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EFFECT OF USING SOME GROWTH PROMOTERS SUPPLEMENTATION ON NUTRIENT DIGESTIBILITY, BLOOD METABOLITES, AND PRODUCTIVE PERFORMANCE IN GROWING BALADI CROSS-BRED CALVES

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ABSTRACT

A growth trial was conducted for 90 days with 20 Baladi cross-bred calves with an average body weight of 227 ±15 kg, which were randomly divided into two groups (10 calves for each). They were evaluated with/without supplementation of a mixture of two growth promoters (immunomodulators and liver support products). The control group (G1) received a basal diet containing concentrate feed mixture (CFM), berseem hay, and rice straw, whereas, in the other group (G2), the CFM was supplemented with 2 kg/ ton of the two growth promoters (1 kg each). The feed intake, nutrient digestibility, some blood hematological and biochemical parameters, immune system response, average daily gain (ADG), and economic efficiency were measured. The results showed that calves in G2 showed non-significant differences in overall nutrient digestibility. The

red blood cells, white blood cells, hemoglobin, immunoglobulins, lysozyme activity, lymphocyte transformation, and phagocytic index were higher in G2. At the same time, a significant decrease in ALT, AST, and total bilirubin was recorded compared to G1($P < 0.05$). The experimental animals in G2 showed a higher ADG by 15.2%, whereas feed cost for producing one kg of gain was decreased by 6.2% increasing the expected daily income by 27.3% compared to the control group. Accordingly, supplementing growing Baladi calves' diets with a mixture of immunomodulators (1 kg/ ton) and liver support products (1 kg/ ton) as a growth promotor improved the blood biochemical parameters, immune system response, exerting a positive influence on the health condition, leading to enhancement of the productive performance and increased the economic efficiency.

Keywords: Growth promoters, Baladi calves, Physiological status, Immune, Productive performance

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INTRODUCTION

The key to optimal health in beef cattle operations is balanced nutrition, which includes protein, energy, vitamins, and minerals. Thus, growth promoters continue vital issues due to their benefits and challenges for improvement animal productivity, and potentially reduce the cost of animal breeding. Growth promoters are substances that are added to feeds as supplement or injection to improve feed utilization and the growth of the animals **(Tamirat and Abebe, 2017)**, Moreover, Beef cattle producers use growth promoters to increase growth rates and improve the meat quality,

and overall efficiency **(Mostafa *et al*., 2014)**. Growth promoters as flavomycin, probiotics, acidifers, enzymes, herbal products, beta agonists, microflora enhancer and immunomodulators **(Devegowda, 1996)**. Furthermore, the use of immunomodulatory feed compounds has grown-up with the accumulative attention in alternatives to antibiotics **(Byrne *et al*., 2020)**. Many of these can enhance innate immune function, such as increasing phagocytosis, increasing reactive oxygen species production and restoring proinflammatory cytokine secretion to leukocytes from transition cow **(Byrne *et al*., 2020)**. Likewise, bovine disease resistance can be increased by using immunomodulatory feed additives **(Shen *et al*., 219)**. Also, in cattle health programs, adequate nutrition, including supplementation with key minerals (e.g., copper, selenium, manganese, and zinc), is a key component **(Palomares, 2022).**

The disorder of fatty liver or fat cow syndrome is developing when mobilization of large amounts of body fat reserves in response to insufficient dietary energy supply results in a transfer of fatty acids to the liver (**Gruffat *et al*., 1996)**. Excessive amounts are deposited in the hepatocyte as triglycerides and can result in disturbed liver function and liver cell injury (**Gruffat *et al*., 1996)**. The condition is associated with pronounced ketosis, feed intake depression, and decreased productivity **(Bobe *et al*., 2004).** Prevention of fatty liver could be by providing animals with adequate nutrients and a clean and health-promoting environment **(Bobe *et al*., 2004).** Moreover, increasing hepatic gluconeogenesis or glucose supply, as well as increasing glucose uptake by extrahepatic tissues, are the main ways to prevent and treat fatty liver **(Bobe *et al*., 2004)**.

Therefore, the aims of this study were to determine the influence of supplementation growing Baladi calves' diets with a mixture of immunomodulators (1 kg/ ton) plus liver support products (1 kg/ ton) on

nutrients digestibility, health parameter, growth performance, and economic efficiency.

