Using manufactured Bee Bread as a biotechnological tool to improve the growth rate and performance in cow's calves

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ABSTRACT

The goal of this study assess how manufactured Bee Bread (BB) affect the performance and blood parameters of male and female calves. Twenty healthy male and female calves (aged 4-6 months with an IBW of (102.4 kg and 98.6 kg for males and females respectively) were randomly assigned into two groups (5 males and 5 females per each). 40g of BB was added to the baseline diet three times a week for the treatment group, whereas the control group was given the basal diet. Animals were weighed monthly, and feed intake was calculated to estimate feed conversion. Blood samples were collected monthly to estimate hemoglobin (Hb), total protein (TP), albumin (Alb), globulin (Glob), triiodothyronine (T_3) and thyroxin (T_4). Animals treated with BB showed higher levels of FBW, BWG, and ADG ($P < 0.05$) compared to the control group, Furthermore, the addition of BB significantly improved the feed conversion ratio (FCR) and significantly raised the daily feed intake (DFI) compared to the control group, the animals in the BB group had higher levels of Hb, TP, Alb, Glob, T_3, and T_4 ($P < 0.05$). In general, BB supplementation in the diet of growing cow's calves may support better growth, more efficient of feed utilization.

Keywords: Bee Bread, Blood metabolites, Feed consumption, Growing calves, Growth performance.

INTRODUCTION

The use of biotechnology is expected to bring a significant transformation in the economic returns from livestock production (Fereja, 2016). Its role in improving animal feed is manifested in three main approaches: Enhancing the nutritional value of forage, producing feed additives, and Manipulating rumen microbes to improve feed utilization (Getabalew & Alemneh, 2019). Biotechnology is very useful for improving the activity and metabolism of gut microbes, which are critical for the growth and well-being of animals (Getabalew & Alemneh, 2019). Modern biotechnology offers a wide range of beneficial applications, including environmental protection, alteration of the gut microbiota and the development of balanced diets and feed additives that promote healthy growth and enhance animal wellbeing (Okon et al., 2022)

Using natural feed additives is one viable and promising way that biotechnology is being used in livestock husbandry, such as bee products, probiotics, and prebiotics. These supplements help improve the microbial balance in the digestive tract. Unlike antibiotics, which eliminate bacteria, probiotics promote the growth of beneficial strains at the expense of harmful ones (McDonald et al., 2010).

Bee products offer a dual advantage: they are nutritionally rich and act as natural probiotics. Among these, Bee bread has drawn interest due to its potential as a feed additive that enhances growth and overall well-being in livestock. In hives, a fermented mixture of bee pollen, honey, and lactic acid bacteria is termed "bee bread.” It has a superior nutritional profile compared to raw pollen and is a valuable source of rare nutrients, although produced in limited quantities (Krell, 1996).This concept led to the idea of artificially manufacturing bee bread, simulating the natural process used by bees, producing larger quantities suitable for animal feeding and investigating its impact on blood parameters, growth, and performance. Probiotics have been found to enhance immunity, growth rate, and health in livestock species, including pigs, cattle, poultry, and small ruminants (Alayande et al., 2020; El-Trwab et al., 2016) However, their efficacy may differ based on outside variables like the

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environment and feed composition (Leistikow, et al., 2022).

In addition to fighting antibiotic resistance, the cattle industry is depending more and more on probiotics to increase production efficiency by (Gilchrist et al., 2007). Animal nutrition has traditionally employed lactic acid-producing probiotics, such as strains of Bifidobacterium, Enterococcus, Streptococcus, Pediococcus, and Lactobacillus (Deng et al., 2022).

Bee products are high in vitamins, minerals, and good fats. These include honey, propolis, pollen, bee bread, bee venom, and royal jelly. While traditionally used by humans as dietary supplements or natural remedies, recent research has explored their potential benefits in animal nutrition and therapy (Madras-Majewska et al., 2015). Studies have shown that bee products positively impact animal health and productivity. They may also serve as alternatives to conventional treatments, especially in cases of antibiotic-resistant infections. Due to their rich nutritional content, bee products could outperform standard mineral-vitamin mixes or complement them during critical breeding periods (Madras-Majewska et al., 2015).

