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Clinical, Haematological, Biochemical Alterations, and Potential Risk Factors Associated with Ill-Thrift in Goats Raised at Smallholder Farms in Egypt

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Abstract

ILL-THRIFT or poor growth in small ruminants is a global concern for both veterinarians and small ruminants' producers. The aim of this study was to assess the risk factors of ill-thrift and the associated clinicopathological changes. Smallholder farms were the source of 150 goats used in the study. Based on clinical findings and body condition score (BCS), the goats were classified into 3 groups: emaciated (BCS 1, n = 46), thin (BCS 1.5-2, n = 52), and control (BCS≥2.5, n = 52), respectively. Blood samples were used for clinicopathological investigations, and risk factors were tested. Goats suffering from emaciation had a significant decrease in haemoglobin (HGB) (P= 0.012), mean corpuscular haemoglobin (MCH) (P= 0.029), mean corpuscular haemoglobin concentration (MCHC) (P=0.03), albumin (P=0.009), sodium (Na) (P=0.039), iron (Fe) (P=0.004), copper (Cu) (P=0.022), and selenium (Se) (P= 0.027) compared to the control group. White blood cell count and globulin levels, on the other hand, were significantly elevated in the emaciated group (P= 0.0001, and P= 0.039, respectively). Goats aged ≤ 2 years (odds ratio (OR): 6.5, P = 0.0001), female goats (OR: 10.1, P = 0.0001), and those fed on unbalanced rations (OR: 13.3, P = 0.032) were at higher risk of ill-thrift. In conclusion, this study evidenced that ill-thrift is associated with significant alterations in the haematological and biochemical profiles. Young age, gender, and unbalanced rations are the potential risk factors for ill-thrift in goats. Recognition of risk factors associated with ill-thrift provides valuable insights for prevention and management programs.

Keywords: Ill-thrift, small ruminants, clinical pathology, epidemiology.

Introduction

Goats are vital to the world economy, particularly in the Middle East and Mediterranean region's nations [1]. Besides meat and milk production, goats can also provide fibers and fertilizers [2, 3]. Because they can adapt to a wide range of temperatures and climates, goats are raised in different localities in the world under diverse climatic circumstances [4]. However, several challenges face smallholder goat producers in underdeveloped nations; including the limited availability of high-quality hay or concentrates [5]. Goat numbers have been steadily increasing. Over the past forty years, the global population has more than doubled, reaching over one billion heads; Egypt alone is home to 4.35 million heads, according to a 2018 Food and Agriculture Organization (FAO) report [6].

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Ill-thrift in veterinary medicine describes a condition where animals grow more slowly than expected, even with enough nutrition [7]. Because it prevents weight gain and may result in a lower survival rate, ill-thrift has a substantial influence on livestock production [8]. Ill-thrift can also lower the reproductive efficiency of small ruminants, offering severe and serious challenges to the livestock industry [9].

The animal's development rate is regulated by a complicated system of genetic and non-genetic components [10, 11]. Non-genetic factors that can impact growth rates include management practices, environmental factors, including temperature, and proper nutrition [12]. Furthermore, animal ill-thrift has been associated with several diseases [13], including intestinal parasites [14], prenatal infections [15], and enteric and respiratory diseases [9]. A lack of essential trace elements is also an additional contributor to ill-thrift in animals [11, 16]. The probability of ill-thrift in sheep is increased by many variables, including the sex of the offspring [17], type of birth, either single, or multiple [9], and the presence of ectoparasites [16] have been identified to increase the likelihood of ill-thrift in sheep.

Body condition scoring (BCS) is an important method that managers and producers of both large and small ruminants can use to maximize animal welfare, reproductive, and feeding programs [15]. For animals under stress with high energy demand, or inadequate nutrition, BCS is a simple measure of its accessible fat stores [14]. Blood analysis is another crucial and trustworthy method for determining the animal's health [18]. Changes in blood parameters can reveal stress caused by environmental factors, nutritional deficiencies, and pathological conditions [19].

