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Effect of Partial Substitution of Soybean Meal by Optigen on Digestion, Rumen Fermentation, and Productive Performance of Buffalo Calves

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THIS work aims to analyze Optigen's effect on growing Buffalo calves as a partial replacement for soybean meal. Eighteen Buffaloes calves live body weight 303 with 14 months aged were divided into three groups based on body weight and age. All calves fed rations consisting of 2% of their LBW concentrate feed mixtures and 1% of LBW roughage to meet their recommended requirements NRC for 107 days. Animals in the control group were fed CFM1 + roughage (without Optigen) R). The tested concentrate mixture, 15 and 30% of soybean meal were replaced by Optigen CFM2 and CFM3, Rations 2 and 3 were composed of CFM2 or CFM 3 plus roughage. No significant differences ($p>.05$) between all groups for the feed intake. Also, no substantial CP, CF, and EE digestibility disparities between all experimental rations. Animals fed R2 had the highest digestibility coefficients for OM and NFE, followed by animals fed R3 but, the values were lowest in the control group. The animal fed R2 recorded the highest significantly ($P<0.05$) TDN value. No considerable vitiations ($p>0.05$) for pH values between the experimental groups. Animal fed R3 recorded the highest rumenal NH3-N, concentration. The concentration of total volatile fatty acids in rumen liquor of animals fed R2 was significantly greater ($p<0.05$) associated with other groups. Calves fed R2 had highest daily gain value and superior feed conversion value among the other groups. It can be recommended that the addition of Optigen at a level of 0.6% under this study was more effective.

Keywords: Digestibility, Rumen activity, Growth performance, Optigen, Baffalo calves.

Introduction

The primary challenge for increasing livestock production in Egypt may be the shortage of feed resources. Due to a shortage or high import grain prices, conventional feed ingredients, especially protein sources like soybean meal, have a tendency to increase the cost of animal production. [1] Since urea is non-protein nitrogen (NPN) source that is break into ammonia in the rumen and can be used by ruminal microorganisms to create microbial protein, it is preferable to substitute the traditional feed protein sources like soybean meal, which have high rumen degradability, for urea [2,3] Ruminant 'diet has usually contained urea since it is less expensive than other protein sources like soybean meals. The quick release of rumen ammonia along with the knowledge that urea might decrease animal performance has led to interest in slow-release urea (SRU) products. Additionally, rapid N hydrolysis allows ammonia to accumulate and escape from the rumen wall, causing toxicity [4]. There may be excessive excretion for the liver to regulate. Developing products that reduce ruminal ammonia production without reducing urea breakdown in the rumen was challenging [5].

One of the greatest advantages of feeding SRU to feed-lotting animals is the production of more microbial protein because the rumen microorganisms receive a steady supply of nitrogen, which lowers feeding costs. SRU successfully replaces soybean meal, a costly feed ingredient in developing nations, in the diet [6]. Additionally, the inclusion of SRU products in the

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diets provides an unusual opportunity to regulate the ruminal carbohydrate fermentation with the rate of NPN release [7]. The most important factors that ruminant nutritionists examine while adopting SRU products are their cost in comparison to urea and vegetable protein sources, as well as their impact on microbial development and animal performance [8]. NPN is an essential part of the diet of ruminants, and Optigen ensures that NPN is released continuously. A blended urea product called Optigen II (Alltech, Lexington, KY) has a lower N release rate that is less than urea and more significant compared with other SRU products [7]. Optigen II provides a high N level is 256% CP in comparison to actual protein sources like soybean meal at 49% CP as DM basis [9].

With varying results, several earlier studies examined the addition of SRU to beef cattle diets [10]. Recently, two meta-analyses performed [11, 12] examined the effect of SRU on beef and dairy production. According to the investigations, SRU addition consistently increased the LWG and FE, which in turn increased the economic efficiency of beef production. According to meta-analysis study on the utilization of SRU in dairy farms [12] with inclusion rate of 0.58% DM diet of SRU in dairy diets that can be reformed with SRU to partially replace vegetable protein sources such as (Soya bean meal) SBM while improving energy sources such as maize, it has been reported that enhanced feed efficiency and NUE were done. With an increased Optigen® level in the diet, calves showed a curvilinear response in final body weights. However, the calves supplemented with 75 g /Kg DM diets showed the highest weight gains of 0.67 kg numerically. Slow-releasing ammonia products supplementation improved N availability and enhanced process of carbohydrate breakdown and daily growth on reduced feed intake. [13].

