات المستشفيات المحلية لمرضى داء الليشمانيا في الفترة من 2021 إلى 2023. تمت مراجعة وجمع البيانات الديموغرافية والسريرية مثل العمر والجنس ومكان الإقامة والمهنة والعلامات السريرية والعلاج والشهر (الموسم). تم تبويب البيانات المجمعة وتحليلها باستخدام برنامجي Microsoft Excelو SPSSعلى التوالي. أظهرت النتائج أن معدل انتشار داء الليشمانيا الإجمالي هو 88.54%، و87.00%) و1.55 % لداء الليشمانيا الجلدي (CL) وداء الليشمانيا الحشوي (VL) على التوالي خلال السنوات الثلاث الماضية. تم تسجيل اعلى عدد من حالات الليشمانيا في عام 2022 (33.44٪)، بينما كان أدني الحالات في عام 2021 (21.98٪). كشفت نتائج التحليل الاحصائي عن وجود فرق معنوية ذات دلالة احصائية (P <0.05)بين معدل انتشار أنماط داء الليشمانيا. كان أعلى معدل انتشار لداء الليشمانيا بين المرض في الفئات العمرية 11-20 سنة، في الذكور، في الريف، في مستشفى محافظة ذمار، الآفات الجلدية، مع استخدام علاج Meglumine بنسبة 30.65، 44.58، 76.78، 26.63، 64.40، 50.46، 45.51% على التوالي؛ في حين تم تسجيل أدني معدل في الفئة العمرية 31-40 سنة (8.36%)، الإناث (43.96%)، في المناطق الحضرية (11.76%)، في المختبر العام (0.64%)، في الأطراف السفلية والعلوية مجتمعة (1.24%)، تضخم الكبد الطحال (1.55%)، في استخدام عقار ستيبوغلوكونات الصوديوم (4.66%). تم تسجيل أعلى معدل للمرض في شهر فبراير (11.15%) وأدنى معدل في شهر نوفمبر (4.33%). أظهر التحليل الإحصائي وجود فروق معنوية ذات دلالة إحصائية (P<0.0) بين معدل الانتشارالمرض والعمر والمركز الطبي والموقع التشريحي في الجسم والعلامات السريرية والعلاج. يستنتج من هذه الدارسة، ان داء الليشمانيا منتشر بين المرضى الذين يترددون على مستشفيات مدينة ذمار ومراكزها الطبية. لذا توصى الدراسة بوضع خطة فعالة لمكافحة داء الليشمانيا في منطقة الدراسة والمناطق الأخرى المشابهة من البلاد.

الكلمات المفتاحية: داء الليشمانيا، دراسة استعادية، ذمار، **اليمن**

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Case report

Concurrent foot & mouth disease and coccidiosis in a 4-year-old Friesian cow: Case report

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ABSTRACT

This case report describes outbreak of foot and mouth disease (FMD) and coccidiosis in cow presented to KM Animal Clinic and Surgery Veterinary Pharm Sdn. Bhd. Taman Perindustrain Batu Caves, Selangor, Malaysia during the year of 2023. The cow was Friesian with four years old and showed clinical signs such as vesicles (blisters) chiefly in the mouth and on the feet, anorexia, fever, shivering, grinding of the teeth, salivating. Physical and laboratory examinations of the cow showed that existing of coccidia oocyst (750 OPG), anorexia, empty abdominal cavity, rumen stops moving, dehydration, white to the yellowish mucous membrane (anaemia), irregular heartbeat, weak body (lost the weight very fast). The cow was treated with antibiotics, vitamins along appetizer and good house management. But the cow was died. Necropsy of the cow revealed severe pulmonary congestion with engorged capillaries within the alveoli, and the heart coalescing basophilic bacterial colonies within the blood vessels, kidney degeneration, and necrosis of the renal tubular epithelium. In conclusion, based in clinical and laboratory findings, the suspected case was confirmed as FMD concurrent with coccidiosis, the findings of this report highlight the symptoms of FMD and coccidiosis in the cow. Vaccination of animal and good management could be effective control measures to prevent infections.