MATERIALS AND METHODS

The Damanhour University Animal Care and Use Committee approved all animal procedures before project initiation. The present study was accomplished in a private farm (58-kilometer Cairo-Alexandria desert road, Egypt) and lasted 15 weeks (3 weeks for adaptation, and 12 weeks as an experimental period). The chemical analysis of feed, feces, and blood samples was performed at the laboratories of the Animal Production Department, Faculty of Agriculture, Cairo University, Egypt.

Animal management and experimental design

Twenty Baladi cross-bred calves with an average body weight of 227 ±15 kg kept under the same environmental, hygienic, and managerial conditions were used in the present study. Calves were kept under similar conditions to accommodation systems in an open house system. Calves were fed the same diet containing concentrate feed mixture (CFM), alfalfa hay, and rice straw according to the National Research Council **(NRC, 2001)** recommendations three times daily at 7.00 am, 1.00 pm, and 7.00 pm. The ingredients of the CFM are stated in **(Table 1).** The freshwater was available continuously to all calves. Before starting the trial, calves were treated for internal and external parasites, in addition to being vaccinated against common infectious diseases.

Calves were randomly divided into two equal groups (10 calf for each). They were assessed with/without supplementation of a mixture of immunomodulators (Lactopluse-keragen Longlife®, Josera company,

Germany) plus liver support products (Design Liver up®, Neovia company, France) as a growth promoter. The control group (G1) received a basal diet, while, in the other group (G2), the CFM was supplemented with 2 kg/ ton of the two growth promoters (1 kg/ton for each). The amount of the two-growth promoters' supplementation was given depending on the recommendations of the producing company. The formulation of the immunomodulator, and liver support products are stated in Tables **2 and 3**, respectively.

Table 1. Formulation of the concentrate feed mixture used in the experiment.

Ingredients,	**Percentage**
Yellow corn grains	55
Soybean meal 44%	7.5
Wheat bran	22.5
Sunflower meal 36%	10
Limestone	2.4
Sodium chloride	1
Vitamins and minerals mixture [1]	0.3
Sodium bicarbonate	0.8
Dicalcium phosphate	0.5
Total (%)	100

[1] Each 3 kg vitamins and minerals mixture contain: Vit A 4800000 IU; Vit D3 1000000 IU; Vit E 28000 mg; Zinc 100000 mg; Manganese 80000 mg; Iron 75000 mg; Copper 30000 mg; Iodine 750 mg; Cobalt 200 mg; Selenium 300 mg; Calcium bicarbonate up to 3 kg.

Table 2. Formulation of the immunomodulators (Lactopluse-keragen Longlife®)

Items	Content
Mono calcium phosphate, %	26.3
Calcium carbonate, %	19.2
Sodium bicarbonate, %	18
Sodium chloride, %	14.8
Magnesium oxide, %	10
Sugar beet molasses, %	2.5
Malt rootlets, %	2
Wheat bran, %	2
Nutritional additives, %	5.2
Vitamin A, IU	800,000
Vitamin D3, IU	120,000
Vitamin E, mg	5,000
Vitamin B1, mg	120
Vitamin B2, mg	90
Vitamin B6, mg	80
Vitamin B12, µg	600
Niacin, mg	2,000
Ca-d pantothenate, mg	300
Folic acid, mg	24
Biotin, mg	100,000
Zinc (zinc chelate of glycine hydrate), mg	3,000
Zinc (zinc oxide), mg	3,000
Manganese (manganese-zinc chelate of glycine hydrate), mg	1,500
Manganese (manganese oxide), mg	15,00
Copper (cupric Chelate of glycine hydrate), mg	450
Copper (cupric Sulphate pentahydrate), mg	450
Iodine (Calcium iodate), mg	100
Cobalt (coated granulated cobalt carbonate), mg	22
Selenium (sodium selenite), mg	15
Carrier (calcium carbonate)	up to 1 kg

Table 3. Formulation of the liver support (Design Liver up®).