The coated form of urea known as slow-release urea (SRU) is used in ruminant diets. When eumenal NH_3-N levels are low, Optigen made release nitrogen gradually over a period of 24 hours to meet rumen bacteria criteria. The effectiveness and production of microbial protein will rise to give a constant N [13]. According to simulation study, the beneficial effects of SRU on LWG and FE increased profitability by lowering feed costs and lowering the production of beef's emissions. The SRU is another sustainable NPN alternative for beef cattle production [11]. A controlled release urea product with a urea coating called Optigen was developed and released in 2005 by Alltech INC. Optigen II, a blended urea product, has a moderate N release rate that is lower than other SRUs nitrogen and higher than some of the source release urea products discussed above. In comparison to true protein sources like soybean meal, which has a CP of 49% based on DM, Optigen II has a higher protein content [9]. Optigen® is SRU consists of urea evenly coated with a semi-permeable vegetable fat matrix containing 88% urea (41% N, 256% crude protein and 11-12% fat [14]. The fat coating in the SRU slows the dissolution of urea, reducing the rate of urea conversion to ammonia in the rumen. The aim of this study was to evaluate the effects of Optigen II (Alltech, Lexington, KY) added to feed on nutrient digestibility, rumen fermentation measures, and animal performance of buffalo calves.

Material and Methods

Animals and ethical statement

The present study was carried out at El-Hamrawy Farm in Kafrelsheikh Governorate's Production Field, Agricultural Research Center, Ministry of Agriculture, and was supervised by the Animal Production Department, Faculty of Agriculture, Kafrelsheikh University, to investigate the partial substitution of Optigen II for soybean meal in the diet affects growth of Egyptian buffalo calves. The NIH Animal Treatment and Usage Guide was preceded by the experimental protocols from the Faculty of Agriculture, Kafrelsheikh University, Egypt (Number 4/2016 EC).

Experimental design

The average initial live body weight of the 18 male calves was 303 ± 5.14 kg, and 14 months aged were divided into three similar experimental groups (six in each) with two replicate pens dependent on age and the beginning body weight. The calves were kept in open sheds. Each group was held in a separate pan. Each day at 8 a.m. and 4 p.m., concentrate feed mixture was supplied, along with clover hay at 9 a.m. and rice straw at 11 a.m. The animals were fed in group feeding daily feed offered was recorded for each group, and fed residue was recorded to calculate daily feed intake. Freshwater was available continuously. The trial lasted 107 days. Calves were fed treatments that included 2% of their LBW concentrate feed mixtures (CFM1, CFM2, and CFM3) as well as 1% of LBW roughage (clover hay and rice straw mixed, 1:1) to satisfy their specified requirements [15]. The control group's calves were fed CFM1 without Optigen + roughage (R1). In the tested concentrate mixture, CFM2 and CFM3 with replacing 15 and 30% of the soybean meal by Optigen, respectively, this represented 0.9 and 1.8% of the concrete mixtures or 0.6 and 1.2% of the total ration. Rations 2 and 3 have been constructed up of CFM2 or CFM3 plus roughage. Table 1 illustrates the formulation of the various trial concentrates. Each group received just one of the experimental dietary treatments.

TABLE 1. The experimental concentrate feed mixtures (CFM %) are formulated as a fed basis and (DM basis):.

Item	CFM1	CFM2	CFM3
Yellow corn	54.00	60.00	66.20
Wheat bran	25.00	25.00	25.00
Soybean meal	17.50	10.60	3.50
Optigen	0.00	0.90	1.80
Sodium chloride	1.6	1.60	1.60
Calcium carbonate	1.6	1.60	1.60
Mineral mixtures*	0.3	0.30	0.30

Item	DM %	Composition% on a DM basis					
		OM	CP	EE	CF	NFE	Ash
Concentrat Mixtures							
CFM1 (control)	90.02	94.49	16.11	9.15	10.77	58.46	5.51
CFM2 (0.9%)	90.84	94.89	16.12	8.01	9.22	61.54	5.11
CFM3 (1.8%)	91.95	94.04	16.97	8.72	8.98	59.37	5.96

CFM1= without Optigen. CFM2= contain 0.9% Optigen. CFM3= contain 1.80% Optigen.Nitrogen-Free Extract (NFE), Ether Extract (EE),crude protein (CP), crude fiber (CF), organic matter (OM).
*1 kg Mineral mixtures contained 1472 mg manganese (manganese sulfate), 1030 mg zinc (zinc sulfate), 2359 mg iron (iron sulfate), 747 mg copper (copper sulfate), 5 mg cobalt (cobalt sulfate) 33 mg iodine (iodide potassium), 1.28 mg selenium (sodium selenite), 4300 mg sodium (sodium sulfate 32.37%) and 4000 potassium (potassium chloride).

