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INFLUENCE OF DIETARY INCLUSION OF PALM KERNEL MEAL (PKM) AND LIVE YEAST ON GROWTH PERFORMANCE, RUMEN FERMENTATION PARAMETER, NUTRIENT DIGESTIBILITY AND BLOOD BIOCHEMICAL INDICES IN BEEF CALVES

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ABSTRACT

The present experiment was carried out to evaluate the effects of using palm kernel meal (PKM) with or without live yeast (LY) in diets on the growth performance, digestibility of diet nutrients, rumen fermentation parameter and selected blood biochemical indices of beef calves. Fifteen uncastrated male crossbred beef cattle calves were used with an average body weight of 303.5 kg and ages ranged from 10 to 12 months. Calves were divided into 5 equal groups (Three calves in each group). The experimental trial extended for 4 months. Fattening calves were assigned to 5 diets (treatments) as following: G1 (basal diet), G2 (basal diet with 10% PKM), G3 (basal diet with 10 % PKM + LY), G4 (basal diet with 20 % PKM) and G5 (basal diet with 20 % PKM + LY). Growth performance parameters were recorded biweekly throughout the experiment .Fecal, rumen content and blood samples were collected from each calve 3 times (day zero, after 2 month, after 4month). The results of growth performance showed significant ($p \leq 0.05$) increase in body weight gain, feed intake and better feed conversion in G3 in comparison with other groups. Rumen fermentation results revealed that calves in G3 showed significant increase in total volatile fatty acids (TVFAs) concentration and decrease in ammonia concentration, Calves in G4 had significant decrease in concentrations of TVFAS and ammonia nitrogen levels. Serum biochemical analysis indicated that calves in G3 and G5 had increase in total protein and BUN values in middle of the experiment with increase in creatinine level at the end of the experiment. The levels of albumin in G3 and G5 were decreased throughout the experiment period.The results concerning nutrient digestibility showed some little degree of variation between different groups .However, all the nutrient digestibility values were within normal ranges. The conclusion is that supplementation of beef

calves diet with 10% PKM + LY has a great effect on calves performance,total bodyweight, gain rumen fermentationparametersandblood biochemical indices.

Key words:

Beef calves, PKM, live yeast, body gain, rumen analysis, biochemical profile.

INTRODUCTION

Proper nutrition and genetic factors are significant principles in successful beef meat production all over the world. The persistent shortages of the conventional feed stuffs for livestock feeding in Egypt are caused largely by inadequate production of farm crops. Moreover, the high cost of feed is a sequel to the competition between man and livestock for these feed ingredients. This has forced animals nutritionists to intensify research into the feeding values of potentially useful, attractive, cheaper and readily available protein and energy sources from unconventional crop products **(Chanjula*etal.*,2011).**

Using agro-industrial by -products as alternative, cheap and sustainable feed for ruminants as palm kernel cake or meal is a good example of unconventional feed resources because of its low cost and its nutritive composition. It is an important by - product of the oil palm industry and is obtained after the extraction of palm kernel oil from the oil palm fruits**, (Alimon and Wanzahari, 2012, Abubakr *et al,* 2014).** In the two last decades, the potential roles of specific microbial supplements have been better defined and there has been considerable interest in using preparations containing live microorganisms as feed supplements for ruminants. The yeast based products were reported to simultaneously enhance growth and performance by enhancing dry matter intake and average daily gain perhaps through the establishment of a healthy gastro intestinal tract. These products may be especially useful in times of potential stress. Yeast supplements have been considered as a tool to mitigate some negative effects of stress and to improve animal health and performance during the receiving period at the feedlot**. (Dawson, 1992; Broad way *et al*., 2015).** Research work dealing with the combined effect of using palm kernel meal and live yeast in beef calf diets is scarce in the available Literature. Therefore , the objectives of the present study were centered on detection the effects of introducing different dietary levels of palm kernel meal with or without live yeast in the diets on the growth performance, digestibility of diet nutrients, rumen fermentation parameter and selected blood biochemical indices in beef calves .