There is a significant research gap about ill-thrift in goats, despite substantial research on the condition in other animals. This study aimed to detect the alterations in haematology and blood chemistry linked to ill-thrift in goats. The study also intended to assess the influence of proposed risk factors for ill-thrift in goats, such as parasitic infestations, age, gender, nutrition, and management practices.

Material and methods

Animals and clinical examination

One hundred and fifty Nubian breed goats of both sexes were randomly selected from 14 smallholder farms in Aswan governorate. The selected goats were aged from 1 to 4 years and weighed from 10 to 45 kg. According to Sherman and Robinson's guidelines [20], the selected goats were thoroughly examined. This clinical examination comprised measuring rectal temperature, inspecting respiratory rate, and auscultating heart rate. Anaemia severity was determined by inspecting the colour of the goat's conjunctiva. The mucous membrane's white colour receives a score of 5, while the red colour mucous membranes receive a score of 1 on a scale of 1 to 5 for this evaluation [21].membranes receive a score of 1 on a scale of 1 to 5 for this evaluation [21].

Body Condition Scoring

The body condition score was performed according to Russel's method [22], which utilizes a scale ranging from 1 to 5. The examiner used palpation and visual inspection to determine the amount of muscle, fat, and connective tissue in certain places, such as the spine's tail, trunk, and bony landmarks. Subtle fat deposits around the eyes were also taken into account. The goats were divided into three groups based on BCS as emaciated group with a score of 1(n=46, 30.66%), the thin group with a score of 2 (n=52, 34.67%), and the control group with a score of >2 (n=52, 34.67%).

Blood Samples

Through jugular vein puncture, three types of blood samples were taken from each goat enrolled in the study. Two millilitres of blood were collected in EDTA-containing test tubes for the haematological analysis, while another two millilitres were collected in sodium fluoride-potassium oxalate vacutainers for plasma glucose testing. An additional five millilitres of blood were drawn into anticoagulant-free tubes for serum separation. Centrifugation at a G force of 1107 for 20 min was performed within two hours of collection to extract serum. After that, sterile disposable Pasteur pipettes were used to obtain clear serum from the supernatant and place it in 1.5 ml dry sterile Eppendorf tubes. The serum was stored at -20°C until biochemical evaluation.

Haematological Analysis

Red blood cells (RBC) count, HGB concentration, packed cell volume (PCV), mean corpuscular volume (MCV), MCH, MCHC, and white blood cells (WBC) count were measured in the Faculty of Veterinary Medicine's central laboratory using an automated analyzer (Exigo, Boule Medical AB, Sweden).

Biochemical Analysis

A UNICAM 969 Atomic Absorption Spectrophotometer was used to quantify the amounts of Fe, Cu, Se, and cobalt (Co) according to the method outlined by Meret and Henkin [23]. Other serum parameters including glucose, total lipids (TL), blood urea nitrogen (BUN), creatinine, uric acid, total protein (TP), albumin, aspartate aminotransferase (AST), Alanine transaminase (ALT), alkaline phosphatase (ALP), Na, phosphorus (P), calcium (Ca), potassium (K), magnesium (Mg), and zinc (Zn) were determined colorimetrically with commercial kits (Bio-Diagnostic, Cairo, Egypt) using a UV/VIS spectrophotometer (T80, PG instruments, United Kingdom). All biochemical assays were performed precisely following the manufacturer's instructions. Globulin levels were calculated by subtracting albumin from TP.

Parasitological Examination

As enteric and external parasites are the major factors of emaciation in small [14]. Therefore, visual inspection was conducted to verify the existence of external parasites using the naked eye [24]. To determine the presence of internal parasites, a faecal examination was conducted. Approximately 6-10 faecal pellets were collected from each goat and placed in airtight containers. These samples were then individually examined using sedimentation and flotation techniques based on the method of Pritchard and Kruse [25].

Determination of Risk Factors

A questionnaire was designed to find animal-level risk factors related to goats' ill-thrift, including variables like age, gender, and management system. The ages of goats in emaciated and thin groups, as well as a control group, were recorded to analyze age impact. The type of floor in goat housing (natural ground or concrete) was also detected. In addition, the feed supplied to goats was rated as balanced or unbalanced.