Many researchers have highlighted the substantial impact that bee products have on the health and performance of animals (Bansal et al., 2005; Dudko, 2008; Dudko, 2003; Hołderna-Kędzia & Kędzia, 2012; Hołderna-Kędzia et al. 2008; Kędzia et al. 2009; Park & Ikegaki, 1998; Roulston & Cane, 2000; Sosin-Bzducha & Strzetelski, 2012) .

MATERIALS AND METHODS

At Assiut University's Animal Production Department, Faculty of Agriculture, Animal Experimental Farm, Assiut, Egypt, the experiment was carried out. In compliance with Assiut University's Faculty of Veterinary Medicine's Ethical Committee (Reference No. 06/2024/0247). Determining the body performance and specific blood metabolites in male and female calves given artificial Bee Bread (BB) made from date palm pollen was the goal of this investigation.

Formulation and Laboratory Processing of Artificial Bee Bread

Artificial bee bread (BB) was made using a modified version of (Dany, 1988) recipe. Date palm pollen, honey, Lactobacillus bulgaricus, and Streptococcus thermophiles were used to artificially replicate the natural bee bread (10 shares of pollen: 1.5 shares of honey: 2.5 shares of clean water: 0.25 shares of lactic acid bacteria), Fermentation was carried out in airtight, wide-mouthed, transparent plastic bottles. There was still enough airspace above the culture (20–25% of the total volume). For the first two or three days, the temperature ranged from 32 to 34 degrees Celsius. The temperature was reduced to 20 to 24°C after the first two or three days. Due to the accumulation of lactic acid, the high starting temperature is crucial in halting the growth of unwanted bacteria as soon as feasible. Certain yeasts continue to proliferate, and only lactic acid generates bacteria (lactobacilli). The former quickly comes to rule the entire culture. After two to three days, the temperature should drop since the lactobacilli's ultimate growth should happen slowly. While lactic acid functions as a natural preservative, the finished product may be kept for years.

Animals, Diets and Experimental Design

Twenty healthy cow's calves (males and females) aged 4-6 months an initial average body weight (IBW) of 102.35 and 98.62 kg for males and females, respectively, were assigned randomly to two groups (5 males and 5 females per group. The basal diet was given to the control group (Con). The components and chemical composition of the basal diet are displayed in Table 1. According to the NRC guidelines (NRC. National Research Council., 2007). For three months, the treated group (BB) received 40 g of produced Bee Bread three times a week along with the basal diet. The animals were given their daily rations twice a day at 7:00 a.m. and 5:00 p.m., which were mixed rations containing 3% DM of body weight to suit their nutritional requirements. Fresh water was available all the time.

TABLE 1. The chemical composition and ingredients of the basal diet

Item	Basal diet
Ingredient, %	
Wheat straw	25
Yellow corn	25
Wheat bran	25
Decorticated cottonseed meal	22
Limestone	1.5
Sodium chloride	1
Premix mixtures*	0.5
Chemical composition	
DM (%)	90.23
OM (% DM)	88.92
CP (% DM)	14.21
CF (% DM)	17.32
EE (% DM)	2.46
NFE (% DM)	54.93
Ash (% DM)	11.08

200,000 IU of vitamin A, 200 mg of vitamin E, 100,000 IU of vitamin D_3, 10,000 mg of iron, 2,500 mg of copper, 100 mg of molybdenum, 20,000 mg of manganese, 100 mg of cobalt, 800 mg of iron, 20,000 mg of zinc, and 100 mg of selenium are all present in premix mixes. Dry matter (DM) and organic matter (OM) Crude protein: Crude fiber; ether extract (EE); nitrogen-free extract (NF)

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Growth Experiment

Before starting the 90-day growth experiment, the animals underwent a 15-day preparatory phase to become acclimated to the experimental diet. To determine the total body weight gain (BWG) and average daily gain (ADG), the animals were weighed as Initial body weight (IBW) at the start of the growth trial and then monthly thereafter. Additionally, the feed conversion ratio (FCR, kg feed/kg growth) was computed using the daily feed intake (DFI, as dry matter).