Material and methods:

The present study was conducted at a private farm for beef calves production at Monshaet El-kanater, Giza governorate to evaluate the impact of certain dietary modifications by using different levels of palm kernel meal (PKM) with or without live yeast (LY) in beef calves diets.

Animals:

Fifteen uncastrated male crossbred beef cattle calves were used in this study with average body weight of 303.5 kg and ages ranged from 10 to 12 months .the animals were tied and kept individually indoors on mud bedding which was cleaned every day. Before the start of the experiment all animals were dewormed by using Zanide® and Ivomic super® for controlling internal and external parasites. All animals were vaccinated against Foot and Mouth disease (FMD) and Rift Valley Fever (RVF).

Tested feed stuffs:

1-Palm kernel meal (PKM).

The material was imported from Malaysia having dark brown color and in the form of meal (small particles). The product was free from dirties or undesirable contaminants with an odor like ground dried bread. The chemical analysis of the used PKM is shown in (Table 1).

Table (1): The proximate chemical analysis of the used PKM.

Nutrient	%
DM	**91.3**
CP	**15.5**
EE	**7.8**
Cf	**17.5**
AsH	**4.1**

2-Live saccharomyces cerevisiae yeast (LY).

The material was produced from LALLEMAND company- France and was imported thorough EGA VET Company Egypt the product is a 200 technical feed additive containing Saccharomyces cerevisiae. It is a digestibility enhancer and gut flora stabilizer used with complete feed for beef cattle at the rate of 0.4 gm /calf/ day as recommended in the directions of its use.

Diets preparation and composition:

The basal concentrate for the control diet was composed of yellow corn, soya bean meal, cotton seed cake, wheat bran, mineral supplements in addition to other feed additives.

The concentrate mixture was formulated to satisfy the commonly known requirements for beef calves (Table 2).

Table (2): Ingredient composition and chemical analysis of the used concentrate mixture.

Ingredients	Amount Kg/ 100Kg
Yellow	**54.6**
PKC	**0**
Soybean meal 44%	**11**
Cotton seed cake	**13**
Wheat bran	**12**
Sodium bicarbonate	**1**
NaCl	**0.5**
Mollases	**5**
Lime stone	**2.5**
Toxin binder	**0.1**
Beef Premix	**0.3**
Total	**100**
Chemical analysis of feed number 1	
CP	**14.17**
EE	**3.15**
CF	**6.5**
TDN	**71.73**
CA	**1.02**
P	**0.47**

The PKM was introduced in the concentrate mixture formula at the rate of 10% (for diet 2) and 20% (for diet 4). Furthermore, live yeast was added to a small amount of the concentrate mixture at a rate of 0.4gm / calf and was fed individually for calves representing diet 3 and diet 5. All concentrate mixtures were formulated to be similar regarding their energy and crude protein content (Table 3). The formulated concentrates (1- S) were fed at a level of 2% of the body weight of the calf daily in addition to wheat straw (Tibn) 2 Kg / calf / day.

Table (3): Ingredient composition and proximate chemical analysis of the used concentrate mixtures in different treatments.

Feed stuff/ Inclusion rate %	Group 1 (control)	Group 2	Group 3	Group 4	Group 5
Yellow corn	54.6	50	50	46.5	46.5
PKC	0	10	10	20	20
Wheat bran	12	10	10	10	10
Soybean meal 44%	11	8.7	8.7	6.5	6.5
Cotton seed cake	13	12.9	12.9	11.6	11.6
Sodium bicarbonate	1	1	1	1	1
NaCl	0.5	0.5	0.5	0.5	0.5
Mollases	5	4	4	1	1
Lime stone	2.5	2.5	2.5	2.5	2.5
Toxin binder	0.1	0.1	0.1	0.1	0.1
Premix	0.3	0.3	0.3	0.3	0.3
Total	0	0	0	0	0
Chemical analysis of feed number					
CP %	14.17	14.09	14.09	14.06	14.06
EE %	3.15	3.61	3.61	4.18	4.18
CF %	6.5	7.54	7.54	8.85	8.85
TDN %	71.73	71.32	71.32	71.54	71.54
CA %	1.02	1.01	1.01	1	1
P %	0.47	0.42	0.42	0.38	0.38

Calculated according to the Egyptian feed composition tables the daily ration (concentrate mixture 2% of the body weight + 2kg tibn / calf) was divided into two meals / day offered at morning and afternoon.