Statistical Analysis

The statistical program SPSS (version 16.0, SPSS Inc., USA) was used to run the analyses. Normality testing using the Shapiro-Wilk test revealed non-normal data distribution. A one-way ANOVA using the Games-Howell post hoc test was used to determine group differences because of the non-normality and uneven group sizes. Statistical significance was set at $P<0.05$. All values are presented as Mean± Standard Error of Mean (SEM). For the identification of animal-level risk factors, descriptive statistics, and risk variable distribution analysis were used to identify potential animal-level risk factors for ill-thrift. To detect the link between ill-thrift, and potential risk factors at the animal level, we employed logistic regression analysis. These involved two stages: The univariate logistic regression served as the first step in identifying individual risk factors for ill-thrift at the goat level. This statistical technique utilizes a dichotomous dependent variable, in this case, the binary categorization of a goat as either normal or ill-thrift, while the independent variables were the suggested risk factors. Meanwhile, the multivariate backward stepwise logistic regression analysis was employed for independent variables exhibiting a significant correlation ($P<0.1$). The results for each variable included the regression coefficient (β), odds ratio (OR) with a 95% confidence interval (CI), standard error (S.E.), and P value. The OR is a crucial measure of association, indicating the change in odds of ill-thrift occurrence per unit change in the independent variable. A higher risk of being ill-thrift is indicated by an OR larger than 1, whereas a lower likelihood is indicated by an OR less than 1.

Results

Clinical Examination

The results in Table 1 showed how the thin, emaciated, and control groups' mucous membrane colour and vital signs changed. The results indicated that the emaciated group's heart rates were significantly (P=0.006) decreased than those of the thin group. While there were no significant changes in respiratory rate or rectal temperature across the groups. Regarding mucous membranes score, there was a significant decrease in the score of the mucous membranes of the control group than those of the emaciated and thin groups.

Haematological Examination

The emaciated group showed a statistically significant decrease in HGB concentration, MCH, and MCHC (P=0.012, P=0.029, and P=0.03, respectively). On the contrary, the emaciated group exhibited a significant (P=0.0001) increase in WBC count compared to the control group (Table 2).

Biochemical Examination

The emaciated group demonstrated a significant (P=0.009) decrease in serum albumin levels and a significant (P=0.039) increase in serum globulin levels compared to the control one (Table 3).

Regarding electrolytes concentrations, the emaciated group showed a significant (P=0.039) decrease in serum Na levels compared to the control group. Conversely, the serum levels of P were significantly (P=0.036) increased in the emaciated group compared to the thin group (Table 4). Concerning trace elements, the Fe serum levels of the emaciated group compared to the control and thin groups demonstrated a significant (P=0.004 and P=0.017, respectively) decrease. Copper serum levels of both emaciated and thin groups displayed a significant (P = 0.022 and P= 0.025, respectively) decrease compared to the control group. Furthermore, the emaciated group demonstrated a significant (P=0.027) decrease in Se serum levels compared to the control group (Table 4).

Parasitological Examination

The current study found that the overall prevalence of ectoparasites among the examined goats was 18% (27/150). Among ill-thrift goats, the prevalence rate of ectoparasites was 20.41% (20/98), while among control goats; the prevalence rate was 13.46% (7/52). On the other hand, the overall infection rate of endoparasites was 80.67% (121/150) represented in protozoal, nematode, and cestode infections with a prevalence of (52.89%, 64/121), (29.75%, 36/121), and (17.36%, 21/121), respectively. Moreover, mixed infections between ectoparasites and endoparasites were detected in 21 goats out of 150 examined goats with a prevalence rate of 14%.

Descriptive statistics, univariate, and multivariate statistical analysis for variables associated with ill-thrift in goats

Table 5 outlined the categorization of goats as those with ill-thrift or control goats in relation to different risk factors. The age-related data showed that 66.33% of the 98 ill-thrift goats were two years or younger, while 44.23% of the 52 control goats were up to two years old. In terms of gender, 76.53% of ill-thrift goats were females, whereas 57.7% of control goats were males. Ectoparasites affected 20.4% of ill-thrift goats and 13.46% of control goats, while endoparasites were found in 82.65% of ill-thrift goats and 76.92% of control goats. 5.1% of ill-thrift goats and 11.54% of control goats were housed on concrete floors, whereas 99% of ill-thrift goats and 88.46% of control goats were fed on an unbalanced ration.