Items	Content
Lysine, mg	212
Methionine (partly micro-encapsulated), mg	55,000
Sorbitol, mg	115,000
Betaine, mg	10,000
Choline chloride, mg	55,000
Vitamin A, IU	4,500,000
Vitamin D3, IU	150,000
Vitamin E, mg	3,000
Copper (Copper sulfate), mg	1,500
Manganese (manganese oxide), mg	8,500
Iodine (potassium iodide), mg	240
Selenium (sodium selenite), mg	30
Zinc (zinc sulfate), mg	8,500
Cobalt (cobalt carbonate), mg	30
Carrier (calcium carbonate)	up to 1 kg

Chemical composition of the diet

Samples of feed ingredients and feces were analyzed for dry matter (DM), ash, ether extract (EE), crude protein (CP) and crude fiber (CF) according to **AOAC (2000)**. Nitrogen free extract (NFE) and organic matter (OM) were calculated on DM basis, as follows:

NFE % = 100 – (%CP + % CF + % EE +% Ash)

OM= % CP + % CF + % EE + % NFE

The chemical composition of feed ingredients, and total mixed ration (TMR) used in the trial is demonstrated in **Table 4**.

Table 4. Chemical composition (on DM basis) of concentrate feed mixture (CFM), alfalfa hay, rice straw and total mixed ration (TMR) used in the trial.

Items (%)	Feeds			TMR
	CFM	Alfalfa hay	Rice straw	
DM	88.47	90.34	90.55	89.26
OM	94.86	90.28	75.40	90.05
CP	16.16	17.04	5.35	14.17
CF	8.56	24.00	27.84	15.51
EE	3.36	2.70	1.58	2.87
Ash	5.14	9.72	24.6	9.95
NFE	66.77	46.54	40.63	57.50

DM, dry matter; OM, organic matter; CP, crude protein; CF, crude fiber; EE, ether extract; NFE, nitrogen free extract; CFM, concentrate feed mixture; TMR, total mixed ration.

Digestion trial

The digestion trial was conducted at the last week of the experiment following the acid insoluble ash (AIA) method according to **Van Keulen and Young (1977)**. Fecal samples were collected from the rectum of 3 animals in each group, at 10.00 am and 4.00 pm for three successive days, and thoroughly mixed (six samples for each animal). Then, they were stored at - 20 °C until analyzed. Samples were dried at 70 °C for 24 hours, and then kept individually in polyethylene bags for chemical analysis. The nutritive value of the experimental diets as total digestible nutrients (TDN) was calculated according to **McDonald *et al.* (1995)** equation, while the AIA, as an internal marker, was applied for the digestibility determination according to **Van Keulen and Young (1977)** equation, as follows: TDN (%) = [digestible CP (%) + digestible CF (%) + digestible NFE (%) + (digestible EE, % × 2.25)]

$$\text{Dry matter digestibility} = 100 - \left(100 \times \frac{\text{AIA\% of feed}}{\text{AIA\% of feces}}\right)$$

$$\text{Nutrient digestibility (\%)} = 100 - \left[100 \times \left(\frac{\text{AIA\% of feed}}{\text{AIA\% of feces}}\right) \times \left(\frac{\text{\% nutrient in feces}}{\text{\% nutrient in feed}}\right)\right].$$

Blood sampling and analysis

Blood samples (10 mL) were collected monthly from the jugular vein from each calf before the morning feeding. After collection, samples were put directly in ice and centrifuged on the same day at 1,500× g for 15 minutes at 4°C, to separate serum and plasma and then frozen at –20°C until analyzed. Hemoglobin (Hb) level was measured by a colorimetric method (Spectrophotometer, Jenway 6300, U.K) according to **Wintrobe (1956)**. Red blood cells (RBCs), white blood cells (WBCs) and platelets were determined by hemocytometer device according to a technique of **Pushkar and Bhatta (2013)**.

Furthermore, total protein, albumin, creatinine, alanine transaminase (ALT), aspartate transaminase (AST), calcium and total bilirubin were determined using commercial test kits (Bio-labo, France) according to **Calamari *et al*. (2016).** Globulin was calculated as the difference between total protein and albumin concentrations for each experimental animal. Serum lysozyme activity was measured according to the methodology of **Ellis (1990)**. Immunoglobulin G and M level was measured by an ELISA assay using a commercial kit (Cusabio, Wuhan, Hubei, China) according to manufacturer's directions. Lymphocyte transformation test was determined by colorimetric method (**Pushkar and Bhatta, 2013**), while phagocytic index was determined according to **Kawahara *et al*. (1991)**.