Experimental design:

The used calves (15) were divided into 5 equal groups, (Three calves in each group). The experimental plied extended for 4 months. Fattening calves were assigned to the 5 dietary (treatments) as following: G1 (basal diet), G2 (basal diet with 10% PKM), G3 (basal diet with 10% PKM + LY), G4 (basal diet with 20% PKM) and G5 (basal diet with 20% PKM + LY).

Growth performance parameters:

Body weight development was recorded by weighing each calf biweekly during the experimental period (4 months), Body weight gain, Feed intake and feed conversion were recorded and calculated throughout the experiment.

Samples:

1- Feed Samples.

Representative sample were collected from different concentrate mixture as well as wheat straw for proximate chemical analysis. Determination of the dry matter, crude protein, ether extract, crude fiber and ash % in the sample was carried out following the methods described in the **AOAC (1990).**

2- Fecal samples.

Samples of the fecal matter were collected directly from the rectum of each animal to avoid contamination with the ground mud. The samples were preserved for subsequent proximate chemical analysis. Dry matter (DM), crude protein (CP), ether extracts (EE), crude fiber (CF), ash and acid insoluble ash% were determined following the **AOAC (1990).** Procedures.

3- Rumen fluid samples.

From each calve 50 ml of rumen fluid sample was collected using rubber stomach tube connected to a suction pump and supported by wooden gag; 2- 3 hours after morning feeding. The sample was examined immediately for physical characters: colour, odour, consistency, pH according to **Dehorety (1984).** The sample was divided after sieving into three portions. The first portion 2ml for determination of ammonia nitrogen level after preservation by adding liquid paraffin oil according to **Conway (1957)**, the second 2 ml for total volatile fatty acids after preservation by adding 2 ml ortho phosphoric acid and m1 hydrochloric acid N / 10 according to **Warner (1964).** .

4-Blood sample

From each animal ,blood samples were collected by jugular veno puncture in a clean dry centrifuge tube for collection of clean non - haemoliyzed serum for determining the levels of total protein,albumin,cholesterol,creatinine, BUN ,glucose and triglycerides spectrophotometrically using specific kits produced by Bio diagnostic Company, Egypt.

Statistical analysis:

The obtained results were expressed as mean and standard error of mean (M±SE) and analyzed statistically by using SPSS 16.0 software package using (ANOVA) (SPSS Inc., Chicago, IL, USA). Significant differences in the values between groups were indicated by P*≤0.05, P**≤0.01and P***≤0.001.

Results and discussion:

Regarding to the results of fattening calves performance and daily feed intake in different experimental groups are presented in (Table 4). The results revealed that calves in G3 (basal diet with 10% PKM + LY) had the best average body weight daily gain , total body weight gain , feed efficiency and lowest feed conversion ratio in comprarison with other groups similar results were recorded in other works **(Ghazanfar *et al* , 2015; Turney *et al* ,2017)** and near to those reported by **(Tipu *et al.,* 2014)** who proved that buffalo calves fed diet containing PKC at levels lower than 30 % have better nutrient digestibility which was reflected on calves performance measurements.

Table (4): Body weight gain, feed intake and feed conversion ratio of the beef calves in different experimental groups.

Measurements	G1	G2	G3	G4	G5
Initial wt.(kg)	307.66	337.33	284.33	290	298.33
Final wt. (kg)	471.33	481	452.33	450.33	456.66
Total body weight gain/120 days (kg)|	163.67	143.67	168	160.33	158.33
Average daily body weight gain (kg)	1.363	1.197	1.40	1.336	1.319
Daily feed intake (kg)	9.81	9.79	9.73	9.67	9.73
FCR(Feed conversion ratio)	7.19	8.17	6.95	7.23	7.37
FE (Feed efficiency)	0.139	0.122	0.143	0.138	0.135
Total feed intake					
Concentrate (kg)	2814.5	2804.5	2784.5	2764.5	2784.5
Roughage(kg)	720	720	720	720	720
Total ration	3534.5	3524.5	3504.5	3484.5	3504.5

G1 (basal diet), G2 (basal diet with 10% PKM), G3 (basal diet with 10% PKM + LY), G4 (basal diet with 20% PKM) and G5 (basal diet with 20% PKM + LY).