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INTRODCTION

Livestock industries play a major role in economic development and in the life of the farmers. In Malaysian sector of economy, a livestock industry shows a vital role such increased demand of cattle, sheep and goats' meat. It also has importance in Malaysia as a source of cash income and food security (Jesse et al. 2022). This case report describes concurrent infections of foot and mouth disease (FMD) and coccidiosis in Friesian cow. foot and mouth diseases and coccidiosis significantly impact livestock health, productivity, and economic outcomes. Concurrent infections complicate diagnosis and treatment, potentially leading to severe clinical outcomes. Common diseases affecting ruminants in

Malaysia are mastitis, contagious ecthyma, helminthiasis, pneumonia, lymphadenitis papilloma-virus, and brucellosis (Jesse et al. 2020; Odhah et al. 2021; Jesse et al., 2022). Additionally, coccidiosis, mange, meliodosis, Caprine arthritis encephalitis, milk fever, coxaella burnetti, Johne's disease and tuberculosis, pasteurellosis, and blue tongue (Jesse et al. 2016; Faeza et al. 2019). FMD is a disease caused by Aphthovirus, a member of the family Picorna-viridae, it has 7 serotypes, namely, A, O, C, Asia 1, Southern African Territories SAT1, SAT2, and SAT3. The disease characterized by erosive or ulcerative lesions in the oral cavity and on the feet that may rupture and cause lameness (Abubakar et al. 2022).

Coccidiosis is a disease of the intestinal tract caused by single celled intracellular parasites of the genus *Eimeria* and characterized by jaundice, haemolytic anaemia and destruction of the intestinal mucosa (Waruiru et al. 2000; Hamid, Kristianingrum and Prastowo, 2019). This might be accompanied by haemorrhage into the lumen of the intestine, catarrhal inflammation, and diarrhoea (Yusof and Md Isa, 2016: Hastutiek et al. 2022).

Existing literature on concurrent foot and mouth diseases (FMD) and coccidiosis cases in Malaysia is limited. Most studies focus separately on these diseases, lacking comprehensive reports on their combined impact on cattle health and productivity. This case report addresses this gap, highlighting critical diagnostic and management insights (Khadijah et al., 2014). Nevertheless, a retrospective study of the outbreaks of FMD in Malaysia Peninsular between in 2001 and May 2007, of 270 cases revealed that serotype O virus represented 89.95 % and serotype A virus represented 7.7 % of the outbreaks. These findings confirmed that FMD is endemic in Peninsular Malaysia (Ramanoon et al. 2013). This case report aimed to document the clinical presentation, diagnosis challenges, and management outcomes of concurrent foot and mouth disease and coccidiosis in a four-year-old Friesian cow.

CASE PRESENTATION

During the year of 2023, A 4-year-old crossbred Friesen cow weighing 180 kg with a body condition score of 2/5(according BCS 5-scale) was referred to the Veterinary Clinic of KM Vet Pharm Sdn. Bhd. The owner complained that, the cow had progressively increased lameness for several weeks and the animal showed hoof problems and loss of appetite Fig (1). Finally, the cow stopped eating and goes into recumbency position and appeared non-responsive to any treatment Fig (2). Besides, the above clinical signs, there were diarrhea, poor body condition. Based on the history, physical examination, clinical findings and eruption of similar cases in other areas of the country, the tentative diagnosis was established as foot and mouth disease.

CLINICAL, PARASITOLOGICAL, HAEMATOLOGICAL EXAMINATIONS

On clinical examination, the cow appeared lethargic, mucous membrane was pale, irregular heartbeat with heart rate 88 bpm, temperature, and respiratory rate of 38.7 °C, and 24 bpm respectively. The tongue had blisters lesions, as well as the lips, and on the soft tissues of the feet and inter-digital clefts. Animal was dehydrated and recumbent. Based on the clinical finding's observations, it was confirmed that animal was suffering with FMD.

Faecal samples were collected to check the presence of parasites or their eggs and oocysts. Qualitative faecal examination was performed by direct and floatation techniques to detect the presence of parasitic ova or oocyst (Mundt et al, 2005); While, McMaster counting technique was used to quantify the oocysts per gram (OPG) of faeces. On faecal examination, typical oocysts of *Eimeria spp.* were found under microscope. The counts of oocysts per gram (OPG) of faeces was 750 OPG. Other parasites or their eggs/oocyst were not noticed in faecal sample examined. on the basis of clinical symptoms and results of faecal examination it was confirmed that animal was suffering with coccidiosis.