The results of the univariate logistic regression model, presented in Table 6, revealed a significant association between ill-thrift and goats with age ≤2 years (P=0.011, OR: 2.44, 95% CI: 1.2-4.9). In terms of the goats' gender, there was a significant association between ill-thrift and females compared to males (P=0.0001, OR: 4.7, 95% CI: 2.2-9.7). There was no significant association between ill-thrift in goats and the presence of ectoparasites (P=0.29, OR: 1.64, 95% CI: 0.64-4.20) or endoparaites (P=0.39, OR: 1.42, 95% CI: 0.62-3.27). Regarding the type of farm floor, no connection was found between the type of floor and ill-thrift in goats (P=0.16, OR: 2.42, 95% CI: 0. 7- 8. 36). In terms of feed, a significant relationship was discovered between feeding unbalanced rations to the goats and the occurrence of ill-thrift in the same goats (P=0.020, OR: 12.6, 95% CI: 1.48-108.17). The results of the multivariate logistic regression model, presented in Table 7, have detected three significant factors associated with ill-thrift in goats (age, gender, and type of feed). The young aged goats ≤2 years had higher odds of being ill-thrift than goats older than 2 years (P=0.0001, OR: 6.5, 95% CI: 2.4-17.3). Female goats showed higher odds of ill-thrift than males (P=0.0001, OR: 10.1, 95% CI: 3.7-27.2). Moreover, goats fed unbalanced rations were more likely to experience ill-thrift than those fed balanced rations with statistical significance (P=0.032, OR: 13.3, 95% CI: 1.25-141.8).

Discussion

Ill-thrift frequently results in significant losses in animal production; although the exact cause is not always clear [26]. Apart from goats, several studies have addressed the disease conditions that cause ill-thrift in animals [10, 27]. To ensure efficient and profitable production with minimal animal loss in sheep and goat breeding, the implementation of certain practical and straightforward measures can be beneficial. Among these measures, the use of BCS is considered a more trustworthy indicator of body fat than live weight [28, 29]. Regarding clinical examination, the present study discovered that the assessment of colour of ocular mucous membranes can indicate the presence of ill-thrift in goats. The observed higher colour score of the ocular mucous membrane in ill-thrift groups (emaciated and thin) compared to the control group is consistent with Yilmaz et al. [7], who also noted a significant correlation between BCS and the colour score of the ocular mucous membranes in goats, suggesting anaemia in animals with low BCS.

Recent studies have focused on detecting alterations in blood parameters associated with different body condition scores. The current investigation found a decreased RBC count and PCV in the emaciated and thin groups compared to the control group, although the decrease was not found significant. These results are comparable to the findings of previous studies. Shawaf et al. [30] reported a significant decrease in the RBC count of Omani goats that suffered from emaciation. In addition, Carlos et al. reported a significant decrease in PCV in sheep with a lower BCS [12]. The significant decrease in HGB observed in the emaciated group in the current study is in parallel with the findings of Yilmaz et al. [7], who reported a significant decrease in HGB in goats with a low BCS. This decline in HGB could be linked to the low serum Fe levels observed in the emaciated goats in the current study [31]. The reductions in RBC count and HGB in the current study could be attributed to malnutrition [32, 33]. The emaciated goats in the present study showed a significant decrease in MCH, and MCHC, aligning with those of Shawaf et al. [30], who reported a significant decrease in these haematological parameters in emaciated Omani goats. In contrary, Torres-Chablis et al. found a non-significant increase in these parameters in Pelibuey ewes with a BCS of < 1.5 compared with those of a BCS of 4 [34]. The presence of normocytic hypochromic anaemia in these animals could hinder their growth potential [26]. White blood cells assessment in the present study revealed the presence of an increase in its levels in the emaciated group compared to the control group. The same results were mentioned recently in the study that was carried out on alpacas and llam [35] in which a negative association between BCS and WBC count was observed. This leucocytosis may be caused by chronic parasitic infestation, such as fascioliasis in sheep [36]. However, other factors such as bacterial infections can also contribute to leucocytosis in ruminants [37].