The chemical composition of the different experimental diets was iso-caloric and isonitrogenous, with nearly similar in their contents of all nutrients for R1, R2, and R3, respectively (Table 2).

TABLE 2. The chemical composition of concentrate mixtures, estimated experimental rations, and feed ingredients (DM basis).

Item	DM %	Composition% on a DM basis					
		OM	CP	EE	CF	NFE	Ash
Yellow corn	91.70	98.58	8.99	3.90	1.54	84.15	1.42
Wheat bran	90.10	95.25	15.35	3.36	7.44	69.10	4.75
Soybean meal CP%	90.90	91.91	49.97	1.52	4.62	35.80	8.09
Clover hay	90.66	87.17	16.01	3.10	29.45	38.61	12.83
Rice straw	91.50	85.56	3.69	1.97	37.23	42.67	14.44
Experimental rations (calculated)							
R1	90.44	90.75	12.28	6.24	20.96	51.27	9.25
R2	90.99	91.18	13.53	6.32	19.87	51.46	8.82
R3	91.68	90.57	13.03	6.01	19.87	51.66	9.43

Concentrate feed mixture (CFM); organic matter (OM); dry matter (DM); crude protein (CP); crude fiber (CF); nitrogen-free extract (NFE); ether extract (EE); total inorganic matter (Ash). R1= 2% of their LBW CFM1 + 1% of their LBW roughage. R2= 2% of their LBW CFM2 + 1% of their LBW roughage. R3= 2% of their LBW CFM3 + 1% of their LBW roughage.

Digestibility trial

To assess the digestibility and nutritional value of the experimental rations, three calves from each group performed in three digestibility trials during the feeding period (in the middle). During the collection period (7 days), Two times each day, at intervals of 12 hours, feces samples were taken from the rectum of each animal. Van Keulen identified insoluble acid ash (AIA) as a biological marker [16]. To assess the dry matter (DM) content, fresh feces were collected and oven-dried for 48 hours at 60°C. At the start, midpoint, and ending of the collecting period, ration samples were taken. Nutrient digestibility was calculated using the equation mentioned in [17]. In accordance to:

$$\text{DM digestibility \%} = 100 - \left(\frac{AIA\ \%\ in\ feed}{AIA\ \%\ in\ feces} \times 100\right)$$

$$\text{Nutrient digestibility \%} = 100\left(100 \times \left(\frac{\text{AIA \% in feed}}{\text{AIA \% in feces}} \times \frac{\text{Nutrient \% in feces}}{\text{Nutrient \% in feed}}\right)\right)$$

Chemical analysis was performed on samples of concentrate feed mixture (CFM), rations, and feces to assess DM, CP, CF, EE, and ash using Horwitz Horwitz's techniques [18].

Rumen liquor samples

Using a rubber stomach tube, samples of rumen liquor were taken on the last day of the digestibility trails, at three hours after the morning feeding. Two layers of cloth were used to screen the samples. Before examination, the rumen samples were placed in deep freezer-safe polypropylene tubes with two drops of formalin to inhibit microbial activity. Orion SA 210 digital pH meters were used to measure the rumen pH immediately following

the samples were strained. Using the steam distillation method, the concentration of TVFA (total volatile fatty acids) was determined [18]. Magnesium oxide (MgO) was used to assess ammonia-N [20].

Blood samples

Blood samples were simultaneously drawn from the jugular vein 3 hours after the morning feeding, centrifuged at 4000 rpm for 15 minutes to separate the blood serum using serological pipettes, and then stored at -20°C until blood biochemical analysis; EDTA used as an anticoagulant and immediately directed to hematological determination according to Drabkin and Austin [21], the total protein was assessed and albumin [22]. Urea [23], blood urea nitrogen [24].

Animal performance

On the first and last days of the trial, the animals were weighed before a morning feeding on two consecutive days, as well as biweekly during the experimental period, to calculate daily gain, feed conversion, and economic efficiency.

Economic efficiency was calculated as follows:

$$\text{Economic efficiency} = \frac{\text{The price of daily body weight gain}}{\text{Daily feed cost}}$$

The price of daily body weight gain was calculated from the body weight gain multiplier in the price of 1 kg.

- - Daily feed cost was calculated from the amount of daily rations intake multiplied by 1 kg for each; all prices and costs were calculated according to market price 2017.

