



The Impact of Bee Pollen as a Natural Growth Promoter on the Performance and Blood Characteristics of Growing Calves and Heifers

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Abstract

THIS study aimed to explore the impact of Bee Pollen (BP) on the performance and blood characteristics of growing calves and heifers. Twenty healthy cow calves and heifers (aged 8-10 months with an IBW of 136.1 and 129.3 kg for calves and heifers, respectively) were assigned randomly to two groups (5 calves and 5 heifers each). The control group received the basal diet, while the treatment group was given 30 g of fresh commercial multifloral BP with the basal diet three times a week. Animals were weighed monthly, and feed intake was monitored to compute feed conversion. Blood samples were collected monthly to estimate Hb, TP, albumin, globulin, T3 and T4. Animals that received BP had heavier ($P < 0.05$) FBW, BWG and ADG than those in the control group. Likewise, adding BP increased ($P < 0.05$) the DFI, and the FCR improved ($P < 0.05$). Hemoglobin, total protein, globulin, albumin, T3 and T4 of animals in the BP group were enhanced ($P < 0.05$) than those in the control group. In conclusion, incorporating BP into the diet of growing calves and heifers could be considered a way to promote growth, improve feed conversion, and lower feeding costs.

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

Introduction

The need for more sustainable and natural growth promoters in livestock production has gained significant attention over the past few years, driven by the need to enhance animal performance while minimizing the use of synthetic additives and their harmful effects. The end products (meat and milk) are affected by the lingering effects of synthetic additives. Humans finally consume these products, and there may be a danger that resistant bacterial strains and other health risks or diseases will develop. Thus, since January 2006, the European Union has prohibited the use of antibiotics as growth promoters in animal nutrition [1]. Consequently, the use of natural resources as feed additives, which provide natural additive properties, would be beneficial in producing safe and hazard-free animal products for human consumption.

Bee pollen (BP) is an agglomerate of flower pollen collected by honeybees from numerous plant sources, which gather grains of floral pollen and mix them with plant nectar and their enzyme-rich saliva,

thus changing its composition and improving its therapeutic potential [2]. Pascoal et al. [3] described BP as a complex mixture of proteins, amino acids, lipids, minerals, vitamins, and phenolic compounds that contribute to its antioxidant, anti-inflammatory, and immune-modulatory effects. The Dietary Supplement Health and Education in the USA defined BP as a nutritional supplement for human consumption [4]. Furthermore, BP is considered to be an energy enhancer, a potential antibiotic, and a growth promoter [5-7].

Pollens are rich in flavonoids and phenolic acid derivatives, which possess strong antioxidant and scavenging capabilities [8-9]. Additionally, Hajková et al. [10] point out that BP is a significant source of antioxidant activity and compounds with health-protective potential. These qualities make BP a promising growth promoter in livestock, especially in young animals like calves and heifers, where optimal growth and development are essential for future productivity. The early growth stages of ruminants are crucial for proper digestion, reaching target body

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weights, and overall health [11]. However, challenges such as poor feed efficiency, metabolic stress, and increased vulnerability to diseases often limit growth performance. Incorporating natural supplements like BP into the diet may help overcome these challenges by enhancing nutrient absorption, boosting immune function, and increasing metabolic efficiency.

Previous studies have demonstrated the useful effects of BP on growth, feed efficiency, and physiological parameters in various animal species [12-15]. Bee pollen has been widely and successfully used as a growth promoter to enhance the performance and blood metabolites in poultry and rabbits; however, studies on their impact on ruminants are few and inconsistent. There is a scarcity of research that has addressed its application in calves and heifers, particularly over extended periods. This study aims to evaluate the impact of fresh commercial multifloral BP as a dietary supplementation on the performance and blood characteristics of calves and heifers.

Material and Methods

The experiment was accomplished at the Experimental Animal Farm, Animal Production Department, Faculty of Agriculture, Assiut University, Assiut, Egypt. Following the Ethical Committee of the Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt (Reference No. 06/2024/0246).

Animals, Diets, and Experimental Design

Twenty healthy cow calves and heifers (aged 8-10 months; an initial average body weight (IBW) of 136.1 and 129.3 kg for calves and heifers, respectively) were assigned randomly to two groups (5 calves and 5 heifers per group). The control group (Con) received the basal diet consisting of 25% wheat straw, 25% yellow corn, 25% wheat bran, 22% decorticated cottonseed meal, 1% Sodium chloride, 1.5% limestone, and 0.5% premix. The treatment group (BP) was given 30 g of fresh commercial multifloral BP with the basal diet three times a week for three months. Table 1 shows the ingredients and chemical composition of the basal diet. According to the NRC guidelines [16], animals got their daily rations individually at a level of 3% DM of body weight as mixed rations twice daily at 07:00 a.m. and 05:00 p.m. to meet their nutrient requirements. Fresh water was available throughout the day.