The current trial's biochemical analysis showed no significant differences in TL, TP, BUN, creatinine, uric acid, ALP, and AST levels among the different examined groups. These results are in the same line with a study by Widiyono et al. [38], who reported no significant changes in serum TP, BUN, creatinine, and liver enzymes such as AST and ALT in Kacang goats with a BCS of 1 to 2 compared to those with a BCS of 3. These findings can rule out the presence of renal and hepatic diseases in goats under investigation [39, 40]. While Widiyono et al. [38] observed minimal changes in the serum albumin levels of female Kacang goats with varying BCS, the findings of the current study indicate a significant decrease in serum albumin of the emaciated group relative to the control group. Titaouine et al.'s findings [41] confirmed the finding of the present study, as the serum albumin levels were notably lower in Ouled Djellal ewes with a BCS under 2.5 compared to those with a BCS over 2.5. Infections of animal with different diseases or unbalanced rations can cause decreased blood albumin levels, whereas chronic infections, inflammation, or liver fluke infestations can lead to low serum albumin and high globulin levels in some animals [42]. Similar to earlier research in Boer and Alpine goats [43, 44], the current study did not identify any significant differences in plasma glucose levels among the groups it evaluated. Sitaresmi et al.'s investigation on Saanen goats, however, revealed that animals with a BCS of 2 had significantly lower blood glucose levels than goats with a greater BCS [45]. Meanwhile, Titaouine et al. observed a significant increase in glucose levels in ewes under BCS of 2.5 compared to those with higher BCS, linking this to low blood insulin levels in emaciated goats with high energy demands [41].

Concerning electrolytes, the insignificant change in the serum levels of Ca between the different BCS groups contradicts the finding of Lérias et al. [46], who studied electrolyte concentrations in Majorera and Palmera goats under different feeding and metabolic statuses. Meanwhile, it agrees with the finding of Ali et al.'s finding of an insignificant link between Ca serum levels and ill-thrift in buffalo calves [16]. Trace element analysis is a helpful method for monitoring health and management issues in flocks of sheep [47]. Iron is a crucial element that plays a vital role in the production of HGB and myoglobin, as well as in the function of catalase, peroxidase, and cytochrome oxidase [48]. The emaciated goats in this research showed a notable decrease in serum Fe levels, which corresponds to a recent study on emaciated goats by Shawaf et al. [30]. According to Kumar et al. [49], in addition to anaemia, iron deficiency in animals can lead to a decreased appetite and a lower BCS. This study suggested that Fe deficiency may contribute to ill-thrift in goats. The significant decrease in serum Cu levels observed in both emaciated and thin groups in this study aligns with Ismaeel et al.'s finding of a significant decrease in serum Cu levels of ill-thrift calves compared to the control ones [11]. Borghese [50] and Sadiek et al. [51] similarly noted Cu deficiency impacting growth of buffalo and buffalo calves. These findings could be attributed to the role of Cu as a cofactor of several enzymes that play an important role in different vital body system activities [52]. The strong link discovered in this study between deficiencies of Cu and Fe and occurrence of ill-thrift aligns with the findings of Abou El-Amaiem [53] in buffalo calves that experienced ill-thrift. Copper deficiency could hinder Fe absorption, potentially leading to simultaneous Cu and Fe deficits [26]. The significant decrease in serum Se levels observed in emaciated goats in this study is consistent with the findings of Shawaf et al. [30], who reported a similar decrease in serum Se levels in emaciated goats. Selenium deficiency may result in a compromised immune function and suboptimal growth in small ruminants [54]. The pronounced decrease in Cu, Se, and Fe serum levels observed in the emaciated group in this study aligns with Ahmed et al.'s [55] findings indicating a deficiency in these trace elements can hinder goat growth. In the present study, Zn and Co showed insignificant changes in their levels in the emaciated group despite the established association between Zn and Co with the occurrence of ill-thrift in calves [8, 11]. These findings do not rule out the possibility of these minerals playing a role in causing ill-thrift in goats.