- The costs are based on the 2017 local price. Soybean meal: 7800 L.E. ($=495.86)/ton. Yellow corn ground: 2750 L.E. ($=174.82)/ ton. Wheat bran: 2500 L.E. ($=158.93) / ton. Optigen: 5000 L.E. ($=317.86)/ ton, Sodium chloride 500 L. E. ($=31.78) /ton. Calcium carbonate 225 L. E. ($=14.30)/ton. Mineral mixture 2600 L. E. ($=165.28)/ton. Clover hay 200 L.E. ($=12.71)/ton. Rice straw 200 L. E. ($=12.71) /ton and Body live weight =55 L.E. ($=3.49) / kg

Data analysis

The data were statistically evaluated using SPSS for Windows (2008) and a generic linear model modified for one-way ANOVA. The SPSS [25] program was used to determine the level of significance between the means using Duncan's test.

Results

Table 3 shows the feed intake, digestibility coefficients for the various nutrients, and nutritional value for the other experimental diets. The data in Table 6 demonstrate that no significant differences ($p>0.05$) among the groups for feed intake ranging from 11.40 to 11.89 kg/day. No significant differences in digestibility of CP, CF, and EE among all experimental diets. The animals fed R2 had the highest OM and NFE digestibility coefficients, followed by animals fed R3, the values were lowest in the control group.

Total digestible nutrients values for animals given R2 were considerably higher ($P<0.05$) (75.15 vs. 74.0.9 and 73.56), but no significant difference between R1 and R2. Furthermore, no significant variations in DCP among all experimental rations of 11.71, 11.99, and 12.23 for animals fed rations 1, 2, and 3, respectively. Table 3 shows that the animals receiving Optigen supplemented diets (R2 and R3) had slightly higher DCP values.

TABLE 3. Digestibility coefficient and nutritional value for different experimental rations fed to buffaloes' steers. (Mean ± SEM).

Item	Experimental rations % DM			P-value
	R1	R2	R3	
OM	67.19^{b}±1.5	69.69^{a}±2.1	67.57^{b}±2.1	0.012
CP	72.74±1.3	74.37±1.78	72.05±1.58	0.122
CF	45.67±1.22	37.76±1.47	36.81±1.14	0.153
EE	92.89±3.1	90.00±2.4	91.90±2.48	0.123
NFE	65.64^{b}±2.4	70.60^{a}±2.4	67.36^{ab}±1.78	0.025
Nutritive value				
DCP	11.71±0.6	11.99±0.23	12.23±1.47	0.142
TDN	74.09^{a}±1.2	75.15^{a}±2.3	73.56^{b}±1.22	0.015

DMI= Dry matter intake; DM =dry matter. OM =Organic matter; CP= Crude protein; CF= Crude fiber; NFE=Nitrogen-free extract; EE=Ether extract; DCP= Digestible Crude Protein; TDN=Total Digestible Nutrients.

The means in the same row that have distinct superscripts are substantially different ($P<0.05$). R1= 2% of their LBW CFM1 + 1% of their LBW roughage R2= 2% of their LBW CFM2 + 1% of their LBW roughage. R3= 2% of their LBW CFM3 + 1% of their LBW roughage.

Table 4 shows that over the period of the trial, there were no appreciable differences in the pH levels across the various experimental groups (p>0.05) and the main pH values for calves fed R1, R2, and R3 were 6.60, 6.67, and 6.73, respectively.

There were notable (P<0.05) variations in ruminal NH3-N concentrations among groups. Which the animal fed R3 (1.8% Opt.) had the highest rumen NH3-N concentration: 7.37, 8.13, and 9.11 mg/100 ml for R1, R2, and R3, respectively. Animals fed R2 supplemented with Optigen (0.9% Opt.) had significantly a higher concentration of TVFs in the rumen fluid when compared to the other groups (P<0.05). In growing buffalo calves (Table 5).

In growing buffalo calves (?Table 5) blood serum concentrations of total protein, albumin, and blood urea nitrogen (BUN) were considerably greater (P< 0.05) in animals fed R3, compared to those fed R1 and R2, respectively. Except for blood serum globulin, which appeared to be highest in animals fed R2, followed by those fed R3, and lowest in animals fed R1 (control).

The effects of Optigen supplementation on animal performance are shown in Table 6. During the trial period the average daily gain did not differ significantly (P>.05) across the various experimental groups. Animals fed R1, R2, and R3 gained 0.77, 0.82, and 0.76 kg/day, respectively. Calves fed R2 showed insignificant high average daily (0.82 vs. 0.77 and 0.76 kg/day), whereas those fed R3 (1.8% Opt.) had the low value.

