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Improvement of Gain, Feed Efficiency and Physiological Body Functions in Native Bovine Calves during Hot Summer Season using Different Nutritional Supplements

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Abstract

The study aimed to investigate effects of different nutritional supplements fed to 24 healthy growing native bovine calves for improvement of gain, feed efficiency and physiological body functions. The experimental calves were divided into four equal groups. The calves in the 1st group were offered the control basal diet which consisting of Concentrate Feed Mixture (CFM) and rice straw. Calves in the 2nd group were offered the same control diet but 20% of yellow maize in CFM was replaced by 20% Dried Olive Cake (DOC). Calves in the 3rd group were offered the same diet of second group plus active dry yeast while calves in the 4th group were offered the same diet of third group plus vitamins A, D3 & E. From chemical composition analyses of the different diets on dry matter basis:, results showed that percentages of Crude Fibre (CF) and ash in calves of 2nd, 3rd and 4th groups were significantly higher than in calves fed of control diet (1st group). Opposite trend was found in percentage of Nitrogen Free Extract (NFE). Daily Body Weight Gain (DBWG), total and daily Dry Matter Intake (DMI) as g/kg Live Body Weight (LBW) and Water Intake (WI) as ml/kg LBW values in calves of 2nd, 3rd and 4th groups were significantly higher than in calves fed of control diet. Supplementation of yeast in 3rd group and both yeast and vitamins in 4th group increased immunity function of growing calves. Total protein values were higher significantly (P<0.05) in 3rd group (7.93 g/dl) and 4th group (8.38 g/dl) than in both 1st group (7.13 g/dl) and 2nd group (7.13 g/dl). Similar trend was observed in globulin values. The highest levels in thyroid hormones were in calves of 3rd and 4th group while the lowest levels were in calves of 1st and 2nd group. T_4 values were 92.58 and 108.63 nmol/L in 3rd and 4th group, respectively, higher significantly (P<0.04) than in 1st group (75.15 nmol/L) and in 2nd group (74.55 nmol/L). T_3 values were 3.25 and 3.55 nmol/L in 3rd and 4th groups, respectively, higher significantly (P<0.04) than in both 1st group (2.75 nmol/L) and 2nd group (2.85 nmol/L). Replacement 20% of DOC instead of 20% yellow maize in CFM was not affected significantly on blood components or hormonal levels. It can be concluded that yeast and vitamins supplement to diet of calves fed CFM containing 20% ODC may be having a stimulating effect on the rumen proper functions and digestion and consequently improved live body weight gain of calves under hot summer season of Egypt.

Keywords: AD3E; Calves; Gain; Olive cake; Yeast

Introduction

There is a problem of animal production in Egypt due to the shortage of feed ingredients and the lack of sufficient feeds to meet the nutritional requirements of the existing animal population. The use of maize in the production of bio-energy will subsequently increase the challenges associated feed availability for animal nutrition. The partial solution of this problem is to add certain supplements, especially, agro-industry by-products to the rations of animals [1,2]. There are some byproducts that can be used for feeding animals as alternative feed ingredients such as Dried Olive Cake (DOC) which may be used instead of maize [3]. Use of olive by-products could partially overcome the feed shortage and reduce production costs.

Active Dry Yeast (ADYs) has beneficial effects in livestock production because is characterized by a high concentrations of viable cells (>10 billion cfu/g) with the most common species being *Saccharomyces cerevisiae* [4]. ADYs increase the Dry Matter Intake (DMI) and milk production in dairy animals [5]. Growth parameters in beef cattle or young ruminants were improved by daily ADY supplementation [6,7]. ADYs have been officially registered as feed additives in Europe [8]. In North America, *Saccharomyces cerevisiae* species is registered and generally recognized as safe. The current purpose of using ADYs as a natural additive is not only to increase productivity but also to diminish the risk of animal digestive pathogens [9]. Feed additives with ADYs have a promising future in ruminant nutrition because ADYs are useful in providing balanced intestinal microflora and appear particularly relevant when the intestinal microbiota are challenged during periods of heat stress conditions [10]. According to the Association of American Feed Control Officials and American Pet Diner Products recommendations, ADY

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must be supplied daily to pelleted rations of animals for best results. In USA, nutrient yeast is used when producing animal feed, as well as an additive to the feed ration of farmed animals.