Results of rumen fermentation parameters in different experimental groups are given in (Table 5) which revealed that calves in G4 had significant decrease in concentrations of TVFAS and ammonia due to defaunating properties of PKM that contain high level of lipids which decrease protozoa population **(Abubakr, *et al.,* 2013)** and consequently affect concentrations of TVFAS and ammonia in rumen **(Wallace *et al,* 1987).** Calves in G3 showed significant increase in TVFAS concentration and decrease in ammonia concentration.

The same findings were observed by other **researchers (Ando *et al,* 2004; Marden *et al*, 2008; Kowalik *et al,* 2011 and Habeeb, 2017).** These findings conforming the best average body weight daily gain, total body weight gain, feed efficiency and best feed conversion ratio in comparison with other groups.

Table (5): Rumen fermentation parameters in experimental calves groups at zero day 2 months and 4 months (end of experiment).

Parameters	Group / Time	G1	G2	G3	G4	G5
PH	Zero day	6.63 ± 0.09^{a}	6.83 ± 0.06^{a}	6.43 ± 0.23^{a}	6.66 ± 0.14^{a}	6.80 ± 0.05^{a}
	2 months	6.27 ± 0.01^{a}	6.53 ± 0.07^{a}	6.02 ± 0.04^{a}	6.62 ± 0.10^{b}	6.42 ± 0.06^{a}
	4 months	6.33± 0.24^{a}	6.00 ± 0.05^{b}	5.90 ± 0.01^{c}	6.51 ± 0.04^{a}	5.95 ± 0.05^{d}
TVFAS (mmol/l)	Zero day	62.50 ± 1.4^{a}	42.50 ± 7.2^{b}	53.00 ± 1.1^{a}	56.50 ± 6.6^{a}	45.00 ± 2.8^{a}
	2 months	78.50 ± 7.2^{a}	52.50 ± 1.4^{b}	92.50 ± 1.4^{a}	38.50 ± 6.6^{c}	48.50 ± 4.9^{d}
	4 months	81.25 ± 10.8^{a}	67.50 ± 7.2^{a}	91.20 ± 10.8^{a}	50.00 ± 5.7^{b}	100.00 ± 2.8^{c}
Ammonia concentration (mmol/l)	Zero day	92.96 ± 2.8^{a}	90.96 ± 2.8^{a}	95.96 ± 1.1^{a}	86.96 ±0.5^{b}	93.96 ± 1.1^{a}
	2 months	98.96 ± 0.5^{a}	104.95 ± 0.5^{b}	105.95 ± 2.3^{c}	97.95± 4.0a	99.95 ± 3.4^{a}
	4 months	96.96 ± 1.7^{a}	96.96 ± 0.5^{a}	90.96 ± 0.5^{a}	92.96 ± 1.7^{a}	97.96 ± 1.1^{a}
Total protozoa count ($x10^{4}$/ml)	Zero day	20.62 ± 1.80^{a}	4.91 ± 2.11^{b}	16.87 ± 0.36^{a}	8.75 ± 0.72^{a}	18.75 ± 5.77^{a}
	2 months	19.37 ± 5.91^{a}	13.75 ± 0.72^{a}	28.75 ± 5.05^{a}	6.25 ± 1.44^{b}	4.37 ± 1.80^{c}
	4 months	26.87± 11.18^{a}	15.00 ± 6.49^{a}	20.00± 0.72^{a}	4.37 ± 1.80^{b}	13.75 ± 0.00^{c}

Results in the same row with differ superscript letters are significant at 0.05 G1 (basal diet), G2 (basal diet with 10% PKM), G3 (basal diet with 10% PKM + LY), G4 (basal diet with 20% PKM) and G5 (basal diet with 20% PKM + LY).

