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PRODUCTIVE PERFORMANCE, RUMINAL AND BLOOD METABOLIC RESPONSES OF BUFFALO CALVES TO GLYCOGENIC PRECURSORS SUPPLEMENTATION

By

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ABSTRACT

The object of this study was to evaluate the effect of supplementing propylene glycol (PG) and calcium propionate (Ca-pr) as energy source on performance, ruminal fermentation, and some metabolic parameters of fifteen Egyptian buffalo male calves average body weight (LBW) 212.27 ±8.684 kg divided into three similar groups (5/each) based on LBW, the experimental animal in the 1st group control drenched at 3 liters of saline solution (Nacl 0.9%) without addition, while, the 2nd group (PG) drenched 300mL of propylene glycol dissolved in 3 liters of (Nacl 0.9%) and the 3rd group (Ca-pr) drenched with 335g of calcium propionate dissolved in 3 liters of (Nacl 0.9%). Calves administered through esophagus via esophagus feeder tube twice/weekly for 6 months experimental period. Statistical analysis revealed that the administration of Ca-pr and PG increased ($P<0.05$) total gain and average daily gain while, DM and TDN feed conversion decreased ($P<0.05$). Moreover, feed intake remained un-affected among treatments. Ruminal pH and calculated eNDF values lower ($P<0.05$) in Ca-pr drenched calves' than PG and control treatments. On the contrary, total VFA's, NH_3-N concentrations, buffering capacity values and ruminal molar proportion of propionate and butyrate tended to be greater in Ca-pr group than animals receiving other treatments however, acetatedidn't affectbytreatments. Ca-pr and PG groups decreased ($P<0.05$) in NEFAplasma and ß-hydroxybutyrate levels while, plasma glucose, serum insulin concentration and glucose to insulin ratio were more significantly ($P<0.05$) than control group during the experimental period.

In brief Ca-pr and PG additives had beneficial impact on performance and some metabolic parameters buffalo male calves so; it could be used partially as energy supply in their diets.

Keywords:

Buffalo calves, glycogenic precursors, oral drenched, performance, rumen and blood profile.

INTRODUCTION

Energy consumption demand increased gradually for animals' growth synthesis and it has not received proper attention in result of decreased energy balances and negative productive performance affect. However, alternative food sources in productive livestock system should be evaluated as energy consumption and economic farmer return, **(Mendoza *et al.*, 2008)**. Although increasing grain in animal diet including more fermentable and increases energy density but also, dry matter intake occasionally reduced by grain excess in rumen, and overall energy intake may not actually increase, **(Oba and Allen, 2003)**. Given that,high-energy feed additives one of attractive resolved methods' that used to partially cover energy reduced and replace grain during growth period with prevent animal's DM consumption lack and body weight mobilization, **(Ferraro *et al.*, 2009**). Propylene glycol produced by fermentation of yeast and carbohydrates, this gives designation of carbohydrate when used in foods and breaks down in the liver into propionic acid and later into glucose. The benefits of using these additives include drop free fatty acids in the blood and easily absorbable glucose provides with increase its serum concentration, **(Daniel Radzikowski, 2017**). Also, calcium propionate supplemented salts one of the main glycogenic precursors can be incorporated into the diet and required for glucose synthesis in the liver as primary energy substrate by increase the concentration of propionate in the rumen, and decreased intake linearly **(Trabue *et al.*, 2007**), also a large amount of calcium salt as oral administration can be used to increase passive diffusion of blood calcium concentration, and decreased acetate concentration in rumen, **(Van Houtert and Leng,1993).** Food and Drug Administration (FDA) and the World Health Organization (WHO) consider it is safe for use the most scrutiny of glycogenic supplements as indirect food additives which is quickly absorbed from the rumen wall or partly transformed to propionate before being absorbed and converted to glucose **(Nielsen and Ingvarsten,2004)**.

To our knowledge, glycogenic consumption evaluates affects for growing calves have not available studies.