Regarding the identification of different risk factors that are related to ill-thrift in goats, this study found a significant connection between the age of goats and ill-thrift, indicating that young goats are more prone to trace mineral deficiencies due to their rapid growth [56]. The significant association between ill-thrift in goats and female gender is consistent with earlier findings by Momoh and Rotimi, [9], which observed that male lambs grew more quickly than female lambs both before and after weaning. These differences in the rates of growth between males and females might be linked to changes in the endocrine system, especially in relation to sexual hormones [13]. The study's finding of an insignificant association between ill-thrift in goats and ectoparasites contradicts with the findings of Ali et al. [16], who ascribed this significant association between ill-thrift in buffalo calves and ectoparasites to parasite-induced malnutrition and discomfort. On the other hand, the study's finding of an insignificant association between ill-thrift in goats and endoparasites aligns with the findings of Singh et al. [18], who found no variations in worm burden between rapid and slow-growing lambs. This suggests other factors play a role in ill-thrift in goats. Goat management is one of the crucial areas that need research, particularly in relation to feeding and nutrition. Malnutrition and ill-thrift were shown to be significantly correlated in the current investigation. This is consistent with the findings of Smith and Sherman [57], who suggested that malnourishment and starvation may be the cause of goat ill-thriftiness.

Conclusions

The current study indicates that goats experienced ill-thrift associated with distinct haematological and biochemical alterations. Additionally, there is emerging evidence regarding the potential risk associated with ill-thrift in goats represented by young age, female gender, and malnutrition, which warrants significant consideration. The state of ill-thrift in goats was largely attributed to trace elements deficiency, including Cu, Fe, and Se.

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Authors' contributions

Sabry A. El-khodery, Mohamed H. Karmi and Magdy M.Elgioushy were responsible for the overall design, planning, drafting, and revision of the manuscript. Esraa A. Elkashefy conducted the survey and collected the blood and fecal samples. Esraa A. Elkashefy, Magdy M. Elgioushy, and Safaa Y. Nour analyzed the samples. Samia A. Fawy conducted the parasitological examinations. All authors carefully reviewed and approved the final version of the manuscript.

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Availability of data and materials

Not applicable

Declarations

All data included in this paper is an original obtained from our work-by-work team

Ethics approval and consent to participate

The current study was approved by The Ethical Committee of the faculty of Veterinary medicine, Assiut University, Assiut, Egypt according to OIE standards for use of animals in research under # (06/2024/0180).

Conflicts of interest

The authors declared no conflicting interests

TABLE 1. Changes in the vital signs and colour of mucous membrane in emaciated, thin, and control groups

Parameters	Control group (n=52)	Emaciated group (n=46)	Thin group (n=52)
Temperature °C	39.33±0.08	39.45±0.07	39.3±0.06
Heart rate (Beat/Min.)	96.24±2.38^{ab}	90.33±2.7^{b}	103.04±3^{a}
Respiratory rate (Cycle/Min.)	31.4±0.76	33.78±0.95	32.88±0.85
Mucous membrane colour	137(1-4)^{c}	171(2-5)^{a}	162(1-5)16^{b}

Values are expressed as mean ± SE, values with different letters in the same row differ significantly (P<0.05).

TABLE 2. Changes in haematological parameters in emaciated, thin, and control groups

Parameters	Control group (n=52)	Emaciated group (n=46)	Thin group (n=52)
RBCs (106/µl)	12.7±0.39	11.6±0.46	11.7±0.51
HGB (g/dl)	8.5±0.26^{a}	7.3±0.31^{b}	7.6±0.36^{ab}
PCV (%)	21.3±0.65	19.4±0.81	19.50±0.85
MCV (fl)	16. 83±0.25	16.74±0.2	16.66±0.25
MCH (pg)	6.7±0.12^{a}	6.3±0.86^{b}	6.4±0.11^{ab}
MCHC(g/dl)	40.2±0.9^{a}	37.7±0.33^{b}	39.1±0.63^{ab}
WBCs (103/µl)	9.5±0.46^{b}	12.2 ±0.49^{a}	11.2 ±0.73^{ab}

Values are expressed as mean ± S.E., values with different letters in the same row differ significantly (P<0.05).