Blood Sampling and Blood Parameters

Every month during the trial period, two blood samples (about 7 ml each) were drawn from each experimental animal by jugular venipuncture. First, the Symex Automated Hematology Analyzer (SAHA) was utilized to estimate hemoglobin (g/L) from a total blood sample. To estimate total protein (g/L), albumin (g/L), globulin (g/L), A/G ratio, triiodothyronine (T_3, ng/mL), thyroxin (T_4, ng/mL), and T_4/T_3 ratio, the second was moved to a tube without anticoagulant and centrifuged at 3000 rpm for 15 minutes to obtain serum. Diamond Diagnostics (Egypt) provided the kits. Prior to analysis, all samples were stored at -20°C.

Statistical Analysis

The SPSS (2008) General Linear Models (GLM) approach was used to examine all of data that was gathered. The data was analyzed using the following statistical model:

$$Y_{ij} = \mu + T_i + G_j + (T \times G)_{ij} + \varepsilon_{ijk}$$

Where µijk is the residual error, µ is the general mean, Ti is the treatment effect (Con and BP), Gi is the gender effect (male and female), and Yij is the dependent variable (blood characteristics and growth performance).

RESULTS AND DISCUSSION

Effect of BB on growth performance:

Supplemented groups of males and females calves showed a notable improvement in the growth rate, feed intake and FCR by supplementing BB to their diet as shown in Table 2. Males and females that received a basal diet with BB had heavier ($P<0.05$) FBW, total BWG and ADG compared with those in control. Similarly, Males had higher FBW, total BWG, and ADG than females ($P<0.05$). (Table2 & Figure 2). Although no statistically significant differences were observed between males and females, the daily feed intake (DFI) showed a notable increase ($P < 0.05$) when Bee Bread (BB) was supplemented to the basal diet of the treated animals (Table 2 & Fig 1). Moreover, the FCR improved ($P<0.05$) in both male and female calves may be related to increasing in BWG (Table 2 & Fig 3).

TABLE 2. Impact of bee bread supplementation on growing male and female calves and its feed intake, feed conversion ratio, and growth performance

Item	Treatment		Gender		SEM	*P*-value		
	Con	BB	Male	Female		T	G	T×G
IBW, kg	102.33	98.64	102.35	98.62	1.071	0.3	0.3	0.3
FBW, kg	170.31	193.68	186.2	177.79	3.445	<0.001	<0.001	0.373
BWG, kg	68	95	83.8	79.2	5.59	0.01	0.01	0.01
ADG, g	755.3	1056	931.7	879.7	21.27	<0.001	<0.001	0.149
DFI, kg	5.11	5.77	5.44	5.43	0.053	<0.001	0.671	0.744
FCR	6.75	5.46	5.95	6.17	0.091	<0.001	<0.001	0.386

Con: experimental animals were fed a basic diet; BB: three times a week, experimental animals were fed a basic diet plus 40 g of dried bee bread; ADG stands for average daily growth, DFI for daily feed intake, FCR for feed conversion ratio, IBW for initial body weight, FBW for final body weight, and BWG for body weight gain.