Growth performance and feed efficiency evaluation

The body weight (BW) of all calves was measured monthly on the 1st, 2nd and 3rd month before the morning feeding, and average daily gain (ADG) was calculated from initial and final BW. An accurate feed intake

for each group was recorded daily (average daily feed intake; ADFI) and converted into feed conversion ratio (FCR). Weight gain (kg/calf): WG = Wt − W0; where W0: the initial mean weight of calf in kg, and Wt: the final mean weight of calf in kg. Average daily gain (kg/calve/day): ADG = Wt − W0/n; where, n: experimental days (90 day). Feed conversion ratio (FCR) = dry matter intake (kg)/calve weight gain (kg). The economic efficiency of the experimental rations was expressed as the cost of feed consumption for producing one kg of body weight gain.

Statistical Analysis

The experimental data was statistically analyzed through one-way ANOVA using Predictive Analytics Software (PASW) statistic 18.0 **(SPSS, 2009, Inc., Chicago, IL, USA)** according to the following model:

$$\mathbf{Y_{ij} = \mu + T_i + E_{ij},}$$

where: Y_{ij}= experimental observation; μ = general mean of treatments; T_i = effect of treatment; E_{ij} = experimental error. Differences among means were compared by Duncan's multiple range test of **Duncan (1955)**, declaring significant at $P < 0.05$ and tending to be significant at $0.05 \leq P < 0.10$.

RESULT AND DISCUSSION

Nutrient digestibility

Nutrient digestibility and nutritional values for the experimental rations are shown in **Table 5.** The results showed that supplementation of a mixture of immunomodulators and liver support products as growth promoters into the growing claves ration hasn't any negative effect on

nutrient digestibility and/or the nutritive values (represented in TDN and DCP), as no significant differences were found in DM, OM, CF, and CP digestibility as well as TDN and DCP ($P > 0.05$). However, a significant difference was found between groups in EE and NFE digestibility ($P < 0.05$). As shown in **Table 2** and **3** the used immunomodulator additives consist of a combination of different high-grade active agents such as glycine chelates, rumen-protected selenium, and rumen-stable B vitamins. Also, the used liver support products supplementation contains some dietetic minerals and methyl donors (i.e. methionine, choline, and betaine). Many of these components can enhance the digestion efficiency.

Table 5. Effect of the experimental rations on nutrients digestibility and nutritive value.

Variables	Experimental groups[1]		SEM[2]	*P*-value[3]
	G1 (Control)	G2 (Treatment)		
Digestion coefficient (g/100 g)[4]				
DM	74.82	74.70	0.258	0.823
OM	76.23	75.46	0.271	0.169
EE	74.24	78.20	0.812	0.004
CF	58.38	57.83	0.351	0.468
CP	75.33	76.00	0.271	0.234
NFE	81.37	75.33	0.362	0.040
Nutritive values (g/100 g)[5]				
DCP	10.68	10.77	0.038	0.234
TDN	71.31	70.76	0.232	0.259

[1]The control group (G1) received a basal diet, G2 received a basal diet supplemented with a mixture of immunomodulators, and liver support products (1 kg/ton for each).

[2] SEM: Standard error of the means. [3] Probability. [4] DM, dry matter; OM, organic matter; CP, crude protein; CF, crude fiber; EE, ether extract; NFE, nitrogen free extract. [5] TDN: Total digestible nutrients; DCP: Digestible crude protein.