Growth Experiment

The animals were acclimatized to the experimental diet over a 15-day preliminary phase before the 90-day growth experiment began. The animals were weighed at the beginning of the growth trial as an IBW and then every month after that to calculate the total body weight gain (BWG) and average daily gain (ADG). Moreover, Daily feed

intake (DFI, as dry matter) was calculated to compute the feed conversion ratio (FCR, kg feed/kg gain).

Blood Sampling and Blood Parameters

Two blood samples (approximately 7 ml each) were collected monthly throughout the trial period from all experimental animals via jugular venipuncture. The first was a total blood sample immediately used for hemoglobin (g/L) estimation using the Symex Automated Hematology Analyzer (SAHA). The second was transferred to a tube without anticoagulant and centrifuged at 3000 rpm for 15 min to gain serum, used to estimate total protein (g/L), albumin (g/L), globulin (g/L), A/G ratio, triiodothyronine (T3, ng/mL), and thyroxine (T4, ng/mL), and T4/T3 ratio using kits supplied by Diamond Diagnostics (Egypt). All samples were reserved at -20°C until analysis.

Statistical Analysis

All collected data were analyzed using the General Linear Model (GLM) procedure of SPSS (2008). The statistical model used for analyzing the data was:

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

Where Y_{ij} is the dependent variable (blood characteristics and growth performance), μ is the overall mean, T_i is the treatment effect (Con and BP), G_j is the gender effect (male and female), and ε_{ijk} is the residual error.

Results

The growth performance, feed intake and FCR of growing calves and heifers as affected by adding BP to their diet are displayed in Table 2. Calves and heifers that received a basal diet with BP had heavier ($P<0.05$) FBW, total BWG, and ADG compared with those in the control. Similarly, compared to heifers, calves in the present study exhibited higher ($P<0.05$) FBW, total BWG, and ADG (Table 2 & Figure 2). Likewise, adding BP to the basal diet of experimental animals increased ($P<0.05$) the DFI, which did not differ significantly between calves and heifers (Table 2 & Fig 1). Moreover, the FCR improved ($P<0.05$) in both calves and heifers because of the increase in BWG (Table 2 & Fig 3).

Hematological analysis of blood samples showed that HB was affected by both BP addition and the gender of the animal (Table 3). Animals that received a basal diet with BP had higher ($P<0.05$) hemoglobin levels than those that received a basal diet alone. Additionally, adding BP to calves' and heifers' diets enhanced most of the blood biochemical indicators, which did not differentiate significantly between the genders. Total protein, albumin, and globulin levels were greater ($P<0.05$) in calves and heifers in the BP

group than in the control group. Similarly, blood samples from animals in the BP group had higher ($P<0.05$) levels of T3 and T4 than those in the control group, and the T3/T4 ratio was increased ($P<0.05$).

Discussion

Changes in body weight are commonly used to monitor the animals' nutritional status and growth performance [17-18]. The addition of BP to the calves' and heifers' baseline diet improved their overall growth performance, as indicated by increases in FBW, total gain in live body weight, and ADG compared to the animals in the control group that only received the basal diet. There was an improvement of about 27.4% in both total BWG and ADG in the BP group compared to the control group. Similar results were achieved on Friesian calves [19]; Saidi rams [20], and Rahmani lambs [21], who found that increasing BP supplementation levels in the diet led to significant increases in both total body gain and ADG. In the same vein, adding BP to the diet of New Zealand rabbits resulted in increases in both FBW and ADG when compared to the control group [15, 22]. Tu et al. [23] explained that the enhancement in growth performance of calves receiving BP supplementation could be attributed to the enhancement in DM and CP digestibility. The findings from other animal species support this interpretation. In chickens, dietary BP enhanced growth performance, egg productivity, feed utilization efficiency, immunity, disease resistance, and survival rate [24]; in growing-finishing pigs, it enhanced digestion, absorption, and immunological function [25].