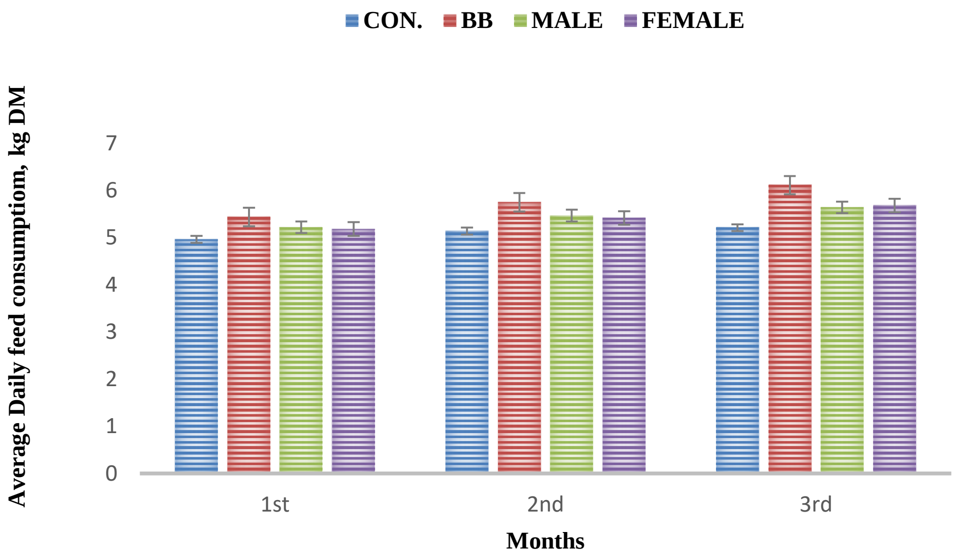

Fig 1. Average daily feed consumption of growing male and female calves that affected by BB supplementation

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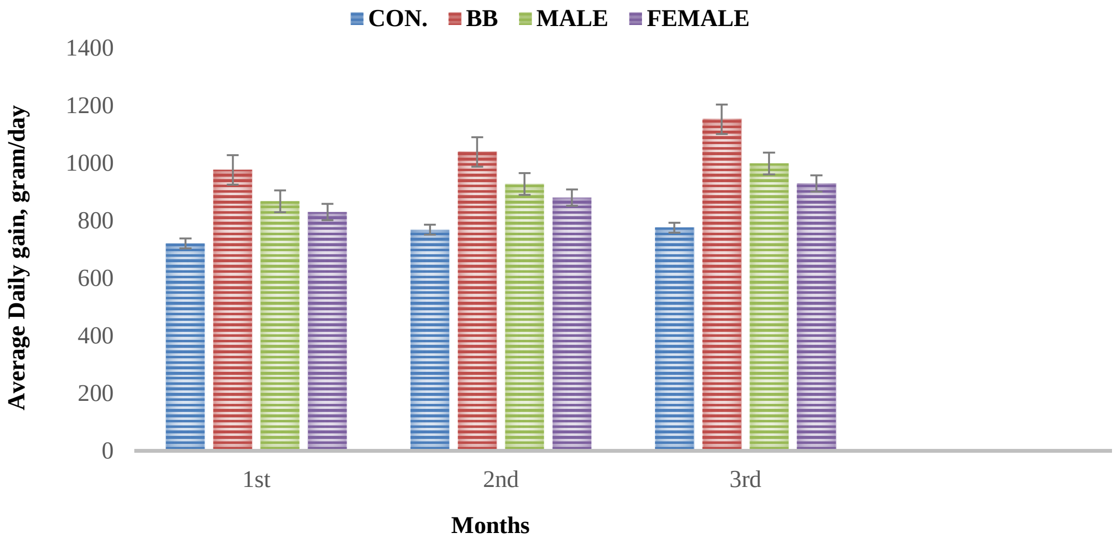

Fig 2. Average daily gain of growing male and female calves that affected by BB supplementation