In the same trend as our results, **Samarin *et al.* (2022)** observed that supplementing lamb diets with organic minerals has no adverse effects on overall diet digestibility and might maintain digestion efficiency under stress conditions. Also, **Mallaki *et al.* (2015)** found that using organic trace minerals in ruminant diets has no significant effect on the digestion coefficient of DM and OM. Moreover, supplementation of methyl donors, such as methionine and betaine, to ruminant diets did not have any negative effect on DM, OM, and CP apparent total tract digestibility **(Lambert *et al.*,2004; Poolthajit *et al.*, 2022).** On the other hand, an improvement in DM, OM, and fiber digestibility was reported in lambs and goats with the addition of inorganic trace minerals to their rations **(Garg *et al*., 2008; Mandal *et al*., 2007; Salama *et al*., 2005).** Otherwise, numerous studies established that betaine positively affects nutrient digestibility, and animal performance by providing methionine and choline through its metabolism in the body **(Klasing *et al*., 2002; Shah *et al*., 2020).** The positive result for EE digestibility was in agreement with **Mohsen *et al.* (2011)** who reported a higher EE digestibility with the inclusion of choline in dairy cows feeding. This may indicate better dietary energy and nutrient utilization with the addition of the immunomodulators, and liver support products, because of the vital role of the methyl donors in the body (i.e., enhancement of intestinal microbiota, optimizing digestion and absorption by intestinal cells, and many roles in the metabolic processes **(Eklund *et al*., 2006; Montaño *et al*., 2019; Amin *et al.*, 2023)**. On the contrary, a decrease in NFE digestibility was found ($P < 0.05$), suggesting more research is needed in this aspect or repeating the trial on a broad scale to accurately investigate the impact of the experimental additives on carbohydrate utilization.

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Blood parameters and immune system response

Results of some blood parameters and immune response measurements are presented in **Table 6**. As indicated the levels of blood hematological and biochemical measures of the experimental claves fell within the physiological ranges for cattle. Many previous studies, established that using organic or inorganic trace minerals (such as Fe, Cu, Zn, and Se) in livestock diets has a positive impact on their immune system response, which could be reflected in animal health, productivity, and farm profitability **(Tyagi *et al*., 2020; Wang *et al.*, 2021; Palomares, 2022)**. In this regard, almost all blood parameters (except for platelets, total protein, albumin, and globulin) showed significant variations due to the treatment ($P < 0.05$). Hence a vital improvement was noted for the hematological parameters such as WBCs, RBCs, and Hb, which may indicate a general enhancement in animal physiological functions **(Tanuwiria and Mushawwir, 2020; Sobolev *et al*., 2021).** Regarding liver functions, supplying calves' diet with a mixture of immunomodulators, and liver support products led to a remarkable positive result. A significant reduction ($P < 0.05$) in ALT, AST, and total bilirubin values by 54.6, 37.2, and 54.9%, respectively, was shown in supplemented calves compared to the control group. These results are in agreement with many studies which declare that including methyl donors such as betaine, choline, and methionine, either ruminal protected or non-protected, in ruminant ration is expected to have a positive impact on liver health and functions, reinforcing achieving a higher metabolism efficiency and eventually better animal productivity **(Zenobi *et al*., 2018; Coleman *et al*., 2019; Chen *et al*., 2022).**

Table 6. Effect of addition of a mixture of two growth promoters* to the growing calves' diet on some blood parameters and immune system response.

Variables[1]	Experimental groups		SEM[2]	*P*-value[3]
	G1 (Control)	G2 (Treatment)		
WBCs ($\times10^3$/µl)	5.70	7.45	0.380	0.005
RBCs ($\times10^6$/µl)	4.18	5.18	0.590	0.002
Hb (g/dl)	11.55	13.33	0.414	0.015
Platelets ($\times10^3$/µl)	175.50	167.00	4.070	0.333
ALT (IU/ml)	114.50	52.00	12.230	<0.001
AST (IU/ml)	49.75	31.25	5.172	0.066
Total bilirubin (mg/dl)	1.33	0.60	0.164	0.009
Serum calcium (mg/dl)	8.00	10.25	0.515	0.012
Creatinine (µmol/L)	102.41	92.95	4.380	0.090
Total protein (g/L)	65.87	70.37	5.680	0.284
Albumin (g/L)	35.26	35.30	0.670	0.127
Globulin (g/L)	30.59	35.19	3.220	0.199
Lysozyme activity (U L^{-1})	33.93	47.69	4.390	0.039
IgG (g L^{-1})	16.83	22.58	0.933	0.014
IgM (g L^{-1})	3.48	4.67	0.194	0.002
Lymphocyte transformation	22.75	43.00	4.073	0.001
Phagocytic index	1.65	3.45	0.367	0.001

* a mixture of immunomodulators, and liver support products (1 kg/ton for each).
[1]WBCs, white blood cells; RBCs, red blood cells; Hb, hemoglobin; ALT, alanine transaminase; AST, aspartate transaminase; IgG, immunoglobulin G; IgM, immunoglobulin M. [2]SEM, Standard error of the means. [3] Probability of significant effects of the experimental treatment.