However, the results of the present study in Table 2 revealed that the DFI (as dry matter) for animals receiving the BP supplement increased by almost 10% compared to those in the control group, with no significant differences between calves and heifers. Likewise, suckling lambs given 0.5 and 1.0 g of BP orally had a considerably higher feed intake compared to lambs in the control group [21]. This finding is in line with that of Braakhuis [26] and Khalifa et al. [27], who claimed that BP supplementation could improve the quality and palatability and raise DFI because it contains several bioactive components that have antioxidant and antimicrobial properties, such as flavonoids and phenolic acids. In contrast, a meta-analysis on broiler chickens [28] and rabbits [15] fed BP supplementation showed a reduction in the DFI. Attia et al. [29] suggest that BP contains vitamins and minerals soluble in water, which enhance nutrient metabolism and increase the availability of metabolic energy in rabbits, resulting in reduced DFI.

Although calves and heifers receiving BP supplementation increased their DFI in the present study, FCR showed significant improvement, and

values were lower in calves than in heifers. This outcome was in line with results from suckling lambs [21]; Friesian calves pre- and post-weaning [19]; and growing rabbits [30], which fed BP supplements; they obtained that the feed amount per kilogram of live BWG was lower for BP-supplemented groups than for the non-supplemented group. Taghian et al. [20] attributed this improvement in the FCR and the decline in feed intake to the potential ability of BP to lower the number of harmful bacteria and increase the digestibility of all nutrients.

The blood analysis in the current study demonstrates that both calves' and heifers' hemoglobin concentrations significantly increased because of BP supplementation. Additionally, most blood biochemical indicators show an increase, with no discernible variations between calves and heifers. Similar results for hemoglobin concentrations, total protein, albumin, and globulin were obtained with weaning Friesian calves [31]; and weaned and growing New Zealand White rabbits [12-32]. Moreover, the dietary BP of iron-deficient rats, as an experimental model of anemia, leads to increased hemoglobin level and significantly reduces the adverse effects of iron deficiency, exerting a restorative effect and enhancing the absorption and utilization of dietary iron [33].

Mohamed [34] suggested that BP has a stimulating effect on the hematopoietic system as it increases Hb, RBCs, ferritin, iron, albumin, globulin, and total protein levels, having a therapeutic effect against disturbances in the oxidant/antioxidant balance of RBCs in diabetic rats. These results indicate that due to its high iron content, BP has an anti-anemic effect [35] and can enhance the function of bone marrow, the main organ responsible for erythropoiesis [36]. Thus, it can be assigned to the BP content of vitamin C, histidine, bioflavonoids, fructose, and the preference for iron absorption [5].

Furthermore, the dietary BP also increases the levels of proteins, albumin, and globulin, helping well in fattening chickens [37-38], which can be attributed to its high free amino acid content [39]. In addition, pollen water extracts enhanced biochemical parameters and hepatic enzymes and decreased oxidative stress markers [40]. On the other hand, Tu et al. [23] did not find any significant differences in concentrations of total protein, albumin, and globulin between Holstein calves fed BP and those fed the control diet.

Moreover, the current study indicated an increase in the levels of T3 and T4 and an improved T3/T4 ratio. This finding is consistent with Tata [41]; Mohamed [34], and Yavuz et al. [42], who found that BP improves thyroid dysfunction and elevates T3 and T4 levels, which correlate with higher metabolic rates, particularly during normal growth and

development, indicating a critical function in controlling energy metabolism and growth processes.

Conclusion

The current study concluded that inclusion of BP in the diet of growing calves and heifers improved their feed intake, feed conversion, and blood characteristics, which in turn improved their growth performance and lower feeding expenses. Enhancing animal growth, especially during the growing stage, undoubtedly contributes to the healthy development of various body organs, particularly for breeding animals that will serve as parents to future generations. Future comprehensive studies are required to demonstrate the effect of dietary BP on the digestion of nutrients in the digestive tract and its effects on blood measurements and the productivity of calves and heifers.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

Ethics of approval

This study follows the Ethical Committee of the Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt (Reference No. 06/2024/0246).

TABLE 1. Ingredient and chemical composition of 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

* Premix mixtures: content 200,000 IU vitamin A, 200 mg vitamin E, vitamin 100,000 IU D3, 10,000 mg Fe, 2500 mg Cu, 100 mg Mo, 20,000 mg Mn, 100 mg Co, 800 mg I, 20,000 mg Zn and 100 mg Se; DM: Dry matter; OM: Organic matter; CP: Crude protein; CF: Crude fiber; NDF: Nitrogen free extract; EE: Ether extract;

TABLE 2. Effect of bee pollen supplement on growth performance, Feed intake and Feed conversion ratio of growing calves and heifers