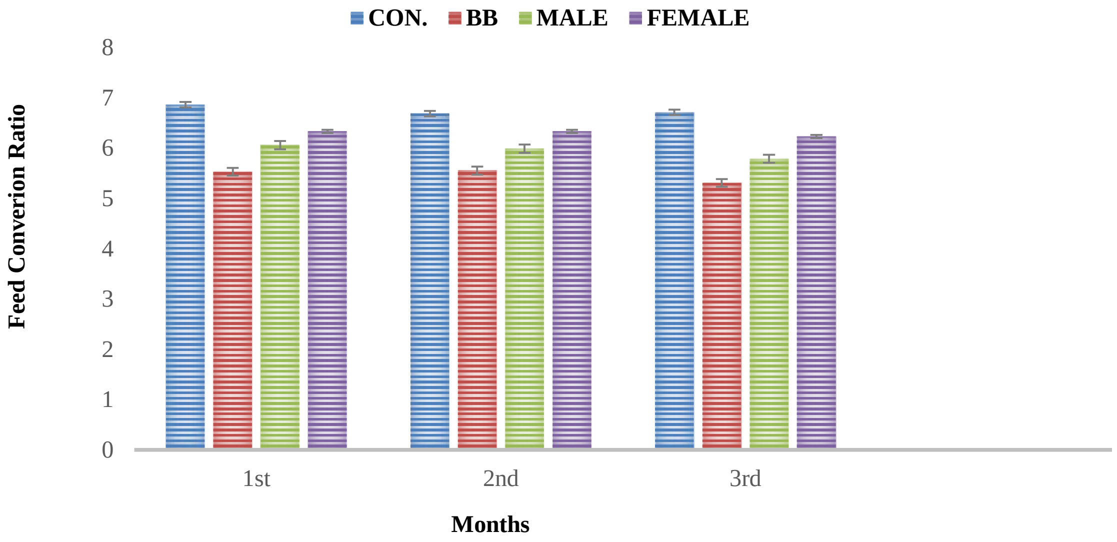

Fig 3. Feed conversion ratio of growing male and female calves that affected by BB supplementation

Variations in body weight are commonly used as markers of an animal's growth efficiency and nutritional condition. In this study, final body weight (FBW) and average daily gain (ADG) of male and female calves were considerably higher (P<0.05) in the BB-treated group than in control group. These results are in line with those of Hussein (2018), who found that lambs supplemented with 20 g seaweed powder, 1 g alpha-amylase, Saccharomyces cerevisiae SC-47 (625.0×10³ CFU), and Lactobacillus sporogenes (37.50×10³ CFU) per kg of diet demonstrated significant (P<0.05) increases in body weight in both sexes when compared to control. In addition, both Abas et al. (2007) and Ismaiel et al. (2010) reported similar findings, indicating that the ADG of lambs was elevated by yeast culture. Furthermore, Hussein (2014), Abdel-Salam et al. (2014), and Mohamed (2018) agreed with us when noted that probiotic-supplemented Najdi lambs outperformed the control group in growth rate (GR), ADG, and total weight gain (TWG) by a substantial margin (P<0.05). In a more recent study, Saleem et al. (2017) discovered that probiotic supplementation improved growth performance in Saidi lambs by raising BWG, TWG, and GR in the post-weaning phase. In contrast to our findings, Taghian et al. (2017) found that rams fed diets containing 30 g/day of DPP, BP, and BB three times a week had significantly higher (P<0.05) feed conversion ratios (FCR), total feed intake (TFI), daily feed intake (DFI), and FBW than control group. Our results in this study are in conflict with those of Baranowski et al. (2007), Titi et al. (2008), and Whitley et al. (2009), who found no impact of yeast supplementation on the growth rate of lambs and goat offspring.