During the experiment, no significant variations (p>0.5) in feed conversion ratio among the different experimental groups. The mean feed conversion ratio for animals fed R1, R2, and R3 was 14.71, 14.42, and 15.54 kg DMI/kg gain, respectively. Animals given R2 had higher feed conversion values (p>0.05) than the other groups, improving by 2.0 and 7.77%, respectively, as compared to the control.

TABLE 4. Ruminal parameters for buffaloes calves fed the experimental rations (Mean ± SEM).

Item	Experimental rations			P-value
	R1	R2	R3	
pH	6.60 ± 0.03	6.67 ± 0.01	6.73 ± 0.01	0.121
NH3-N (mg/100ml)	7.37 ± 0.26^{c}	8.13 ± 0.09^{b}	9.13 ± 0.05^{a}	0.011
TVF's mmol /100ml.	96.25 ± 0.08^{b}	97.29 ± 0.07^{a}	94.90 ± 0.10^{c}	0.015

The means in the same row that have distinct superscripts are substantially different (P< 0.05).
R1= 2% of their LBW CFM1 + 1% of their LBW roughage R2= 2% of their LBW CFM2 + 1% of their LBW roughage.
R3= 2% of their LBW CFM3 + 1% of their LBW roughage. pH = pH values. NH3-N= Ammonia-N; TVF`s =Total volatile fatty acids.

TABLE 5. Some blood parameters of buffaloes calves' blood fed the experimental rations. (Mean ± SEM).

Item	Experimental rations			P-value
	R1	R2	R3	
Total protein (g/dl)	$7.30^{b} \pm 0.58$	$8.50^{a} \pm 0.47$	$8.70^{a} \pm 0.78$	0.021
Urea (mg/dI)	$35.07^{b} \pm 0.1.02$	$31.88^{c} \pm 10.3$	$33.00^{a} \pm 1.03$	0.013
BUN (mg/dl)	$15.6^{b} \pm 0.78$	$13.0^{c} \pm 0.96$	$17.3^{a} \pm 0.1$	0.011
Globulins (g/dI)	$3.0^{b} \pm 0.01$	$3.5^{a} \pm 0.05$	$3.2^{b} \pm 0.02$	0.014
Albumin (g/dI)	$4.3^{b} \pm 0.3$	$5.0^{a} \pm 0.1$	$5.3^{a} \pm 0.1$	0.016

Means with different superscripts within the same row are significantly different (P<0.05)
R1= 2% of their LBW CFM1 + 1% of their LBW roughage R2= 2% of their LBW CFM2 + 1% of their LBW roughage. 3= 2% of their LBW CFM3 + 1% of their LBW roughage. BUN= Blood urea nitrogen.

Table 6 shows the economic efficiency as it is impacted by Optigen supplementation. Optigen supplementation slightly raised (P> 0.5) daily feed cost for calves during the experiment period (26.06, 27.21, and 28.04⁄ L.E for R1, R2, and R3, respectively). While feed cost/kg gain for animals fed R 3 (containing 1.8% Optigen) increased significantly as compared to other treatments, it was 36.91 vs. 33.84 and 33.18 L. E for calves fed control and R2 rations, respectively.When compared to the control group, 0.9% Optigen supplementation increased daily gain (net revenue) by 9.82%.

TABLE 6. Displays the impact of Optigen supplementation on the performance and cost-effectiveness of animals given various experimental diets (SEM Mean).

Item	Experimental rations			P-value
	R1	R2	R3	
Feed intake kg/ day	11.33±0.47	11.83±0.47	11.81±0.78	0.54
Initial body weight/ kg	293±8.10	307±8.20	310.5±5.45	0.21
Final body weight/ kg	375±10.20	394.8±8.10	391.3±7.48	0.33
Total gain	82±2.10	87.8±1.15	80.8±4.22	0.50
Daily gain kg/day	0.77±0.01	0.82±0.01	0.76±0.03	0.42
Feed conversion kg feed/kg gain	14.71±0.89	14.42±0.78	15.54±0.89	0.41
Feed cost/ head/ daily/ L. E	26.06±1.30	27.21±1.01	28.04±1.01	0.54
/ $	(1.660)	(1.734)	(1.782)	
Feed cost/ kg gain/ L.E.	33.84±1.14	33.18±1.14	36.91±1.56	0.23
/ $	(2.151)	(2.109)	(2.346)	
Total revenue (L. E.)	42.35±1.20	45.10±1.02	41.80±1.45	0.41
($)	(2.692)	(2.867)	(2.657)	
Net revenue (L. E.)	8.51±0.63	11.92±0.47	4.89±0.10	0.23
($)	(0.54)	(0.75)	(0.310)	
Relative economic efficiency to control	100±1.20	134±2.10	53.40±1.40	0.31