Vitamins A, D_3 and E as fat soluble vitamins are potent antioxidants and animals cannot produce these vitamins in their bodies. Therefore an exogenous regular supply is needed to cover the physiological requirements and to sustain high production performance [11]. In addition, supplementation of heat stressed animals with these vitamins resources is required to correct the protein and energy negative balances during hot weather season in Egypt [12].

For these reasons, the aim of this research was to study the utilization of the DOC, ADY and vitamins A, D3 and E in the diets fed to growing heat stressed native bovine calves and evaluate both the individual and combined effects of the additives on gain, feed efficiency, hormonal levels and physiological body functions of calves.

Materials and Methods

Animals and experimental design

The present study was conducted in bovine farm project, Experimental Farms Project, Biological Application Department, Atomic Energy Authority, Inshas, Cairo, Egypt. This work was reviewed and approved by the Animal Care and Welfare Committee of Zagazig University, Egypt (ANWD-206). The experiment was carried out for 12 weeks (84 days) from day 22 of June to 31 day of August during hot summer season of 2016 on 24 healthy native bovine calves aged 5 months, with average body weight of 116.4 kg. The experimental calves were divided into four equal groups. The 1st group was offered diet which consisting of Concentrate Feed Mixture (CFM) and rice straw and served as control group while calves in the 2nd group were offered the same control diet but 20% of yellow maize in CFM was replaced by 20% Dried Olive Cake (DOC). The experimental calves in the 3rd group were offered the same diet of second group plus dry yeast at the rate of four boxes to each ton of CFM (16 g *Saccaromyces cervisia* wall extract) /calf) while calves in the 4th group were offered the same diet of third group plus vitamins A, D3 and E at the rate of four bags to each ton of CFM (40000 IU vitamin A, 12000 IU vitamin D3 and 40 mg vitamin E were supplemented to each kg CFM). The four experimental rations used in this research had similar concentrations of crude protein and gross energy. The experimental calves were offered the diet which consisted of CFM and Rice Straw (RS) to cover their requirements according to live body weight and daily body gain [13]. The ingredients as percentage of the CFM and analyses of chemical composition of the different feed diets used in the feeding of the four experimental groups (on DM basis %) according to AOAC [14] are presented in Table 1. Averages of Ambient temperature at midday during experimental period of hot summer season inside the farm were 34.0, 35.8 and 36.8 °C during June, July and August months, respectively. The corresponding values outside the farm were 35.8, 36.8 and 37.8 °C. Feed CFM was offered once daily at 10.00 hrs while RS was offered *ad libitum* at midday to experimental calves and fresh drinking water was available all the time. The experimental calves were left loose day and night during the experimental period in four separate soil floored yards (20 x 40 meters) surrounded with wire fence (1.5 meter height). One-third of the surface area of the yard was covered with concrete shading roof in the middle (3.5 meter height) with natural ventilation. Each yard was provided also with troughs and source of drinking water to be available automatically at all time to the calves.

Measurements of growth feed and water intake

Live Body Weight (LBW) of each calf was measured at the beginning of the experiment and at the end of experimental period to estimate total live body weight gain (kg) after 84 days and to calculate Daily Body Weight Gain (DBG). Food consumption from CFM and rice straw for each group in the four experimental groups was measured three times; at Fourth Week (W4), Eighth Week (W8) and Twelfth Week (W12) by subtracting the residuals of feed from that offered for calves in the previous day and calculated as Dry Matter Intake (DMI). The DM concentration of the feed stuffs was determined from the weight difference before and after oven drying at 105°C for 24 h. The daily DMI of each group was calculated by multiplying the daily fresh feed intake with the DM concentration. Total DMI, g/ kg LBW as Feed Efficiency (FE) was calculated. Water intake was measured three times at W4, W8 and W12 for each group by subtracting the residuals of water from that offered for calves in the previous day. It was taken into account evaporate the water on consideration in estimation of water intake. Water intake (ml/ kg LBW) was also calculated.

Estimation of physiological body functions

One blood sample was collected from the jugular vein of each calf before morning meal at the end of experiment (day 84). Blood samples were withdrawn in vacutainer tubes and then placed on ice water immediately following collection and then were centrifuged at 2000 x g for 25 min. to obtain plasma and stored at -20°C until analysis. Total protein, albumin, urea, creatinine, total cholesterol, triglycerides, total lipids and glucose concentrations as well as Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) enzymes activities were estimated by the colorimetric method using commercial kits (Diamond Diagnostic, Egypt). Globulin was estimated by subtraction of albumin from total proteins. T_3 and T_4 hormones were estimated using Radioimmunoassay (RIA) technique by the coated tubes kits (Diagnostic Systems Laboratories, Inc., Webster, Texas, USA) and the radioactivity of iodine-125 (^{125}I) was determined in gamma counter. T_4/T_3 ratio was also calculated.