Furthermore, the used liver support products could present another benefit regarding liver function, as they contain sorbitol, a sugar alcohol, in their formula. According to **Maty (2023)** and **Islam *et al*. (2007)**, sorbitol positively influences detoxification, circulation, and ammonia removal from the body. Also, it reduces the risk of fatty liver and enhances liver functions and overall animal health. This point of view may be supported by decreasing plasma creatinine concentration ($P < 0.10$) as one of some indicators for renal clearance efficiency of urea **(Müller *et al*., 2021)**. As a

result of the previous findings for improving liver functions, it has been noted that blood calcium was significantly increased ($P < 0.05$) by the treatment, which might be attributed to the activation of vitamin D receptors in the liver and its well-known relationship with calcium absorption from the intestinal tract into the bloodstream **(Dong *et al.*, 2020; Polzonetti *et al.*, 2020; Poindexter *et al.*, 2020)**. The IgG and IgM were recorded higher for G2 by 34.17 and 34.20%, respectively, compared to G1, indicating a positive impact on the immune-biochemical status of the experimental animals (**Costa *et al.*, 2021; Tsai *et al.*, 2021)**. In parallel, it was noted that supplying calves' diet with a mixture of immunomodulators, and liver support products significantly ($P <0.05$) increased lysozyme activity and lymphocyte transformation in G2 by 40.55 and 89%, respectively, compared to the control group. Also, the phagocytic index was significantly found ($P < 0.05$) to be higher by 109% more in G2 in comparison to the control group, which reflects the ability of the immune system to identify pathogens and high power of phagocytes to engulf microorganisms **(Ghoneem *et al.*, 2022)**.

Growth performance and economic efficiency

Effect of the supplementation of a mixture of the two growth promoters (immunomodulator and liver support products) on the growth rate, during the experimental period is exhibited in **Figure 1.** As shown, a mixture of the two growth promoters' addition to the calves' diet improved the daily gain of the growing calves in 1st month from 1.15 to 1.22 kg/h/d (+72 g/h/d) for G1 and G2, respectively. In the 2nd month, ADG was also numerically enhanced from 1.21 to 1.37 kg/h/d (+160 g /h/d) for G1 and G2, respectively. However, differences were not significant ($P > 0.10$) in both months (1st and 2nd). On the other hand, there was a difference between groups ($P < 0.05$) in the ADG of the 3rd month (from 1.01 to 1.29

kg/h/d (+280 g/h/d) for G1 and G2, respectively. Likewise, ADG overall in the experiment was significantly improved (from 1.12 to 1.29 kg/h/d for G1 and G2, respectively; $p < 0.05$), increasing 170 g daily overall during the experimental period (i.e., 15.2% higher compared to the control group). Also, it was observed that ADG was improved by increasing the time of using the experimental feed additives (70, 160, and 280 g/h/d in the 1st, 2nd, and 3rd months, respectively) in G2 compared to control. These improvements could be attributed to the many components of the used growth promoters in the present study. Our results agreed with those obtained by **Samarin *et al*. (2022)** who found that adding organic trace minerals to growing lambs' diet led to an increase in ADG by 17.7% compared to the control group. Also, **Aliarabi and Chhabra (2006)** found that including chelated Zn in cross-bred calves' diet led to an enhancement in ADG.