R1= 2% of their LBW CFM1 + 1% of their LBW roughage. R2 = 2% of their LBW CFM2 + 1% of their LBW roughage. R3= 2% of their LBW CFM3 + 1% of their LBW roughage. L.E. = Egyptian pound. $ =United States Dollar

Discussion

Table 3 displays the various nutrients' digestibility coefficients, and the nutritional value of the other experimental rations.

Table 3 similarly revealed no significant variations in CP, CF, or EE digestibility among the experimental rations. The animals fed R2 (0.9% opt.) had the highest digestibility coefficients for OM and NFE, followed by those fed R3 (1.8% Opt.), whereas the control group had the lowest. Increasing digestibility coefficients was demonstrated because Optigen can indirectly stimulate anaerobic fermentation of dry matter, improving nutrient utilization efficiency, and play a direct role in improving digestion in the abomasum; these findings strongly agree with Edwards et al., [26] and Santiago et al., [27]. They found that substituting slow-release urea for soybean meal didn't reveal variations in the digestibility of DM, CP, and NDF. Furthermore, Sinclair et al., [28] shown that substituting SRU for SBM can be performed without affecting diet digestibility.

The TDN **and** DCP values for animals fed R2 (0.9% Opt.) confirmed the significantly (P< 0.05) TDN value (75.15 vs. 74.0.9 and 73.56), whereas no significant difference between R1 and R2. Furthermore, as well as significant differences in DCP between all experimental rations, 11.71, 11.99, and 12.23 for animals fed rations 1, 2, and 3, respectively. Even though the animals fed Optigen supplemented rations (R2 and R3) had slightly higher DCP values (Table 3). This might be explained by the slower microbial use of additional N sources by slow-release diets during ruminal fermentation. As a result, it's possible to more effectively regulate the release of ruminal NH_3-N and the supply of carbohydrates. The daily gain of steers fed rations supplemented with Optigen (70 gm) was significantly higher (P 0.05) than steers fed rations without Optigen, according to Eweedah et al. [29], who also found that using Optigen at 1.35% and 1.85% on a DM basis can replace soybean meal in the diet of calf fattening calves without affecting growth performance. Ahmad et al. [13] also looked into how different concentrations of Optigen® (0, 25, 50, and 75 g/Kg of diet DM) affected the amount of dry matter consumed and the average daily weight gain in developing buffalo calves. Different groups of calves responded curve linearly (P<0.05) in DM consumption and quadratically (Q 0.05) in final body weights to increasing levels of Optigen® in the diet. There was no change in the calves' daily average growth. The biggest weight gains, or 0.67 kg in numerical terms, were achieved by the calves fed 75 g/Kg of DM. The effectiveness of slow-release urea supplementation (Optigen®, 10 grams/animal twice a day) on the growth performance of grazing Kaghani sheep was examined by Zulfiqar et al. [30]. Animals treated with Optigen® had considerably (P< 0.05) greater average body weights and fleece weights than the control animals. During the testing period, there were no appreciable pH value discrepancies between the various experimental groups. Calves

fed R1, R2, and R3 had main pH values of 6.60, 6.67, and 6.73, respectively (Table 4). Van Soest [31] claimed that the optimal ruminal pH value for cellulolytic bacteria growth was 6.7 in order to achieve these values within the normal range. The average indicates ranges between 6.5 and 6.8. Additionally, Taylor et al. [32] showed that the SRU had no effect on the pH value, concentration, or molar ratios of VFA in the rumen ($P > 0.05$).

Animal fed R3 simultaneously showed the highest concentration of rumen NH_3-N, with respective values of 7.37, 8.13, and 9.11 mg/100 mi rumen fluid for the animals fed R1, R2, and R3. Ruminal NH_3-N concentrations varied amongst the various groups in a significant ($P< 0.05$) proportion. According to these findings, N from the Optigen diet could breakdown more quickly than N from the control diet with soybean meal, but slower than urea. By stating that coated urea's (CU) ruminal NH_3-N concentrations were lower than urea [33, 34] provided some support for these data. According to Benedetti et al. [35], the rumen's NH_3-N concentration increased when SRU was used to substitute SBM in a high-concentrate diet.