Statistical analysis

Data were analyzed using the SAS statistical software [15]. The treatments were subjected to a one-way ANOVA of the general linear models, and the differences between group means were compared using the new multiple range test [16]. The percentage change due to diet was calculated as follows: Change%= (value of treatment diet-value of control diet) x100/ value of control diet. The values in Tables are presented as mean±SE.

Results and Discussion

Effect of different nutritional supplements on chemical composition of diet

The results showed that DOC had significantly (P<05) higher CF, EE and ash percentages and had significantly (P<0.05) lower level in NFE than those values in yellow maize. Percentages of CF, EE and ash in control diet of CFM containing yellow maize (1st group) were 11.28, 3.50 and 5.27 and while in CFM containing 20% DOC (2nd, 3rd

Table 1: Means of Ingredients and chemical composition of the four experimental diets.

Ingredients and chemical composition of different diets	Control diet (CD) (1st group)	CD containing 20% DOC (2nd group)	CD containing 20% DOC plus yeast (3rd group)	CD containing 20% DOC plus yeast and vitamins (4th group)
Ingredients of the concentrate diets (%):				
Un-decorticated cotton seed cake	18	18	18	18
Yellow maize	30	10	10	10
Wheat bran	30	30	30	30
Sugar beet pulp	20	20	20	20
Dried olive cake	--	20	20	20
*Dry yeast	--	--	Dry yeast	Dry yeast
**AD_3E	--	--	---	AD_3E
Sodium chloride	1	1	1	1
Di-calcium phosphate	1	1	1	1
Chemical composition analyses of the different diets% (on dry matter basis):				
Dry matter	90.29	91.3	91.3	91.3
Organic matter	94.73	93.18	93.18	93.18
Crude protein	14.91	14.69	14.69	14.69
Crude fiber	11.28^b	19.12^a	19.12^a	19.12^a
Ether extract	3.50^b	5.39^a	5.39^a	5.39^a
Nitrogen-free extract	65.04^a	53.98^b	53.98^b	53.98^b
Ash	5.27^b	6.82^a	6.82^a	6.82^a
Gross Energy (MJ/kg DM ration)	18.39	18.71	18.71	18.71

*Four boxes from dry yeast were added to each ton of CFM. Dry yeast (16g *Saccaromyces cervisia* wall extract) (on DM basis)=8g CP, 5.3g NFE, 0.96g EE and 1.28g ash/ head/daily. Average gross chemical composition of the dry yeast biomass is CP 50%, EE 6%, carbohydrates 33%, moisture 3% and minerals 8% (Reed&Nagodawithana, 1991).

**Four boxes from vitamins A, D3 and E were added to each ton of CFM. AD_3E =160000 IU vitamin A, 48000 IU vitamin D3 and 160 mg vitamin E /head.

a,b,c ...Row means with different superscripts differ significantly at P<0.05.

Table 2: Mean (±SE) total and daily body weight gain of Egyptian native bovine calves fed different experimental diets during hot summer season of Egypt.

Growth traits, Kg	1st group	2nd group	3rd group	4th group	Overall mean
Initial LBW	117.0±1.2	116.5±1.0	117.0±1.2	117.5±1.1	
LBW after 4 weeks	132.0^b±1.1	133.5^b±1.1	135.0^a±1.1	136.5^a±1.2	134.25^C±1.0
LBW after 8 weeks	149.0^b±1.0	150.0^b±1.2	153.0^{ab}±1.1	155.5^a±1.2	151.88^B±1.5
LBW after 12 weeks	165.0^d±1.2	168.0^c±1.1	172.0^b±1.0	175.5^a±1.5	170.1^A±2.3
Total gain, kg (84 days)	48.0^d±0.3	51.5^c±0.4	55.0^b±0.5	58.0^a±0.5	
Total gain increase over control, kg	-	3.5	7	10	
Daily gain, g	571^d±10	613^c±13	655^b±12	690^a±11	
*Change,% due to treatment and significant	-	7.4 (P<0.05)	14.7 (P<0.05)	20.8 (P<0.01)	

LBW = Live Body Weight.

*Change%= (values of treatments (2nd or 3rd or 4th) - values of control 1st group x100 / values of control1st group.