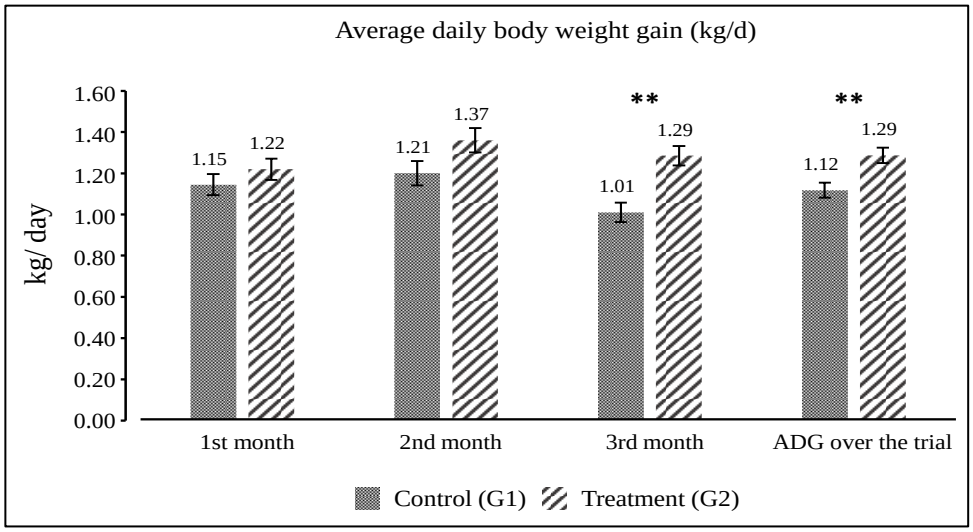

Figure 1. Effect of addition of a mixture of two growth promoters (a mixture of immunomodulators, and liver support products (1 kg/ton for each)) to the growing calves' diet on average daily body weight gain (kg/day) throughout the trial.

Results are means and error bars indicate standard error of means, while "**" indicates a significant difference between groups ($P < 0.05$).

Table 7. Live body weight, average daily gain, feed conversion ratio and economic efficiency of the experimental animals fed ration containing a mixture of two growth promoters*

Variable	Experimental groups		SEM	*P*-value
	G1 (Control)	G2 (Treatment)		
Body weight change				
Initial body weight (kg)	242.60	212.50	5.918	-
Final body weight (kg)	343.60	328.90	6.555	-
Total body weight gain (kg)	101.00	116.40	3.371	0.018
Average daily gain (kg/h/d)	1.12	1.29	0.037	0.019
Average daily Feed intake (kg/h/d)				
Concentrate feed mixture	6.00	6.00	-	-
Alfalfa hay	2.00	2.00	-	-
Rice straw	2.00	2.00	-	-
Feed intake (As fed)	10.00	10.00	-	-
Total DMI[1]	8.93	8.93	-	-
FCR (kg DMI/ kg gain)[2]	8.05	7.00	0.231	0.018
Economic efficiency				
Concentrate price (LE/kg)	7.00	7.70	-	-
Alfalfa hay Price (LE/kg)	4.00	4.00	-	-
Rice straw price (LE/kg)	1.30	1.30	-	-
Total daily Feed cost (LE/h/d)[3]	52.60	56.80	-	-
Feed cost/ 1kg gain (LE)[4]	46.87	43.96	-	-
REE (%) / 1kg gain[5]	100%	93.8%	-	-
Daily gain income (LE/h)[6]	84.17	96.90	-	-
Income (LE/h/d)[7]	31.57	40.10	-	-
REE (%) /h/d[8]	100%	127.0%	-	-

*a mixture of immunomodulators, and liver support products (1 kg/ton for each). SEM: Standard error of the means. [1] DMI: dry matter intake. [2] FCR: Feed conversion ratio. [3] Price of feeds and feed additives in 2022: [4] Feed cost/ 1kg gain (LE): Total Feed cost (LE/h/d) / ADG (kg/h). [5] REE (%) / 1kg gain: Cost of feed intake to grow 1 kg of body weight per head in the treatment group relative to the control group cost *100; REE: Relative economic efficiency. [6] Daily gain income (LE/h): Average ADG (kg/h) * market price of one kg of body weight. [7] Income (LE/h/d): ADG value (LE/h) – Total Feed cost (LE/h/d). [8] REE (%) /h/d: Income (LE/h/d) in the treatment group relative to the control group income (LE/h/d) *100.