Blood samples were also collected aseptically from the jugular vein for hematological analysis. Blood samples were analyzed according to techniques described by Katsogiannou et al. (2018) and Kim et al. (2024). The results confirmed presence of chronic anaemia .

TREATMENT

In current case, the treatment plan was commenced with hoof trimming, cleaning and applying heal cream with bandages on affected areas. In addition, meboliv powder was given to improve appetite. Administration of flunivet injection for 5days (2ml/45kg), Penicillin Streptomycin mixture (1ml/25kg) and 500 ml of Aminoplex through an intravenous (IV) were given. The bed was prepared with hay, dung was removed to maintain the environment dry and clean. One week later, to assist the animal to recover fast, additional 500 ml of Aminoplex IV, 20 ml of Catosal injection and 10 g of Rumitone, 100 g Nutrisacc and 100 ml of Provical forte (vitamin) were given.

Figure 1. The cow on presentation with signs of non-weight bearing lameness, lethargy, and recumbency with neck bent towards the right flank.

Figure 2. A-lung shows severe pulmonary congestion with engorged capillaries within the alveoli. B- kidney photograph. C- the heart shows coalescing basophilic bacterial colonies within the blood vessels. D- The reticulum showed one metal screw, which created some ulcers.

POST-MORTEM EXAMINATION

Systematic post-mortem examination of the carcass was carried out to ascertain the actual cause of death using techniques described by McInnes, (2015) and Brooks (2016). The examination include: visual examination, palpation, and incision of vital visceral organs such as the lung, spleen, liver, kidneys, oesophagus, omasum, abomasum, spleen, and small intestine.

The post-mortem examination of the lung showed severe pulmonary congestion with engorged capillaries within the alveoli. There is diffuse thickening of the alveolar septa with infiltration by lymphocytes and plasma cells shown in (figure 2-A). Heart examination revealed that, coalescing basophilic bacterial colonies within the blood vessels as shown in (figure 2-B). In the kidney, degeneration and necrosis was observed diffusely throughout the renal parenchyma as well as in the renal tubular epithelium. In addition, there was multifocal, mild infiltration of lymphocytes and plasma cells in the interstitium of the renal cortex and focal lymphocytic infiltration in the renal pelvis as seen in (figure 2-C). Oesophagus showed mild inflammation of the submucosa layer. In reticulum, one metal screw was found, which created some ulcers as shown in figure 2-D.

DISCUSSION

Foot and mouth disease (FMD) is a highly contagious and transboundary viral disease of domesticated and wild cloven-hoofed animals. Outbreak of FMD is associated with huge economic loss to the global livestock industry (APHIS, 2007; Biswal et al., 2012). FMDV is a member of the genus Aphthovirus family Picornaviridae and is considered to be the most contagious agent infecting farm animals. In Malaysia, Previously Ramanoon et al (2013) reported that the FMD disease outbreak in cattle occurred with O and A serotypes of the virus. It can spread rapidly through livestock populations across continents. FMDV is often transmitted through air or direct contact (Gomes et al., 1997).

Diagnosis of FMD is commonly made by observing clinical signs but it is difficult to detect serotypes of virus involved. The diagnosis of viral serotypes is usually made by enzyme-linked immunosorbent assay (ELISA), complement fixation test (CFT), virus neutralization test and PCR (Knowles and Samuel, 2003).

Based on the clinical signs, history and laboratory examinations, the current case was confirmed as FMD. This result is in agreement with

previous studies (APHIS, 2007; Biswal et al., 2012; Ramanoon et al. 2013; Jesse et al. 2016; Nazneen et al .(2016; Elnekave et al. 2016) in Peninsular Malaysia and other countries of the world. In addition, these authors also reported that, an infected animals may show fever commonly rises to 40°C to 41.5°C, erosions and ulceration onto the hooves, lips, mouth, teats, snout and tongue. Outbreaks of FMD in cattle are common and may be exacerbated by use of ineffective FMD vaccines, lack of routine immunization, introduction of mutant viruses through cattle movement, use of vaccines of heterogeneous strains or diverse strains of FMD viruses even within same serotypes (Alexandersen et al., 2003).