Different letters between row of each item indicate significant differences at P<0.05 (a>b>c>d).

Different letters between overall mean column due to experimental weeks indicate significant differences at P<0.05 (A>B>C).

and 4th groups) were 19.12, 5.39 and 6.82, respectively. The opposite trend was found in percentage of NFE which was significantly higher (P<0.05) in control diet of CFM containing yellow maize (65.04%; 1st group) than in CFM containing 20%DOC (53.98%; 2nd, 3rd and 4th groups). NO significant differences between diets in gross energy (MJ/kg DM ration) (Table 1). DOC is characterized by high neutral detergent fibred; NDF (51.3% DM) and acid detergent lignin, ADL (24% DM) but low crude protein; CP (5.5% DM) and is consumed readily by many livestock species, especially, ruminants without any harmful effects on health.

Effect of different nutritional supplements on body weight gain of calves

Total Live Body Weight (LBW) and DBWG values in calves fed the diet containing 20% DOC (2nd group), diet containing 20% DOC plus yeast (3rd group) and diet containing 20% DOC plus yeast and vitamins A, D3 and E (4th group) were significantly (P<0.05) better than in calves fed control diet. Live body weight of calves

Table 3: Mean (±SE) dry matter intake of feedstuffs (kg/calf) in bovine Egyptian native calves fed different experimental diets during hot summer season of Egypt.

DMI of feedstuffs	Experimental diets	Experimental weeks (age of calves)			Overall mean each group
		Week 4	Week 8	Week 12	
Daily DMI (kg/calf) from CFM	1st group	3.70c±0.06	4.20c±0.07	4.50c±0.06	4.13c±0.23
	2nd group	3.80b±0.04	4.60b±0.04	4.70b±0.04	4.37b±0.29
	3rd group	4.50a±0.07	5.20a±0.04	5.70a±0.07	5.13a±0.35
	4th group	4.70a±0.09	5.30a±0.07	5.90a±0.04	5.30a±0.35
	Overall mean each week	4.18C±0.3	4.83B±0.3	5.20A±0.4	
Daily DMI (kg/calf) from Rice straw	1st group	0.30d±0.02	0.30c±0.02	0.50b±0.01	0.37b±0.07
	2nd group	0.40c±0.01	0.45bc±0.02	0.50b±0.01	0.43b±0.14
	3rd group	0.50b±0.02	0.50b±0.01	0.60a±0.01	0.53a±0.03
	4th group	0.60a±0.01	0.60a±0.01	0.60a±0.01	0.60a±0.00
	Overall mean each week	0.45B±0.06	0.46B±0.06	0.55A±0.03	
Total DMI (kg/calf) from feedstuffs	1st group	4.00c±0.12	4.50b±0.10	5.00b±0.11	4.50c±0.29
	2nd group	4.20b±0.11	5.05b±0.13	5.20b±0.12	4.82b±0.31
	3rd group	5.00a±0.12	5.70a±0.11	6.30a±0.15	5.67a±0.38
	4th group	5.30a±0.16	5.90a±0.15	6.50a±0.15	5.90a±0.35
	Overall mean each week	4.63C±0.31	5.29B±0.32	5.75A±0.38	
Total DMI, g/ kg LBW (FE)	1st group	30.30b±0.3	30.20b±0.3	30.30b±0.35	30.27b±0.03
	2nd group	31.60b±0.4	33.70b±0.3	31.00b±0.38	32.10b±0.82
	3rd group	37.00a±0.4	37.30a±0.4	36.60a±0.46	36.97a±0.20
	4th group	38.80a±0.5	37.90a±0.4	37.00a±0.51	37.90a±0.52
	Overall mean each week	34.43A±2.1	34.78A±1.8	33.73A±1.8	

Different letters between column of each item indicate significant differences at P<0.05 (a > b > c > d).
Different letters between row of each item indicate significant differences at P<0.05 (A > B > C).

Table 4: Mean (±SE) daily water intake (L/day) in bovine Egyptian native calves fed different experimental diets during hot summer season of Egypt.