Animals fed R2 supplemented with Optigen had a significantly higher concentration of TVFs in their rumen fluid than the other groups ($P< 0.05$). These results showed that anaerobic fermentation was more efficient and quicker for the release of nitrogen as a progressive degradation, yielding higher TVFs than in the control group, which was consistent with the digestibility result (Table 3). The results from this study were in line with those of [36], who evaluated a diet containing a slow-release coated urea product (Optigen 1200, Alltech Inc. Nicholasville, KY, USA) against a control diet (a diet comprising soybean meal as a source of protein). While Bush et al. [36] and Ceconi et al., [37] demonstrated that adding coated urea and slow-release urea to the diet had no effect on the concentration of TVF'S or the pH of the rumen.

Except for blood serum globulin, which was recorded at the highest level in animals fed R2, followed by those provided R3, and the animals fed R1 (control) had the lowest levels total protein, albumin, urea, and blood urea nitrogen (BUN) levels in the blood serum of growing buffalo calves (Table 5) were boosted ($P< 0.05$) considerably in the animal fed R3 followed in the order in R1 and R2, respectively. This may be because Optigen encourages more efficient ruminal digestion and microbial protein synthesis, both of which increase economic efficiency. These findings were consistent with those reported by [39], who noted a favourable relationship between dietary protein and plasma protein concentration.

The impact of Optigen addition on animal efficiency is display in Table 6. The average daily gains increase amongst the different experimental groups within the trial period did not differ significantly ($p>.05$). Animals fed R1, R2, and R3 gained an average of 0.77, 0.82, and 0.76 kg per day. Calves fed R2 showed a slightly higher daily gain value (0.82 vs. 0.77 and 0.76 kg/day) than the other groups, whereas those fed R3 had the lowest mean value ($p > 0.05$). These findings corroborated [15], who stated that soybean meal may be replaced in diets for beef steers with Optigen at 1% dry matter without having any negative effects on growth efficiency. Additionally,[34,39] evaluated the partial replacement SBM for Holstein lactating cows using Optigen®ii encapsulated urea from a control diet. 160 gram of Optigen® II was used to replace 1 kg SBM. No significant variations ($P> 0.05$) foe all feed intake groups ranging from 11.40-11.89 kg⁄day, which attributed to the fact that the Optigen`s replacement level was slightly low, as observed by Edwards et al., [26]. They found that when SRU was fed replacing urea, feed efficiency did not improve.

The differences in feed conversion were not significant, so there were no differences between R1, R2, and R3. The key value of the animal feed conversion ratio was 14.71, 14.42, and 15.54 kg DMI/kg gain, respectively. Animal-fed R2 reported a greater feed conversion value when compared to other groups, with improvements of 2.0 and 7.77 present when compared to control and R3 given, respectively. These findings concur with those reported in [35, 36], which revealed that substituting slow-release urea (SRU) for soybean meal did not have an impact on various aspects of intake, dry matter digestibility, or milk production in crossbred cows. Additionally, Tedeschi et al., [40] findings that slow-release urea did not improve animal performance. When supplemented at 0.8 or 1.2% of DMI, SRU did not affect average daily gain (ADG), DMI, or gain feed ratio, according to Edwards et al. [26], But whether supplementation was at a lower or higher dosage (0.4% or 1.6%, respectively), SRU reduced ADG and gain: feed ratio without noticeably influencing DMI.

With Optigen supplementation, calves' average daily feed costs increased slightly ($P>0.5$) (R1, R2, and R3, respectively 26.06, 27.21, and 28.04), demonstrating the economic effectiveness of Optigen supplementation during the experimental period (Table 6). Although feed cost/kg gain for animals fed R 3 (contained 1.8% of Optigen) slightly increased ($P>0.05$) compared to other 36.91 vs. 33.84 and 33.18 L treatments, respectively.

In comparison to the control group, the 0.9% supplement with Optigen increased daily gain (net income) revenue by 9.82%. For rations 1, 2, and 3, the feed intake/kg values (14.71, 14.42, and 15.45, respectively) did not differ significantly across any feed conversion groups. These findings conflict with those of [34, 36], who discovered that animals given Optigen-supplemented meals were more economically successful than those given unsupplemented rations.

Conclusion

From the present data, it could be concluded the animals fed R2 (0.6% Opt.) gained about 6.57% more than both fed R3 (1.2% Opt.) or control ration. It also improved daily gain (net revenue) income by 9.82 and 30% compared with the control and R3 (1.2% Opt.). While holding the same feed level, we may demonstrate an increase in digestibility coefficients of all the nutrients because Optigen, especially at a level of 0.6%, can indirectly stimulate anaerobic fermentation of dry matter, improving nutrient utilization efficiency and a direct function in improving digestion in the abomasum subsequently improved the animal performance and economic efficiency. Finally, we recommended that Optigen supplementation in calves ration at 0.6% was more economically successful.