Bovine coccidiosis caused by protozoan parasites. It's reported in animals less than one year age and occasionally occurs in adults because of lower immune competence in young animals (Soulsby, 1986; Maheshwari et al., 2024). The infection is transmitted through the ingestion of sporulated oocysts in contaminated feed, water and licking of contaminated surfaces. Coccidiosis in animals characterized by severe diarrhea, dysentery, dehydration, depression, anorexia, weakness and recumbency (Ahmed and Soad, 2007). In this case report, the parasitological examination was crucial to reach the diagnosis of coccidiosis. Qualitative faecal analysis revealed the existing the coccidiosis and quantative analysis revealed that the counts of oocysts per gram (OPG) of faeces was 750 OPG in investigated cow. These results are in contrast with findings of Avellaneda-Cáceres et al. (2022) who observed more clear clinical signs and higher counts of oocysts in faeces and; partially in agreement with findings of Yatoo et al. (2013). The contrary and accordance among the results of current report and findings of above workers may be due the age of animals and immunological factors.

In the present case report, treatment of animal(cow) was initiated with administration of antibiotics, Vitamin and supplements and good management. One week later, antibiotic, Vitamin and other medicine were given to help the animal to recover fast. Similarly in Iraq, a treatment trial conducted by Abd et al. (2024) with the aim of preventing FMD complications and saving the life of cow using a combination of antimicrobials, anti-inflammatory, supportive therapy and antiseptic solutions. However, in current report, the treatments do not save the life of animal and the cow was died. The reason behind death of animals could due to interaction among the medicine given to animal (Cow) or poisoning due to overdoses.

CONCLUSION

Based in clinical signs, laboratory analysis and postmortem examination findings, the suspected case is confirmed as FMD concurrent with coccidiosis. The findings of this report highlight the symptoms of FMD and coccidiosis in the cow. Vaccination of animal and good management could be effective control measures to prevent infections.

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CONTRIBUTION OF AUTHORS

SHA, SKS, MCM, MNAO, ZKHM and GB performed the study, attended outbreak and collected samples, tested the samples and prepared initial and final draft. All authors checked and agreed with final manuscript.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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ETHICS STATEMENT

Ethical review and approval were not required for the animal study because the presented case was initially submitted for routine diagnostic purposes (for determination of the cause of disease and necropsy).

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تزامن الحمى القلاعية مع داء الكوكسيديا في بقرة الفريزيان بعمر 4 سنوات: تقرير حالة

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الملخص

يصف تقرير الحالة هذا تفشي مرض الحمى القلاعية (FMD) بالتزامن مع وداء الكوكسيديا في احدى ابقار الفريزيان التي تم احضرها إلى عيادة KM Animal Clinic and Surgery Veterinary Pharm Sdn. Bhd. Taman Perindustrain Batu Caves، Selangor، ماليزيا خلال سنة 2023. كان عمر البقرة أربع سنوات، وقد ظهرت عليها علامات سريرية مثل الحويصلات (البثور) بشكل رئيسي في الفم وعلى القدمين وفقدان الشهية والحمى والارتعاش وصرير الأسنان وسيلان اللعاب. وبعد الفحوصات السريرية والمخبرية للبقرة كشفت النتائج عن وجود متكيسات الكوكسيديا، وفقدان الشهية وتوقف حركة الكرش، وظهور أعراض الجفاف، وتغير لون الغشاء المخاطي من الأبيض إلى الاصفر (فقر الدم)، وعدم انتظام ضربات القلب، وضعف الجسم (فقدت الوزن بسرعة كبيرة). تم علاج البقرة بالمضادات الحيوية والفيتامينات بالإضافة إلى المقبلات والإدارة الجيدة. لكن البقرة توفيت. كشفت نتائج تشريح الجثة عن احتقان رئوي شديد مع احتقان الشعيرات الدموية داخل الحويصلات الهوائية، واندماج مستعمرات بكتيرية قاعدية في الأوعية الدموية، وتنكس كلوي، ونخر في ظهارة الأنبوب الكلوي. بناءً على النتائج السريرية والمخبرية، خلصت الدراسة الى ان الحالة المشتبه بها تم التأكد من انها كانت مصابة بمرض الحمى القلاعية بالتزامن مع داء الكوكسيديا. يُمكن الوقاية من العدوى والمرض بتطعيم الحيوانات وتوفر الإدارة الجيدة والفعالة.

الكلمات المفتاحية: مرض الحمى القلاعية، الكوكسيديا، بقرة الفريزيان

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