WI items	Experimental diets	Experimental weeks (age of calves)			Overall mean each group
		Week 4	Week 8	Week 12	
Water intake, L/day	1st group	20.0b±0.5	22.5b ±0.5	25.0b±0.8	22.5b±1.45
	2nd group	21.0b±0.4	23.5b±0.8	26.5b±1.0	23.67b±1.60
	3rd group	23.5a±0.5	26.5a±0.6	30.0a±0.5	26.67a±1.89
	4th group	24.0a±0.5	27.5a±0.5	30.5a±1.0	27.33a±1.89
	Overall mean each week	22.1B±0.97	25.00AB±1.2	28.00A±1.34	
Water intake, mL/ kg LBW	1st group	151.5b±3.5	151.00b±4.3	151.50b ±3.9	151.33b±0.17
	2nd group	157.9b ±5.4	156.70b±4.5	157.70b±4.3	157.43b±0.37
	3rd group	174.1a 5.4	173.20a±5.3	174.40a±4.6	173.90a±0.36
	4th group	175.8a±4.6	176.80a±4.9	173.80a±5.2	175.47a±0.89
	Overall mean each week	164.8A±6	164.43A±6.3	164.35A±5.8	

Different letters between column of each item indicate significant differences at P<0.05 (a>b>c>d).
Different letters between row of each item indicate significant differences at P<0.05 (A>B>C).

increased significantly (P<0.05) due to increasing calves age; being 134.25, 151.88 and 170.13 kg after 4, 8 and 12 weeks of experiment, respectively (Table 2). Improvement of gain in calves feeding on diet of 3rd and 4th groups may be due to that the fact yeast and vitamins A, D3 and E improve the appetite of animals and the palatability of feed which leads to increase in the DMI and consequently increased weight gain of the treated animals. The beneficial effects of addition of *Saccharomyces cerevisiae* may be due to an increase in the digestion of diet nutrients in the rumen of calves [17]. Yeast stimulates some of the cellulolytic bacteria in intestine of animals [18]. The increase in cellulose digestion may increase the volatile fatty acids production in the rumen which is used as building blocks for protein, fat as well as vitamins synthesis necessary to increase in weight gain and feed efficiency. Yeast is considered a good source of excellent protein and a good source of B-complex vitamins which represent the digestion and appetite stimulating vitamins. Yeast also stimulates rumen microbes to enhance microbial protein synthesis and provides the digestive enzymes amylase for starch digestion, protease for protein digestion

Table 5: Mean (±SE) physiological body functions in Egyptian native bovine calves fed different experimental diets during hot summer season of Egypt.

Physiological body functions	1st group	2nd group	3rd group	4th group	p values
Immunity function:					
Total protein(g/dl)	7.13c±0.2	7.1c± 0.2	7.93b±0.06	8.38a±0.19	0.05
Albumin, A(g/dl)	4.03±0.2	3.98±0.3	3.95±0.11	3.98±0.06	0.11
Globulin, G (g/dl)	3.10c±0.02	3.2c±0.02	3.98b±0.02	4.40a±0.03	0.04
A/G ratio	1.30a±0.01	1.26a±0.01	0.99b±0.01	0.90c±0.01	0.05
Liver function:					
AST (U/L)	27.20±0.9	31.50±1.9	27.50±1.66	30.00±2.7	0.15
ALT (U/L)	24.5±0.96	27.50±1.0	24.50±1.55	27.75±1.0	0.12
Kidney function:					
Urea (mg/dl)	24.75b±1.7	31.25a±1.3	35.00a±1.87	32.25a±2.2	0.05
Creatinine (mg/dl)	0.88b±0.09	1.13a±0.11	1.15a±0.10	1.18a±0.05	0.05
Thyroid function:					
T_4 (nmol/L)	75.15c±3.9	74.55c±3.1	92.58b±3.22	108.63a±2.6	0.04
T_3 (nmol/L)	2.75c±0.06	2.85c±0.06	3.25b±0.10	3.55a±0.10	0.04
T_4/T_3 ratio	27.33	26.16	28.49	30.6	

Different letters between row of each item indicate significant differences at P<0.05(a>b>c>d).

and lipase for fat digestion [9].

Yeast is a live microbial feed supplement increased digestibility of CP from 63.9 to 68.7% in crossbred male calves [19] and increased CF digestibility of nutrients in Barki male lambs by 12.3% [20]. Yeast also improved significantly the CP digestibility from 70.6 to 79.5 and CF digestibility by 26.9 % when ADY was added to the diet of animals. Yeast culture (Saccharomyces cerevisiae) improved the neutral detergent fiber digestion in steers fed oat straw based diets [21].