The hypothesis of the current study was that calcium propionate or propylene glycol as fed energetic product supplementation can improve energy status as key indicated of blood

metabolite parameters, performance, feed intake, feed efficacy, feeding costs and some rumen parameters on male buffalo calves.

MATERIAL AND METHODS

Animals were managed following the principles and specific guidelines of Buffalo Research Station, Mahallet Mousa, Kafer El-Sheikh Governorate department Animal Production Research Institute (APRI). Agricultural Research Centre, Ministry of Agriculture, Egypt.

Animals, Housing, and Diets:

A total number of 15 Egyptian buffalo male calves (*Bubalus bubalis*) with an average live body weight 212.27±8.684 kg and 13.0±0.42 months old randomly assigned to one of three equal groups based on live body weight. Calves in the 1st treatment served as a control and drenched 3 liters of saline solution (Nacl 0.9%) without any addition, while, the 2nd treatment (PG) drenched 300ml of propylene glycol (310 g= 4.08mol glucose precursor) dissolved in 3 liters of saline solution and the 3rd treatment (Ca-pr) drenched with 335g of calcium propionate (=81.6g calcium and 4.08 mol of glucose precursor) (NutroCal®; Kemin Industries, Inc., Des Moines, IA) dissolved in 3 liters of saline solution according to **Gavana and Motorga, (2009).** Animals were kept indoors semi-open well ventilated sheds yards in separated individual pens and fed individually a conventional concentrate mixture composes of (35.5% wheat bran, 31.5% decorticated cotton seed cake, 15% yellow corn, 10%sun flower seed cake, 3.5% vinas, 3%limestone and 1.5% common salt (Nacl) based on LBW twice daily in two equal portions at 08:00 and 15:00h to meet the protein requirements for maintenance and growth according to **NRC, (2005)** recommendations. Whereas, mineral blocks and fresh water were available as free choice with access *ad lib* of berseem hay and rice straw during the experimental trial (6 months), all drenched animals delivered into the esophagus via an esophageal feeder tube twice/weekly with adapted for 21 days while, CFM animals' daily requirements gradually changed qualitatively biweekly according to increased body weight.

Growth assay:

To estimate the ADG animals were weighed at the start of the trial for two consecutive days prior and then fortnightly in the morning before drinking and feeding. Feed intake, feed conversion and efficiency were calculated after the feeding period.

Blood sampling:

Blood samples were collected individually from jugular vein puncture in heparinized test tube from experimental animals intervals at (8 a.m.) before feeding (zero time) and then at 60, 120, 180, 240 and 480 min after treatment administrations and centrifuged for 4000 rpm× g at 15 min on 4°C to collecting plasma analyses while, a clot activator tubes allowed to remain at room temperature to determined serum insulin concentration. Samples were recovered and frozen at -20 °C for further analyses using commercial kits (Sigma Diagnostics Co.,Egypt). Plasma glucose concentrations were determined by using glucose oxidase strip method with a glucose analyzer (Bayeer, Germany), based on method of **Trinder, (1969).** Also**,** BHB concentrations estimated according to **Williamson *et al.,* (1962).** Non-esterified fatty acids concentrations (NEFA) as a modified procedure described of **Chromy *et al.,* (1977)** using a colorimetric chemical reagent enzymatic kit (Wako NEFA c KIT, Biochemical Diagnostics Inc., Edgewood, NY). Serum insulin concentrations analyzed by using an enzyme immunoassay RIA (ELISA method, kit 10-1131-01, Mercodia, Uppsala, Sweden).