Concerning to the results of blood biochemical indices observed in the experimental calve groups. The glucose level was significantly increase in the middle of experiment in G2 and

G4 but still within the normal range the same result was reported by **Sani, *et al* (2017)**. Total serum protein value in the middle of the experiment was higher in G2 than G4 as the result recorded by **(Sani, *et al,* 2017).** The BUN values obtained in this study were within the normal range for healthy calves. When rumen ammonia is absorbed into the systemic blood, it is converted to urea by the liver thus; the moderate levels of serum urea with inclusion of PKC in the diet could be a pointer to better urea nitrogen utilization. The level of cholesterol in G4 was higher than in G2 but still within normal range this may be due to level of PKM is higher in G4 than G2 and its properties on lipid content. Addition of live yeast (LY) to the diet in G3 and G5 besides 10 %, 20 % PKM respectively had effect on biochemical indices, Increase total protein and BUN values in the middle of the experiment with increase in creatinine level at the end of the experiment. The levels of albumin in G3 and G5 were decreased throughout the experiment period. The same findings were reported by **El- Ashry *et al* (2001).** The cholesterol levels were decreased in G3 and G5 the same result expressed in other studies **(Marden *et al,* 2008 and Kowalik *et al.,* 2011).** This may be due to increased VFA concentrations that can slow down cholesterol synthesis in the liver and may alter the blood lipid profile.

Table (6): Biochemical indices in different experimental calve groups at zero day, 2 months and 4 months of the experiment.

Parameters	Group / Time	G1	G2	G3	G4	G5
Total protein (g/dl)	Zero day	7.00 ± 0.34^{a}	8.70 ± 0.05^{b}	7.53 ± 0.54^{a}	7.00 ± 0.3^{a}	7.63 ± 0.14^{a}
	2 months	6.93± 0.26^{a}	6.20 ± 0.11^{a}	6.92 ± 0.32^{a}	6.10 ± 0.75^{a}	7.70 ± 0.11^{b}
	4 months	7.66± 0.62^{a}	6.82 ± 0.25^{a}	7.56 ± 0.20^{a}	7.89 ± 0.74^{a}	8.82 ±0.42^{b}
Albumin (g/dl)	Zero day	3.84 ± 0.10^{a}	4.00 ± 0.30^{a}	3.80 ± 0.09^{a}	3.40 ± 0.17^{b}	3.46 ±0.14^{c}
	2 months	3.90 ± 0.05^{a}	3.53 ±.08^{b}	3.40 ± 0.28^{c}	3.80 ± 0.05^{a}	3.7 ± 0.17^{a}
	4 months	4.45 ± 0.14^{a}	3.80 ± 0.05^{b}	4.05± 0.02^{c}	3.90 ± 0.05^{d}	3.95 ±0.14^{e}
Globulin (g/dl)	Zero day	3.17 ± 0.4 ^{a}	4.69 ± 0.09^{b}	3.74 ± 0.64^{a}	3.89 ±0.22^{a}	4.13 ±0.03^{a}
	2 months	3.04 ± 0.02^{a}	2.96 ± 0.22^{a}	3.55 ± 0.04^{a}	2.30 ± 0.80^{a}	4.57 ±0.06^{b}
	4 months	3.21 ± 0.48^{a}	3.03 ± 0.30^{a}	4.88 ± 1.37^{b}	4.02± 0.78^{b}	4.90 ± 0.26^{c}
BUN (mg/dl)	Zero day	24.60± 0.63^{a}	24.74± 0.55^{a}	26.78 ± 0.10^{a}	26.05 ± 0.31^{a}	22.53 ± 0.21^{a}
	2 months	32.04 ±2.62^{a}	27.06 ± 3.17^{a}	41.65 ± 6.89^{b}	32.12 ± 0.01^{a}	34.30 ± 5.13^{a}
	4 months	40.00 ± 1.03^{a}	28.73 ± 2.55^{b}	37.85 ± 6.37^{a}	36.42 ± 3.42^{a}	40.04 ± 3.31^{a}
Creatinine (mg/dl)	Zero day	2.06 ± 0.36^{a}	1.61± 0.30^{a}	1.65 ± 0.04^{a}	1.15 ± 0.07^{b}	1.22 ± 0.01^{a}
	2 months	1.55 ± 0.12^{a}	1.70 ± 0.17^{a}	1.27 ± 0.04^{a}	1.79 ± 0.02^{a}	1.52 ± 0.03^{a}
	4 months	1.64 ± 0.15^{a}	2.06 ± 0.05^{b}	1.73 ± 0.34^{a}	1.60 ± 0.05^{a}	2.48 ± 0.99^{b}
Triglycerides (mg/dl)	Zero day	32.48 ±0.56^{a}	43.91± 7.96^{b}	19.66 ± 6.03^{c}	19.62 ± 0.21^{d}	29.27 ± 8.30^{e}
	2 months	33.45± 9.67^{b}	27.56 ±1.14^{a}	27.50 ± 1.44^{a}	26.30 ± 3.63^{a}	24.45 ± 0.83^{a}
	4 months	38.94 ± 0.26^{a}	26.95 ± 0.60^{b}	33.80 ± 5.08^{a}	24.20 ± 3.34^{b}	15.47 ± 1.20^{c}
Cholesterol (mg/dl)	Zero day	171.75±11.9^{a}	113.95 ±3.08^{b}	109.50 ± 1.32^{c}	109.50 ±4.04^{d}	88.20± 5.31^{e}
	2 months	125.35±17.5^{a}	109.25 ± 15.7^{a}	150.45± 10.7^{a}	150.70 ± 12.5^{a}	111.85 ± 2.6^{a}
	4 months	136.10±2.13^{a}	91.70 ± 7.33^{b}	129.55± 9.9^{a}	111.60 ± 2.8^{a}	110.90 ± 4.5^{a}
Glucose (mg/dl)	Zero day	68.45± 6.2^{a}	57.71 ± 1.74^{a}	68.43 ± 6.20^{a}	53.55 ± 3.49^{a}	62.35 ± 3.29^{a}
	2 months	77.25 ± .89^{a}	74.90 ± 1.21^{a}	67.90 ± 4.56^{a}	83.95 ± 0.54^{a}	81.70 ± 3.63^{a}
	4 months	83.70 ± 2.82^{a}	74.25 ±13.71^{a}	62.90 ± 2.36^{b}	61.25 ± 10.1^{c}	59.00 ± 13.85^{d}