The high improvement in gain of calves fed diet containing 20% DOC plus yeast and vitamins A, D3 and E may be due to the fact that these vitamins are involved in the synthesis of important co-enzymes (NAD and FAD), which are responsible for the biological oxidative process that produces the necessary ATP for protein, fat and carbohydrate biosynthesis. Also, the addition of yeast and vitamins A, D3 and E to the diet may have corrected the negative protein balance which occurs during hot weather periods, consequently resulting in the improved gain of calves during the hot summer [22].

Effect of different nutritional supplements on DMI and feed efficiency of calves

Averages of total DMI values from feed stuffs (including CFM rice straw) in calves fed the diet containing 20% DOC (2nd group), diet containing 20% DOC plus yeast (3rd group) and diet containing 20% DOC plus yeast and vitamins A, D3 and E (4th group) were (4.82, 5.67 and 5.90 kg DM /calf) significantly (P<0.05) better than in calves fed control diet (4.50 kg DM /calf) during 12 weeks of experiment. When expressed total DMI as g/kg LBW (Feed efficiency), total DMI values in 3rd and 4th groups were 36.97 and 37.90 DMI, g/ kg LBW significantly P<0.05) better than in calves fed control diet (30.27 DMI, g/ kg LBW) and 2nd one (32.10 DMI, g/ kg LBW). In the same time, total DMI as g/kg LBW values were not affected by change in age of calves being 34.34, 34.78 and 33.73 during 4, 8 and 12 weeks,

Table 6: Mean (±SE) energy metabolites in Egyptian native bovine calves fed different experimental diets during hot summer season of Egypt.

Energy metabolites (mg/dl)	1st group	2nd group	3rd group	4th group	p values
Glucose	102.25±3.0	108.0±4.6	102.75±2.6	102.25±2.0	0.12
Total lipids	508.8±5.2	515.8±5.7	498.50±3.3	505.00±3.5	0.15
Triglycerides	97.00±4.02	92.0±2.04	90.00±3.24	95.50±5.33	0.22
Cholesterol	117.75±4.6	103.3±2.3	106.25±1.3	104.50±3.0	0.16

respectively without significant difference between experimental weeks (Table 3). The insignificant difference in total DMI as g/kg LBW values may be due to the increase in each of live body weight and DMI with the same level during experimental weeks.

The increase in DMI in calves fed CFM containing 20% DOC (G2) may be due to the higher CF% in the chemical composition of DOC than CF% in yellow maize. The increase in DMI in calves fed diet supplemented with yeast culture may be due to that yeast improves the appetite of animals and the palatability of feed which lead to increase the DMI. Yeast increase rate of fiber digestion and the rate of digested flow and improved nutrient utilization and consequently increase in feed efficiency. Some of the benefits associated with yeast include increased NDF digestion and increased the number of ruminal total bacteria, especially, cellulolytic bacteria which increases the fiber digestion rates and enhancing the utilization of feed [23]. Cellulolytic bacteria increased significantly with increased yeast supplements to the diet may be results to increase DMI and improve feed efficiency [24,25]. The increase in DMI in calves fed diet supplemented with A, D3, and E may be due to that vitamins play as a biological substance led to enhances digestibility of nutrients, growth of microorganisms in the rumen and ability of protein synthesis and may be also increase the absorbed nutrients from small intestine consequently increased feed intake.

Table 7: Economical efficiency and return due to different experimental diets (all prices at 2016).

tems	Economic benefits of four experimental diets			
	1st group	2nd group	3rd group	4th group
Daily body gain, g/calf	571	613	655	690
Increase in daily body gain due to treatment, g/calf	-	42	84	119
Price of increase in daily body gain, L.E.	-	1.26	2.52	3.57
Price of kg CFM from each diet, L.E.	2.53	2.01	2.04	2.14
Benefit in one kg due to treatment, L.E.	-	-0.52	-0.49	-0.39
Average CFM intake daily as kg DM/calf	4.2	4.6	5.2	5.3
[1]Average CFM intake daily as kg fed /calf	4.67	5.11	5.78	5.89
Price of CFM intake daily/ head, L.E.	11.815	10.27	11.791	12.605
Average rice straw intake daily as kg DM /calf	0.3	0.45	0.5	0.6
[1]Average rice straw intake daily as kg fed /calf	0.326	0.489	0.543	0.652
Price of rice straw intake daily / calf, L.E.	0.114	0.171	0.19	0.228
Total cost of daily feed intake daily, calf, L.E.	11.929	10.44	11.981	12.833
Feed cost of kg gain, L.E	20.89	19.56	18.29	18.59
[2]Economical efficiency,%	43.61	53.37	58.56	61.38
Return (Economical benefit), due to supplements	100	122.38	134.28	140.75

[1]DM in CFM and rice straw were 90 and 92%, respectively, Price of one kg live body weight is 30 L.E

Price of one ton from yellow maize and dried olive cake is 3000 and 400 EL, respectively. Price of one ton from rice straw is 350 EL and price of 4 bags from each yeast and AD_3E added to one ton CFM is 30 and 100 EL, respectively.