TABLE 3. Changes in biochemical parameters in emaciated, thin, and control groups

Parameters	Control group (n=52)	Emaciated group (n=46)	Thin group (n=52)
Glucose (mg/dl)	44.2±3.4	42.2±3.69	48.7±3.62
Total lipids (mg/dl)	530.56±20.8	565.1±19.4	537.67±20.04
BUN (mg/dl)	36.06±2.01	34.2±2.59	39.5±2.5
Creatinine (mg/dl)	0.56±0.022	0.54±0.037	0.59±0.023
Uric Acid (mg/dl)	1.6±0.29	1.09±0.12	1.1±0.08
Total Protein (g/dl)	6.1±0.22	6.7±0.3	6.5±0.25
Albumin (g/dl)	2.5±0.06[a]	2.2±0.08[b]	2.4±0.06[ab]
Globulin (g/dl)	3.6±0.24[b]	4.48±0.27[a]	4.07±0.28[ab]
AST (u/L)	50.13±1.8	54.88±3	53.67±1.1
ALT (u/L)	13.56±0.71[ab]	11.12±0.82[b]	14.45±0.42[a]
ALP (u/L)	160.59±10.2	149.3±10.8	167.93±9.6

Values are expressed as mean ± S.E. Values with different letters in the same row differ significantly (P<0.05).

TABLE 4. Changes in electrolytes and trace elements in emaciated, thin, and control groups

Parameters	Control group (n=52)	Emaciated group (n=46)	Thin group (n=52)
Sodium (mmol/L)	98.2±1.8[a]	91.02±2.3[b]	94.4±1.7[ab]
Phosphorous (mmol/L)	2.07±0.13[ab]	2.52±0.21[a]	1.87±0.13[b]
Calcium (mmol/L)	2.22 ± 0.1	2.35 ± 0.12	2.17 ± 0.39
Potassium (mmol/L)	3.9±0.11	4.6±0.25	4.3±0.16
Magnesium (mmol/L)	1.03±0.041	0.98±0.032	0.98±0.041
Iron (µg//dl)	69.8±2.9[a]	55.8±3.2[b]	75.1±6.06[a]
Copper (µg/dl)	0.36±0.04[a]	0.23±0.029[b]	0.23±0.03[b]
Selenium (µg/dl)	1.1±0.18[a]	0.67±0.05[b]	0.94±0.1[ab]
Cobalt(µg/dl)	0.32±0.043	0.35±0.042	0.28±0.04
Zinc (µg/dl)	153.4±8.7	142.4±10.9	163.7±10.7

Values are expressed as mean ± SE. values with different letters in the same row differ significantly (P<0.05).

TABLE 5. Categorization of goats as those with ill-thrift or control goats in relation to different risk factors

Variable	Ill-thrift goats		Control goats	
	(N=98)	%	(N=52)	%
Age:				
Up to 2 years	65	66.33	23	44.23
More than 2yea	33	33.67	29	55.77
Gender:				
Male	23	23.47	30	57.7
Female	75	76.53	22	42.3
Ectoparasites:				
Present	20	20.4	7	13.46
Absent	78	79.6	45	86.54
Endoparasites:				
Present	81	82.65	40	76.92
Absent	17	17.35	12	23.08
Floor:				
Concrete	5	5.1	6	11.54
Natural ground	93	94.9	46	88.46
Feeding:				
unbalanced ration	97	99	46	88.46
Balanced ration	1	1	6	11.54

TABLE 6. Univariate logistic regression model for animal-level risk factors associated with ill-thrift in goats

Variable	β	S.E.	OR	95.0% C.I. Lower	Upper	*P*
Goats aged ≤ 2 years vs. those of >2 years	0.89	0.35	2.44	1.2-4.9		0.011
Females vs. males	1.5	0.37	4.70	2.2-9.7		0.0001
Presences of ectoparasites	0.50	0.47	1.64	0.64-4.20		0.29
Presence of endoparaites	0.35	0.42	1.42	0.62-3.27		0.39
Concrete Floor vs. natural ground	0.88	0.63	2.42	0.70-8.36		0.16
Unbalanced ration vs. balanced ration	2.5	1.09	12.6	1.48-108. 17		0.020