Furthermore, **Amin *et al*. (2023)** revealed that rumen-protected choline supplementation led to a 26.6% increase in ADG of fattening calves. Also, **Montaño *et al*. (2019)** recorded higher ADG in Holstein steer calves by 8.3% when their diet was enriched with rumen-protected methionine and lysine. Data in **Table 7** presents the effect of the supplementation with a mixture of the two growth promoters on the daily gain, average daily feed intake (kg/h), feed conversion ratio (kg DMI/ kg gain), and economic efficiency of the experimental animals. The daily feed intake was restricted quantity; 6 kg CFM+ 2 kg alfalfa hay and 2 kg rice straw by total of 10 kg as fed/h/d and 8.93 kg DM/h/d and this represents approximately on average 3% DMI/h/d. The feed conversion ratios (FCR) were 8.05 and 7.0 kg DMI/ kg gain in G1 and G2, respectively, and this improvement (1.05 kg DM/h/d; $P < 0.05$) in G2 represents approximately 13 % decrease in DMI for produce the one kg of growth. This improvement in the FCR of G2 is related to the increase in daily weight gain for G2 compared to G1. The total daily feed cost (LE/h/d) was 52.6 and 56.8 in G1 and G2 respectively. The price of CFM in G1 was 7 and G2 was 7.7 (LE). The feed cost for producing one kg of gain decreased from 46.87 LE (in G1) to 43.96 LE in G2 by 2.91 LE (6.2%) decreased for producing one kg of gain.

CONCLUSION

Supplementing growing Baladi calves' diets with a mixture of immunomodulators (1 kg/ ton) and liver support products (1 kg/ ton) as a growth promotor improved the blood hematological and biochemical parameters, immune system response, exerting a positive influence on the

health condition, leading to enhancement of the productive performance and increased the economic efficiency.

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الملخص العربي

تأثير استخدام بعض المكملات الغذائية المحفزة للنمو على هضم العناصر الغذائية والمكونات البيوكيميائية للدم والأداء الإنتاجي في العجول الهجن البلدي النامية

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أجريت تجربة نمو لمدة ٩٠ يومًا باستخدام ٢٠ عجلاً بلديًا هجينًا بمتوسط وزن ٢٢٧ ± ١٥ كجم، وتم تقسيمها عشوائيًا إلى مجموعتين (١٠ عجول لكل مجموعة). حيث تم تقييم تأثير استخدام مزيج من اثنين من منشطات النمو (منتجات لرفع المناعة ومنتجات دعم الكبد) كمكملات غذائية للعليقة. حيث تلقت المجموعة الكونترول نظامًا غذائيًا أساسيًا يحتوي على خليط العلف المركز ودريس البرسيم، وقش الأرز بينما في المجموعة المعاملة تم استكمال خليط العلف المركز بـ ٢ كجم / طن من محفزي النمو (1 كجم لكل منهما). تم قياس استهلاك العلف، وهضم العناصر الغذائية، وبعض المعايير الكيميائية والحيوية للدم، واستجابة الجهاز المناعي، ومتوسط الكسب اليومي للوزن والكفاءة الاقتصادية. أظهرت النتائج أن العجول في المجموعة المعاملة أظهرت اختلافات غير معنوية في قابلية هضم العناصر الغذائية بشكل عام. وكانت خلايا الدم الحمراء، وخلايا الدم البيضاء، والهيموجلوبين، والجلوبيولين المناعي، ونشاط الليزوزيم، وتحول الخلايا الليمفاوية، ومؤشر البلعمة أعلى في عجول المجموعة المعاملة. بينما انخفض تركيز انزيمات ALT،AST والبيليروبين الكلي مقارنة بعجول المجموعة الكونترول وارتفع معدل النمو اليومي بنسبة ١٥.٢% في عجول المجموعة المعاملة في حين انخفضت تكلفة العلف لإنتاج كيلوغرام بنسبة ٦.٢%، مما أدى إلى زيادة الدخل اليومي المتوقع بنسبة ٢٧.٣% مقارنة بالمجموعة الكونترول. وبناء على ذلك، فإن استكمال النظام الغذائي للعجول البلدية النامية بمزيج من منتجات رفع المناعة (1 كجم/ طن) ومنتجات دعم الكبد (1 كجم/ طن) كمحفزات للنمو أدى إلى تحسين المعايير الكيميائية والحيوية للدم، واستجابة الجهاز المناعي، مما كان له تأثير إيجابي على صحة العجول مما يؤدي إلى تحسين الأداء الإنتاجي وزيادة الكفاءة الاقتصادية.

الكلمات المفتاحية: محفزات النمو، العجول البلدي، الحالة الفسيولوجية، المناعة، الأداء الإنتاجي.