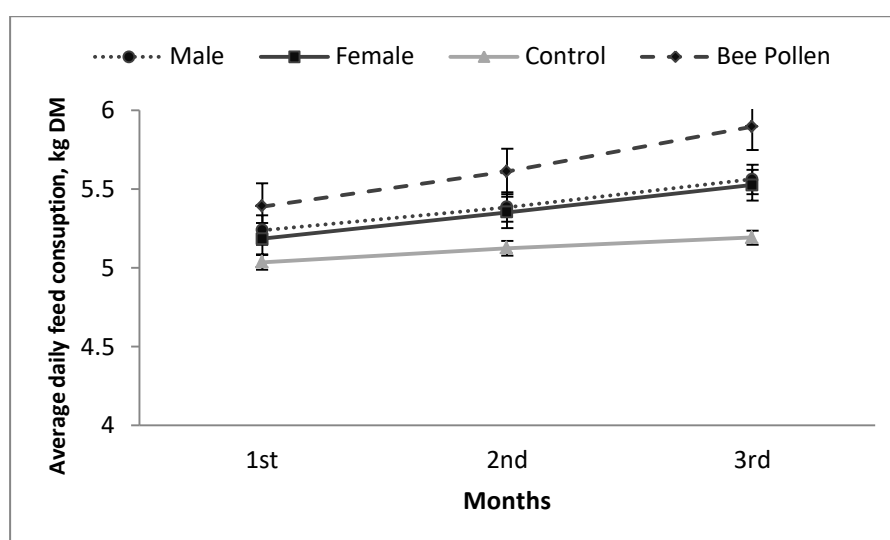
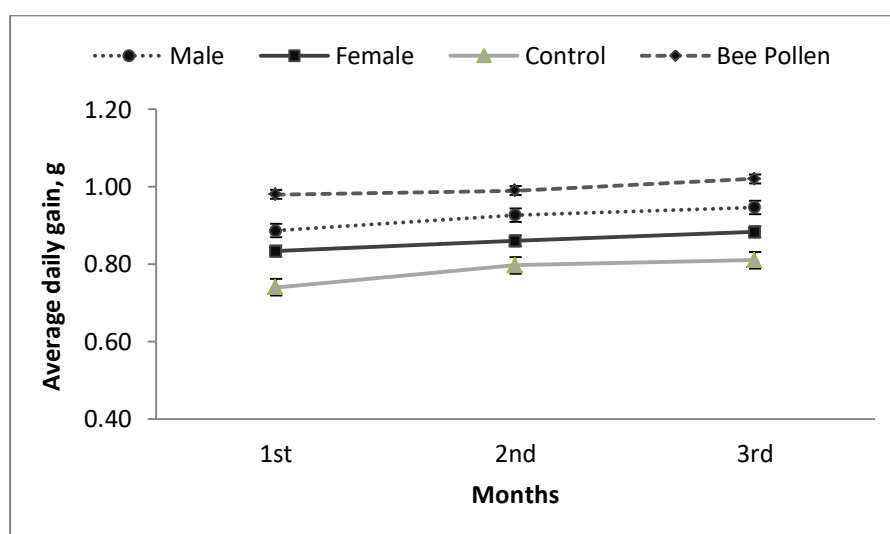
Item	Treatment		Gender		SEM	P-value		
	Con	BP	Male	Female		T	G	T×G
IBW, kg	133.6	131.8	136.1	129.3	1.088	0.274	0.001	0.804
FBW, kg	204.0	221.5	218.9	206.6	2.565	<0.001	<0.001	0.672
BWG, kg	70.4	89.7	82.8	77.3	2.362	<0.001	<0.001	0.797
ADG, g	782.2	996.7	920.0	858.9	26.24	<0.001	<0.001	0.796
DFI, kg	5.12	5.63	5.40	5.35	0.062	<0.001	0.299	0.873
FCR	6.56	5.66	5.92	6.30	0.124	<0.001	0.005	0.697

Con: experimental animals received basal diet; BP: experimental animals received basal diet + 30 g of fresh commercial multifloral bee pollen three times a week; IBW: Initial body weight, FBW: Final body weight, BWG: Body weight gain, ADG: Average daily gain, DFI: daily feed intake, FCR: Feed conversion ratio.