While our findings are consistent with those of Ghazanfar et al. (2015), who noted enhanced growth rates in dairy heifers fed Saccharomyces cerevisiae, and Timmerman et al. (2005), who showed higher BWG in calves treated with probiotics. In the other hand, Soliman et al. (2016) noticed that lambs given probiotic-supplemented meals (DFM) had a noticeably higher feed intake than lambs given prebiotics or control diets. This difference was probably caused by using different bacterial strains. Our results are in line with those of other studies by Ismaiel et al. (2010), Chiofalo et al. (2004), Antunović et al. (2005), and Whitley et al. (2009), who also found that probiotics improved ruminant dry matter intake, nutrient utilization, weight gain, and FCR. BB's contains high nutrient content of antioxidants, vitamins, minerals, essential fatty acids, amino acids, and enzymes also, protected BP's compounds contain flavonoids, carotenoids, and phenolics, which can improve feed value, digestibility, and absorption, which may explain BB's beneficial impact on growth performance, (Saric et al., 2009; Leja et al., 2007) Another possible explanation for the probiotic's impact on BWG is enhanced cellulolytic activity, which improves fiber breakdown and microbial protein synthesis, hence increasing the supply of post-ruminal amino acids (Erasmus et al., 1992). BP also has growth-promoting, energy-boosting, and even antibacterial properties (Almaraz-Abarca et al., 2004). Its nutritional and medicinal benefits as an antioxidant, anti-aging agent, and immune-enhancing supplement have been widely recognized (Almaraz-Abarca et al., 2004; Battaa & El-Kholy, 2014).A notable observation in this study is that the improved growth efficiency in BB-supplemented animals was closely associated with increased feed intake and better FCR, this is in line with findings by Krehbiel et al. (2003) and Antunović et al. (2006), who reported that probiotic-supplemented beef cattle had higher BWG and FCR. According to Fiems et al. (1993) who added Saccharomyces cerevisiae to the diet increased BWG in calves by 9.5% and in developing adult cattle by 7.8%. Numerous researchers have found improved FCR using phytogenic growth promoters. According to Zawadzki et al. (2011) found that propolis extract enhanced weight gain and FCR in feedlot bull diets. Since BP is poorly digested, Rimpler (2003) postulated that breaking down its walls could improve digestibility and bioavailability. This could be the reason why artificial BB performed better in this investigation. Lactic acid, which is produced when Lactobacillus bulgaricus and Streptococcus thermophilus ferment BP in the presence of honey, breaks down pollen walls and releases their contents, improving the final BB product's digestibility and adding new nutrients. The

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interesting thing is that bees only use BB to feed their larvae.

Therefore, the performance-enhancing effects of probiotics may also be linked to improved rumen development, such as an increased propionate-to-acetate molar ratio which reduces hydrogen availability for methane production, thereby lowering emissions Retta (2016). Additionally, higher propionate levels increase the production of glucose in the liver which increases lactose synthesis substrates and boosts energy efficiency (Stein et al., 2006).

Lastly, Wang et al. (2024) showed that probiotic supplementation enhances feed efficiency and growth performance, as evidenced by higher BW and ADG and lower FCR as a result of higher total dry matter intake (TDMI).

Effect of BB on blood parameters and Plasma Protein Profile:

Haematological analysis of blood samples showed that Hb was affected by both BB addition and the gender of the animal (Table 3). Animals fed a basal diet plus BB had higher Hb levels than animals fed a basal diet alone ($P<0.05$). Additionally, adding BB to male and female calves' diets enhanced most of the blood biochemical indicators, which did not differentiate significantly between both genders. Male and female calves in the BB group had higher levels of total protein, albumin, and globulin ($P<0.05$) than those in the control group. There were also notable gender differences in the A/G ratio, as well as significant differences in total protein and albumin levels ($P<0.05$).

TABLE 3. Effect of Bee Bread supplement on blood haemoglobin, biochemical and serum thyroid hormonal parameters of growing male and female calves:

	Treatment		**Gender**		**SEM**	***P*-value**		
Item	**Con**	**BB**	**Male**	**Female**		**T**	**G**	**T×G**
Hb, g/L	10.63	11.63	11.29	10.97	0.077	<0.001	0.041	0.982
Total Protein, g/L	3.79	6.37	4.85	5.31	21.27	<0.001	<0.001	0.149
Albumin, g/L	2.14	3.26	2.47	2.95	0.053	<0.001	0.671	0.744
Globulin, g/L	1.65	3.11	2.38	2.38	0.051	<0.001	0.558	0.232
Albumin/Globulin ratio	1.31	1.07	1.09	1.29	0.012	0.685	0.892	0.346
T_3, ng/mL	1.40	1.74	1.61	1.53	0.091	<0.001	<0.001	0.386
T_4, ng/mL	91.81	93.57	92.73	92.66	3.445	<0.001	<0.001	0.373
T_4/T_3 ratio	1.52	1.85	1.73	1.64	21.27	<0.001	<0.001	0.149

Con: experimental animals received basal diet BB: experimental animals received basal diet + 40 g of Dried Bee Bread three times a week Hb: hemoglobin; T3: triiodothyronine; T4: thyroxin.