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Conflicts of Interest

The authors declare no conflicts of interest.

Ethical approve:

All experimental procedures were approved by the ethical committee of Faculty of Agriculture, Kafrelsheikh University, Egypt.

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Author`s contributions

Nabil Mohamed Eweedah; Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Writing original draft; Abdel Salam Mousa Metwally; Conceptualization, Formal analysis, Investigation, Methodology, Writing-original draft; El-sayd Mohamed Abdel El-Rouf; Formal analysis, Methodology, Writing-original draft; Mostafa Sukry Atta; Methodology, Writing-original draft; Mohamed El-Sayd El-Sharawy; Conceptualization, Formal analysis, Funding acquisition, Writing-original draft; Mostafa Mohamed Al-Aidy; Formal analysis, Investigation, Methodology, Writing-original draft.

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الاستبدال الجزئي لكسب فول الصويا بالأوبتيجين كيوريا بطيئة التحرير وتأثيره على الهضم وتخمر الكرش وأداء العجول الجاموس

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تهدف هذه الدراسة الي دراسة تأثير أوبتيجن كبديل جزئي لحبوب فول الصويا في علائق العجول النامية. تم تقسيم ثمانية عشر عجلا من الجاموس متوسط وزن الجسم الحي ٣٠٣ ± ٥,١٤ كجم وعمر ١٤ شهرا إلى ثلاث مجموعات تجريبية (ستة في كل منها) على أساس وزن الجسم الأبتدائي والعمر. كانت تتغذي جميع العجول علي علي عليقة تتكون من ٢% من وزن الحيوان مخلوط العلف المركز CFM1، CFM 2، CFM3 بالإضافة الي ١% من وزن الحيوان علف خشن (تبن وقش الارز بنسبة ١:١) لمدة ١٠٧ يوم. تم تغذية الحيوانات في المجموعة اللكنترول علي CFM1 + المواد الخشنة (بدون اوبتجين). تم استبدال ١٥ و٣٠% من كسبة فول الصويا بـ الاوبتجين في المخاليط CFM2 وCFM3 علي التوالي وهو ما يمثل ٠,٩ و١,٨% من المخلوط المركز أو ٠,٦ و١,٢% من العليقة الكلية. كانت تتكون العليقة الثانية والثالثة من CFM2 or CFM 3 بالإضافة الي المواد الخشنة. اظهرت النتائج عدم وجود اختلافات معنوية بين العلائق المختلفة بالنسبة للغذاء الماكول وكان يتراوح من ١١,٤٠- ١١,٨٩ كجم/ يوم. ايضا لم يكن هناك اختلافات معنوية بالنسبة لهضم كلا من البروتين الخام والالياف الخام والدهن. في حين ان الحيوانات المغذاء علي العليقة الثانية (٠,٦% اوبتجين) سجلت زيادة معنوية في هضم كلا من المادة العضوية والمستخلص الخالي من الازوت يليها العليقة الثالثة (١,٢% اوبتجين) وسجلت المجموعة الكنترول اقل القييم. كما سجلت العليقة الثانية اعلي القييم بالنسبة لمجموع المواد الغذائية المهضومة (٧٥,١٥ مقابل ٧٤,٠٩، ٧٣,٥٦). لم يكن هناك اختلافات معنوية بالنسبة لدرجة حموضة الكرش بين المعاملات المختلفة. سجلت الحيوانات المغذاة علي العليقة الثالثة (١,٢% اوبتجين) اعلي قيم بالنسبة لتركيز الامونيا في الكرش (٧,٣٧، ٨,١٦، ٩,١١ مجم / ١٠٠ مل من سائل الكرش) بالنسبة للعلائق الاولي والثانية والثالثة علي التوالي. كما سجلت المجموعة الثانية اعلي القيم بالنسبة لتركيز الاحماض الدهنية الطيارة الكلية. سجلت المجموعة الثانية (٠,٦% أوبتجين) اعلي معدل نمو وافضل كفاءة تحويلية غذائية. وبذلك يوصي بإضافة الاوبتجين بمعدل (٠,٠٦%) حيث كان اكثر كفاءة.

الكلمات الافتتاحية: الهضم- نشاط الكرش- مقاييس النمو- الاوبتجين- عجول الجاموس.