TABLE 3. Effect of bee pollen supplement on blood hemoglobin, biochemical and serum thyroid hormonal parameters of growing calves and heifers

Item	Treatment		Gender		SEM	P-value		
	Con	BP	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	5.06	6.16	5.73	5.49	0.092	<0.001	0.216	0.088
Albumin, g/L	2.79	3.31	3.09	3.01	0.046	<0.001	0.350	0.114
Globulin, g/L	2.27	2.85	2.63	2.49	0.048	<0.001	0.138	0.092
Albumin/Globulin ratio	1.23	1.16	1.18	1.21	0.009	<0.001	0.092	0.942
T3, ng/mL	1.35	1.63	1.50	1.47	0.019	<0.001	0.429	0.585
T4, ng/mL	90.98	114.10	103.25	101.83	1.681	<0.001	0.677	0.344
T4/T3 ratio	67.62	70.08	68.58	69.13	0.312	<0.001	0.379	0.216

Con: experimental animals received basal diet; BP: experimental animals received basal diet + 30 g of fresh commercial multifloral bee pollen three times a week; Hb: hemoglobin; T3: triiodothyronine; T4: thyroxine.

**Fig. 1.** Average daily feed intake of growing calves and heifers as affected by BP supplementation**Fig. 2.** Average daily gain of growing calves and heifers as affected by BP supplementation

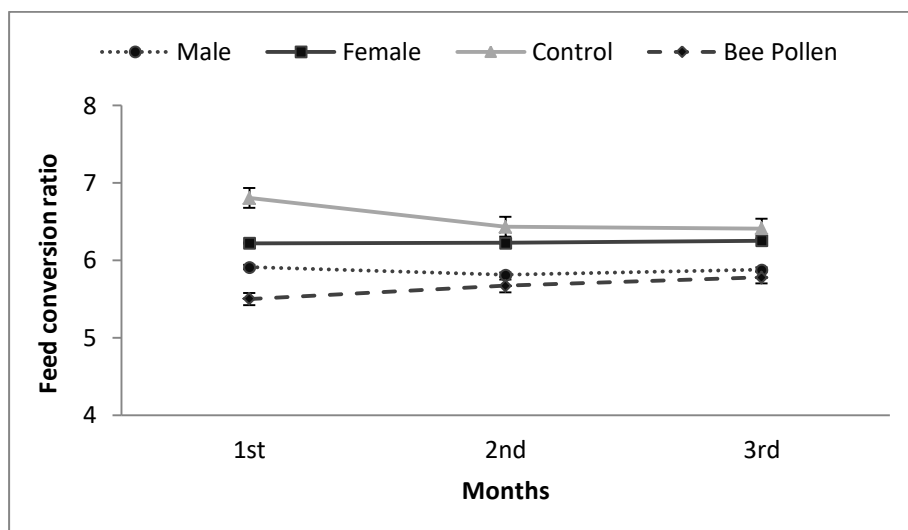


Fig 3. Feed conversion ratio of growing calves and heifers as affected by BP supplementation

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تأثير حبوب لقاح النحل كمحفز طبيعي للنمو على أداء وخصائص الدم للعجول والعجلات النامية

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الملخص

هدفت هذه الدراسة إلى استكشاف تأثير حبوب لقاح النحل (BP) على أداء وخصائص الدم للعجول والعجلات النامية. تم توزيع عشرين من العجول والعجلات السليمة (تتراوح أعمارهم بين 8 و 10 أشهر بوزن في بداية التجربة 136,1 و 129,3 كجم للعجول والعجلات على التوالي) عشوائيًا على مجموعتين (5 عجول و 5 عجلات لكل منهما). حصلت المجموعة الكنترول على النظام الغذائي الأساسي، بينما حصلت المجموعة المعاملة على 30 جم من BP التجاري الطازج 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 الكلي والألبومين والجلوبيولين و T4 و T3. كان الوزن ومتوسط الزيادة اليومية للحيوانات التي حصلت على BP أعلى ($P < 0.05$) من تلك الموجودة في المجموعة الكنترول. كذلك، أدت إضافة BP إلى زيادة ($P < 0.05$) في كمية المأكول من العلف (DFI)، وتحسن ($P < 0.05$) معدل التحويل الغذائي (FCR). أيضًا، تحسنت مستويات كل من الهيموجلوبين والبروتين الكلي، والجلوبيولين، والألبومين، و T4 و T3 في دم الحيوانات في مجموعة BP مقارنة بالحيوانات المجموعة الكنترول. وفي الختام، يمكن اعتبار إضافة BP إلى النظام الغذائي للعجول والعجلات النامية وسيلة لتعزيز النمو، وتحسين معدل التحويل الغذائي، وخفض تكاليف التغذية.

الكلمات الدالة: حبوب لقاح النحل، ميتابولزم الدم، استهلاك العلف، العجول النامية، أداء النمو.