B: Regression coefficient; SE: Standard error; OR: Odds ratio; 95% CI: Confidence interval; P: P value

TABLE 7. Multivariate logistic regression model for animal-level risk factors associated with ill-thrift in goats

Variable	β	S.E.	OR	95.0% C.I. Lower	Upper	*P*
Goats aged ≤ 2 years vs. those of >2 years	1.87	0.49	6.5	2.4–17. 3		0.0001
Females vs. males	2.32	0.50	10.1	3.7- 27.2		0.0001
Unbalanced ration vs. balanced ration	2.59	1.2	13.3	1.25-141.8		0.032
Constant	-2.5-	0.46	0.08			0.03

B: Regression coefficient; SE: Standard error; OR: Odds ratio; 95% CI: Confidence interval; P: P value

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التغيرات الاكلينيكيه والدموية والكيميائية الحيوية وعوامل الخطر المحتملة المرتبطة بسوء النمو في الماعز المرباه في المزارع الصغيرة في مصر

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المستخلص

سوء النمو في المجترات الصغيرة يعد مصدر قلق عالمي لكل من الأطباء البيطريين ومنتجي الحيوانات المجترة الصغيرة. تهدف الدراسه الحالية إلى اكتشاف تأثير سوء االنمو في الماعز على إحداث تغييرات في المعاييرالاكلينيكيه والدموية والكيميائية الحيوية. بالاضافه ، تم تحديد عوامل الخطر ذات الصلة. وكانت المزارع الصغيرة مصدرًا لـ 150 من الماعز المستخدمة في الدراسة. تم اجراء الفحص الاكلينيكى و مقياس حاله الجسم (BCS) الشامل للحيوانات التي تم اختيارها. اعتمادا على مقياس حاله الجسم، تم تصنيف الماعز إلى 3 مجموعات: الهزال (عدد = 46) رفيعة (عدد = 52)، وضابطه (عدد = 52)، على التوالي. تم استخدام عينات الدم لإجراء الفحوصات الدموية والبيوكيميائية للمجموعات التي تم اختبارها. وعلاوة على ذلك، تم إجراء تقييم عوامل الخطر المحتمله . أظهرت نتائج اختبارات الدم والكيمياء الحيوية أن الماعز التي تعاني من الهزال لديها انخفاض كبير في الهيموجلوبين (HGB)، ومتوسط الهيموجلوبين الكري(MCH) ، ومتوسط تركيز الهيموجلوبين الكري (MCHC)، والألبومين، والصوديوم(Na) ، والحديد(Fe) ، النحاس (Cu) والسيلينيوم (Se) مقارنة بالمجموعة الضابطة. من ناحية أخرى، أظهر عدد خلايا الدم البيضاء ومستويات الجلوبيولين مستويات عالية بشكل ملحوظ في المجموعة الهزيلة. كان العمر والجنس والتغذية من عوامل الخطر البارزة التي تؤدي إلى سوء النمو، حيث كانت الماعز التي يبلغ عمرها اقل او يساوى عامين (نسبة الأرجحية6.5 :(OR) ، (P = 0.0001، وإناث الماعز10.1 :OR) ، (P = 0.0001)، وتلك الماعز الذين تم تغذيتهم بحصص غير متوازنة (نسبة الأرجحية: 13.3، (P = 0.032) كانوا أكثرعرضة لخطر سوء النمو. في الختام، أثبتت هذه التجربة أن سوء النمويؤدي إلى تغييرات كبيرة في المعايير الدموية والكيميائية الحيوية. يعد صغر السن والجنس الأنثوي والحصص الغذائية غير المتوازنة من عوامل الخطر المهمة لسوء االنمو في الماعز. إن الكشف عن عوامل الخطر التي تسبب سوء النمو يوفر رؤيه قيمة لبرامج الوقاية والإدارة لمنع سوء النمو

الكلمات الدالة: سوء النمو،الماعز،التغيرات الدمويه،التغيرات فى الكيمياء الحيويه،عوامل الخطر.