It can calculate the economical efficiency and return due to different experimental diets with prices of 2016 using $ according to that each 7.80 Egyptian pound (E.L.) changed by one American dollar (Egyptian Central Bank at 15-8-2016).

[2]Economical efficiency = (price of gain- cost of feed) x100 **/** cost of feed.

Effect of different nutritional supplements on water intake of calves

The water intake (WI L/day) values were significantly (P<0.05) higher in calves fed diet containing 20% DOC plus yeast (3rd group) and calves fed diet containing 20% DOC plus yeast and vitamins A, D3 and E (4th group) than in calves fed basal ration (1st group) and calves fed the diet containing 20% DOC (2nd group) during each of experimental weeks (W_4, W_8 and W_{12}) as shown in Table 4. No significant difference between the averages of WI in calves fed diets of 3rd and 4th groups. WI value affected significantly by change of age of calves being 22.13 L/day during first four weeks and increased to 25.00 L/day during second four weeks and increased again to 28.00 L/day during third four weeks. When expressed WI as mL/kg LBW, the values were also significantly (P<0.05) higher in 3rd and 4th groups than in calves fed control diet (1st group) or 2nd group without difference between 3rd and 4th groups indicating that AD3E supplementation not affected on calves WI. WI as ml/kg LBW values were not affected by change in age of calves (Table 4). This insignificant changes in WI as ml/kg LBW in calves from 1st and 2nd to 3rd and 4th groups may be due the gradually increasing in both LBW and WI was the same level.

Effect of different nutritional supplements on physiological functions of calves

Immunity function: Total protein and globulin values in calves fed diet containing 20% DOC plus yeast (3rd group) and calves fed diet containing 20% DOC plus yeast and vitamins A, D3 and E (4th group) were significantly (P<0.05) higher than in calves fed basal ration (1st group) and calves fed the diet containing 20% DOC (2nd group). The opposite trend was observed in albumin/globulin ratio. Albumin values in calves were not changed due to fed different experimental supplements (Table 5) These results indicated that yeast and vitamins A, D3 and E supplementation increased immunity function of growing calves, because yeast exerting their beneficial affects through antagonism against specific groups of pathogenic organisms and increased enzymes activities (amylases, proteases, lipases and celluloses) for increasing the protein biosynthesis [26]. Yeast and A,D3 and E vitamins supplement to diet of calves may be having a stimulating effect on the rumen proper functions and digestion and increased protein biosynthesis led to higher blood plasma total protein and globulin concentrations. Vitamin A is essential for maintaining healthy immune function and deficiency can lead to an impaired response to infection [27]. Supplying sufficient amounts of vitamins A and E may improve the immune status of the parturient cow [28]. Vitamin E is important for the formation of red corpuscles and it has an important activity as a biological antioxidant [29]. Vitamins A, D3 and E mixture increased total protein and globulin concentrations progressively with increased the level of vitamins injection [10]. Vitamin A, D3 and E mixture could be used to alleviate the negative effect of heat stress on physiological response of goat bucks [22].

Liver function: Serum AST and ALT enzymes activities in calves were not changed due to fed different experimental diets (Table 5). Similarly, AST and ALT activities were not changed when added 10 g/h/day Baker's yeast (containing 10^9 CFU *Saccharomyces cerevisiae* per gram) for lactating buffalo [30].

Kidney *function:* Urea and creatinine concentrations in calves fed the diet containing 20% DOC (2nd group), diet containing 20% DOC plus yeast (3rd group) and diet containing 20% DOC plus yeast and vitamins A, D3 and E (4th group) are in within normal range without changes between them and at the same time were significantly ($P<0.05$) higher than that value in calves fed basal diet (1st group) (Table 5). Urea concentration was not affected with yeast supplements [31]. The results indicated that the levels of inclusion of yeast and vitamins A, D3 and E in the diets of the calves did not have a negative effect. These results indicated that yeast and vitamins A, D3 and E supplementation had not seriously affected on treated calves.