Following BB supplementation, Hb levels in both Male and female calves significantly increased, according to blood analysis from the current study. Additionally, most blood biochemical parameters showed elevated values, with notable gender differences observed in Hb levels. These results are in line with those of Yasmin et al. (2021), who found that probiotic-supplemented groups had significantly higher levels of total protein, globulin, packed cell volume (PCV), red blood cell (RBC) count, and mean corpuscular volume (MCV). Similarly, probiotic-treated heifers had greater Hb and RBC counts ($P<0.05$) than control, according to Ghazanfar et al. (2015). Additionally, probiotic-fed crossbred calves showed increased PCV and Hb content (Al-Saiady, 2010; Dar et al., 2017). El-Sayed and Mousa (2020) found that probiotic-supplemented lambs had significant increases ($P<0.05$) in Hb, PCV, and RBC count. Probiotic-induced vitamin B synthesis, which promotes hematopoiesis, and improved iron absorption in the small intestine may be responsible for the reported increases in hemoglobin levels (Kander, 2004).

Comparable results were obtained by Abdel-Raouf et al. (2018) in Friesian calves given black seed and bee pollen during the weaning process, showing increased Hb, TP, Alb, and Glob levels. Mohamed (2018) further emphasized the therapeutic potential of bee pollen (BP), suggesting its stimulatory effect on the hematopoietic system by increasing Hb, RBCs, Ferritin, iron, Alb, Glob, and TP. BP also demonstrated a role in correcting oxidative imbalances in RBCs in diabetic rats. These effects are likely due to BP's high iron content and the presence of vitamin C, histidine, bioflavonoids, fructose, and other compounds that promote iron absorption and bone marrow function. TP, Alb, and Glob levels in the male and female groups treated with BB differed significantly from the control. The A/G ratio, however, showed no noticeable differences. These findings are consistent with those of Hussein (2018), who found that probiotic supplementation significantly ($P<0.05$) raised plasma levels of Glob and TP, but had no effect on Alb or the A/G ratio. Better protein digestibility through protease activity and changed amino acid profiles as a result of increased microbial protein synthesis could be the causes of the rise in plasma protein (Williams, 1989; Abdel-Khalek et al., 2000). Similar results were seen in sheep by (El-Shaer, 2003; El-Ashry et al., 2003), and in goats by (Kholif, 2001; Abu El-Ella & Kommonna, 2013), who found that supplementing with yeast culture raised TP levels. However, Abdel Rahman et al. (2012) discovered that while yeast culture did not significantly alter TP and Glob in sheep, it did raise Alb concentration. Probiotic-supplemented lambs showed a significant ($P<0.05$) decrease in TP and Alb, according to Hossein-Ali et al. (2014). In Saidi lambs, Saleem et al. (2017) discovered no discernible changes in TP, Alb, or Glob during the post-weaning phase. Additionally, Tu et al. (2014) found no observable differences in TP, Alb, or Glob. between Holstein calves fed BP and control. However, gender differences were observed in TP levels, with females showing significantly higher values, consistent with AL-Hadithy and Badawi (2015) in Awassi sheep. According to Carlos et al. (2015), there were no discernible gender variations in Alb, Glob., or the A/G ratio in Morada Nova sheep. Raghda A.Taghian (2017) reported that supplementation with DPP, BP, and BB increased plasma TP and Glob concentrations in treated lambs, indicating that the higher protein levels could be the result of these supplements' increased supply of protein and amino acids.