Results in the same row with differ superscript letters are significant at 0.05 G1 (basal diet), G2 (basal diet with 10 % PKM), G3 (basal diet with 10 % PKM + LY), G4 (basal diet with 20% PKM) and G5 (basal diet with 20% PKM + LY).

Table (7): Average dietary nutrient digestibility% in different groups during the experiment.

Group / Nutrient	G1	G2	G3	G4	G5
CP	**71.19 ± 2.97**	**68.37 ± 3.75**	**70.55± 2.54**	**68.34 ± 2.39**	**65.80 ± 2.26**
EE	**80.53 ± 0.77**	**75.68 ± 2.8**	**79.29 ± 1.13**	**75.44 ± 3.41**	**74.69 ± 2.82**
CF	**48.26 ± 4.63**	**41.06 ± 1.87**	**49.8 ± 5.92**	**42.74 ± 0.91**	**46.17± 2.16**
Ash	**73.83 ± 3.23**	**71.51 ± 3.84**	**73.91 ± 2.3**	**67.10 ± 2.03**	**71.10 ±1.81**
NFE	**63.57 ± 7.5**	**53.44 ± 2.62**	**61.22 ± 7.11**	**60.57 ± 1.29**	**61.33±3.02**

The results concerning nutrient digestibility (Table 7) show some degree of variation between groups .However all the nutrient digestibility values are within normal ranges.

CONCLUSION

From the obtained results , It could be concluded that supplementation of beef calves diet with 10%PKM + Live yeast have an a improving effect on calves performance , total body weight, gain, rumen fermentation parameters, nutrient digestibility and blood biochemical indices .

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