Thyroid function

The highest levels in thyroid hormones (T_4 and T_3) were in calves fed diet containing yeast and vitamins A, D3 and E (4th group), being 108.63 and 3.55 nmol/L, respectively. While the lowest levels were in calves fed basal diet (1t group) (75.15 and 2,75 nmol/L, respectively) and in calves fed diet containing 20% DOC (2nd group) (74.55 and 2.85 nmol/L, respectively) without changes between them (Table 5). Thyroid hormones (T_4 and T_3) levels in calves fed diet containing yeast were (92.58 and 3.25 nmol/L, respectively) higher than those levels in calves fed basal diet (75.15 and 2.75 nmol/L, respectively) and calves fed diet containing 20% DOC (74.55 and 2.85 nmol/L, respectively) and lower than in calves fed diet containing yeast and vitamins A, D3 and E (4th group) (108.63 and 3.55 nmol/L, respectively). Adding ADY to the diet of CFM of calves may have caused a significant increase the protein biosynthesis which leads to enhance thyroid function and increase the levels of both T_4 and T_3 hormones**.** Injection of vitamin AD3E mixture in heat stressed goats bucks is effective in improving performance of animals through restoration of blood components and hormonal levels by impacting some blood biochemical responses [10].

Energy metabolites: Glucose, total lipids, triglycerides and total cholesterol concentrations in calves were not affected due to fed different experimental supplements (Table 6). It seem that different supplements in the diets of calves not affected on blood metabolites of energy either glucose or fat fractions. These results may be due to that the four experimental rations used in this research had similar concentrations of gross energy.

Economic efficiency: The feed costs of kg gains in supplemented groups were in 19.56, 18.29 and 18.59 L.E. in 2nd, 3rd and 4th groups, respectively, lower than in control ration (20.89 L.E.). The feed cost of kg gain was lower by 6.37, 12.45 and 11.01 % in calves fed diets of 2nd , 3rd and 4th groups than calves fed 1st group although increase in price of supplements and DMI. Animals fed rations containing supplements showed the highest economic benefit, being 122.38, 134.28 and 140.75% compared with the control group which considered 100% (Table 7).

This can be explained by the significant of adding nutrient supplements in the diet of growing calves. The net return in 2nd, 3rd and 4th were 22.38, 34.28 and 40.75, respectively.

DOC could be successfully used in formulating CFM for animals to 20% and this feed ingredient reduces the feed cost by 22.38 % without any adverse effect or harmful to healthy of animals. Yeast stimulates the appetite of animals and helps maintain maximum DMI by stimulating rumen fermentation and improving fiber digestion. AD3E as a biological substance led to enhances digestibility of diet nutrients and ability of protein synthesis and consequently increased efficiency of nutrient utilization and consequently led to more gain. Therefore, yeast and vitamins help incoming animals on to full feed quicker with an improvement in rate of gain and/or feed conversion, consequently reduction in overall feed cost per kilogram gain.

The economic efficiency revealed that relative economic efficiency as a percentage of control group were improved by 112.82 and 124% for lambs fed ration containing 10 and 20% olive pulp, respectively [3]. The relative economic efficiency was significantly lower (better) in calves fed rations containing biologically treated DOC compared to the control group [32]. Recently, Shaaban et al. [33]. found that ewes and lambs fed rations containing ODC showed the highest economic benefit compared with animals fed control diet and the feed cost/kg gain was significantly decreased in experimental groups compared with the control. Injection ewes with vitamin AD3E in Jordan showed an average additional net return of US$ 5.66/ewe [34].

Generally, improvements in gain, DM and feed efficiency and the trends towards normal blood components in experimental calves fed diets containing 20% DOC plus yeast or/ and vitamins A, D3 and E may be as a result of the increase in dietary nitrogen (yeast) and biological active substances (A, D3, E vitamins). These combined substances may have been associated in increasing the retained nitrogen and consequently improving the daily gain in supplemented calves. Moreover, the increase in T_3 and T_4 hormones in calves treated with yeast or/and vitamins may have stimulated the protein synthesis by decreasing the proteolytic action of glucocorticoids or increasing the glucose transport to provide the energy required for peptide synthesis [22].

Conclusion

Diet of calves contained 20% ODC may be having a stimulating effect on the rumen proper functions and digestion and therefore diet containing ODC showed the highest economic benefit and the feed cost/kg gain was very low compared with the control**.** Adding Yeast and AD3E vitamins to rations of calves' improved nutrient digestibility enhanced the immune responses and productive performance, especially, under hot summer conditions of Egypt.

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