Effect of BB on Thyroid Hormones (T_3, T_4, T_3/T_4 Ratio)

T_3 and T_4 levels in blood samples from animals in the BB group were also greater ($P<0.05$) than those in the control group, and the T_3/T_4 ratio was higher ($P<0.05$) with no appreciable gender-based differences.

The current study also revealed increased levels of T_3 and T_4 hormones, along with an improved T_3/T_4 ratio. Significant gender differences ($P<0.05$) were observed, favoring male calves. These findings align with the findings of Raghda A.Taghian (2017), who reported increased plasma TP, globulin, glucose, T_3, and T_4 levels, and reduced cholesterol and triglycerides following DPP, BP, and BB supplementation. This aligns with findings by (Tata, 2011; Mohamed, 2018; Yavuz et al., 2019), who demonstrated that BP supports thyroid function by increasing T_3 and T_4 levels, which are closely linked to metabolic activity and growth regulation. Kassab et al. (2017) suggested

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that increased thyroid hormone secretion in probiotic-treated groups may result from enhanced metabolism of carbohydrates, fats, and proteins, and increased intake of total digestible nutrients (TDN), reflecting improved energy metabolism. This is supported by earlier studies from (Toshihiro, 2010; Zanouny, 2011; Ahmed, 2003; Kassab, 2007; Kassab and Hamdon, 2014), who supported the idea that calorie intake and thyroid hormone levels are positively correlated.

Conclusion

The results obtained in this study suggested that BB supplementation enhances growth, efficiency, and health status, offering a promising natural alternative to conventional feed additives. Moreover, the product can be considered a direct application of biotechnology in animal production, functioning as both a probiotic and a prebiotic. This is due to its composition, which includes Bee pollen, the core ingredient, along with lactic acid bacteria strains and exposure to fermentation, all of which enhance its nutritional value and biological efficacy.

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إستخدام خبز النحل المصنع كأداة بيوتكنولوجية لتحسين معدل النمو وأداء عجول الأبقار

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الهدف من هذه الدراسة هو تقييم مدى تأثير خبز النحل المصنع (BB) على أداء ومقاييس الدم للعجول الذكور والإناث تم توزيع عشرين من العجول من الذكور والإناث السليمة صحياً (تتراوح أعمارهم فى بداية التجربة بين ٤-٦ أشهر بوزن (١٠٢.٤ كجم و٩٨.٦ كجم للعجول الذكور والإناث على التوالي) بشكل عشوائي إلى مجموعتين (٥ ذكور و٥ إناث لكل مجموعة).

.حصلت المجموعة الكنترول على النظام الغذائي الأساسي، بينما حصلت المجموعة المعاملة على ٤٠ جم من BB مع النظام الغذائي الأساسي ثلاث مرات في الأسبوع. تم وزن الحيوانات شهريًا وتم تسجيل كمية العلف المستهلك لحساب معدل التحويل الغذائي .تم جمع عينات الدم شهريًا لتقدير الهيموجلوبين والبروتين الكلى والألبيومين والجلوبيولين وثلاثي أيودوثيرونين (T_3) والثيروكسين(T_4). كان الوزن ومتوسط الزيادة اليومية للحيوانات التي حصلت على BB أعلى من تلك الموجودة في المجموعة الكنترول. كذلك، أدت إضافة BB إلى زيادة ($P<0.05$) معنوية في كمية المأكول من العلف (DFI)، وتحسن معدل التحويل الغذائي (FCR) أيضاً تحسناً معنوياً، تحسنت مستويات كل من الهيموجلوبين، والبروتين الكلي، والجلوبيولين، والألبيومين، T_3وT_4 في دم الحيوانات في مجموعة BB مقارنةً بحيوانات مجموعة الكنترول. وأخيراً، يمكن اعتبار إضافة خبز النحل المصنع إلى النظام الغذائي للعجول الذكور والإناث وسيلةً لتعزيز النمو، وتحسين معدل التحويل الغذائي.

الكلمات الدالة: خبز النحل المصنع، ميتابولزم الدم، استهلاك العلف، العجول النامية، أداء النمو.