Rumen fermentation:

Rumen fluid (100 ml) was collected from experimental calves at last of trial during two consecutive days and extracted at 08:00 a.m. before feeding (fasted for 16hr) at (0 time), 1, 2, 4 and 8hr post feeding by using a rubber stomach tube gentle mouth suction and rumen samples filtered immediately through four layers of surgical gauze to measure pH using (Microcomputer pH-vision Model 6007 (JENCO) following to **Jounay, (1982)** and then ruminal fluid was acidified with 1ml of sulphuric acid (300 g/L) and stored at - 20°C until further analyses. Volatile fatty acids were measured according to **Erwin *et al.,* (1961)** while**,** ammonia nitrogen concentration estimated according to **Con-way methods, (1962).** Rumen buffering capacity (their ability to resist pH change) was also determined as milli-equivalents (ME) of hydrochloric acid to require pH change of 100 ml rumen liquor to 4.5 described according to **Jasaitis *et al.,* (1987)** and the effective natural detergent fiber (eNDF) was calculated according to **Fox *et al.,* (2000).**

Feed samples and chemical analysis:

Feed samples were collected monthly and composted to chemical analyzed of dry matter (DM), ether extract (EE), crude fiber (CF),crud protein (CP), and ash while,nitrogen-free extract (NFE) calculated by the differences according to **A.O.A.C, (1996)**. Fiber fractions as Neutral detergent fiber (NDF), acid detergent lignin (ADL) and acid detergent fiber (ADF) were

carried out according to procedures of **Van Soest *et al.*, (1991)**. Cellulose calculated as= ADF-ADL and Hemicelluloses =NDF-ADF while, Non-fibrous carbohydrates (NFC) as: NFC%=OM-(%NDF+%CP+%EE) **(Calsamiglia *et al.*, 1995)** as shown in (Table 1).

Table (1): Chemical composition (%DM) and calculated experimental ration fed calves.

Items	Ingredient diet		
	CFM	Berseem Hay	Rice straw
DM	91.2	88.7	90.5
Chemical composition (%DM)			
OM	90.08	86.42	84.36
CP	13.37	14.55	2.96
CF	24.66	31.63	38.83
EE	3.2	0.7	1.23
NFE	48.85	39.54	41.34
Ash	9.92	13.58	15.64
Fiber fraction% of DM			
NDF	27.06	51.17	68.5
ADF	16.93	28.12	37.43
AD L	5.67	7.58	7.86
Hemicellulose	10.13	23.05	31.07
Cellulose	11.26	20.54	29.57
NFC	46.45	20	11.67
Feeding Value% of DM			
TDN%*	60.151	62.355	53.878
DCP% *	9.280	10.412	-0.710
DE (M Cal/kg DM)*	2.652	2.749	2.375
ME (M Cal/kg DM)*	2.229	2.327	1.949
NE (M Cal/kg DM)*	1.354	1.408	1.200

***(TDN) Total Digestible Nutrients = 129.39-0.9419(CF+NFE); Digestible Crud Protein (DCP) = 0.9596 CP-3.55; Digestible Energy (DE) = 0.04409 (TDN %); Metabolizable Energy (ME) = 1.01 (DE)-0.45; Net Energy (NE) = 0.0245 (TDN %) - 0.12 (NRC, 2005).**

Statistical analysis:

All data were statistically analyzed using the General Linear Model's procedures (GLM) of **SAS, (1999)**. Data were analyzed using one-way classification model for feeding values, body weight gain, and relative growth rate. While, rumen fermentation and blood parameters constituents were subjected using two-way analysis of variance model (ANOVA).

The significant differences between treatments were detected using Duncan's multiple Range test procedure **(Duncan, 1955).**

RESULTS AND DISCSSION

Effect of drenched glycogenic precursors on growth performance of buffalo calves:

Data in (Table 2) showed that the initial body weight was nearly similar between groups. However, average final body weight, total gain and average daily gain (ADG) were significantly higher ($P<0.05$) in calcium propionate group than the other groups. Similarly, relative growth rate (RGR) was greater in calves' drenched Ca-pr than PG and control groups (93.46 vs. 83.43 and 78.42%), respectively. ADG and RGR were higher insignificant in control group during the first three months compared with the other treatments whereas; in the last 3months of the trial Ca-pr calves group gained faster than control as a compensatory growth Fig. (1). This could be due to calves consumed in the first 3months and elevated microorganism environmental gradually by drenching Ca-pr with maximum ruminal propionate production, the finding comes in accordance with, **(Liu *et al.,* 2009**) **Parsons *et al.,* (2009)** observed that ADG was more than 0.5 kg/day in Ca-pr supplemented calves associated with increased production of ruminal propionate, as well as **Ferraro *et al*., (2009**), found that ADG increased in cattle feedlot receiving up to 10% PG in diet. These results are contradictory with those of **Hoedemaker, *et al*., (2004)** who found PG calves addition group decrease daily weight gain and DMI due to unpalatable additives in itself and mixing TMR.

Average DMI in PG (10.7 kg) and Ca-pr (10.2 kg) supplemented calves reduced numerically without significant differences compared to the control (11.1 kg) during the experimental period, therefore, the amount of TDN intake was lower in Ca-pr and PG groups than the control. This finding comes in accordance with **(Miyoshi *et al.,* 2001 and Bradford and Allen, 2007)**. **Ingvartsen and Andersen, (2000)** observed that calcium propionate reduced feed intake by 11%. On the other hand**,** either no change in feed intake was observed by **(Oba and Allen, 2003 and DeFrain *et al.,* 2005), Liu *et al.,* (2009)** found no negative effects on DM intake with Ca-propionate supplementing diets at inclusion rates (100, 200 and300 g/ day). Also, DMI has no significant difference with add dry PG reported by **(McNamara and Valdez, 2005 and Moallem *et al.,* 2007)**.

Table (2), showed that feed conversion as (DMI kg/ kg gain) decreased significantly ($P<0.05$) in Ca-pr and PG drenched groups compared with the control group (9.307 and 10.808 *vs.* 12.013 kg), respectively.

Table (2): Effect of drenched glycogenic precursors on growth performance and feed efficiency of buffalo calves (Means±SEM).

Items	Control	PG	Ca-pr
No. calves	5	5	5
Duration period (days)	180	180	180
Initial LBW (kg)	212.2 ±7.193	213.6 ±8.998	211 ±9.669
W $^{3/4}$	55.60 ±3.152	55.78 ±5.067	55.36 ±5.891
Final LBW (kg) at 180 days	378.6 ^{b} ±5.853	391.8 ^{b} ±4.139	408.2 ^{a} ±9.912
Total weight gain, kg	166.4 ^{b} ±4.760	178.2 ^{b} ±3.105	197.2 ^{a} ±4.104
Av. Daily gain (ADG), kg	0.924 ^{b} ±0.026	0.990 ^{b} ±0.017	1.096 ^{a} ±0.023
RGR* %	78.42 ±4.349	83.43 ±4.513	93.46 ±5.527
Feed intake (kg/day/head) as:			
DM	11.1 ±0.197	10.7 ±0.240	10.2 ± 0.206
TDN	8.181 ±0.067	7.781 ±0.084	7.281 ±0.095
DCP	0.678 ±0.023	0.707 ±0.020	0.742 ±0.018
Feed conversion (..... /kg BW gain)			
DM (kg)	12.013 ^{a} ±0.130	10.808 ^{b} ±0.160	9.307 ^{c} ±0.170
W $^{0.75}$ (g)	199.64 ±6.351	191.52 ±6.590	184.25 ±7.130
TDN (kg)	8.854 ^{a} ±0.032	7.860 ^{b} ±0.043	6.643 ^{c} ±0.026
DCP (kg)	0.734 ±0.043	0.714 ±0.061	0.677 ±0.059

^{a,b,c}, Means with different superscripts in the same row are significantly different(P<0.05);

RGR, relative growth rate % = daily weight gain/ initial weight gain X 100.

±SE = Standard error of least squares mean; Ca-pr=calcium propionate; PG=Propylene glycol.

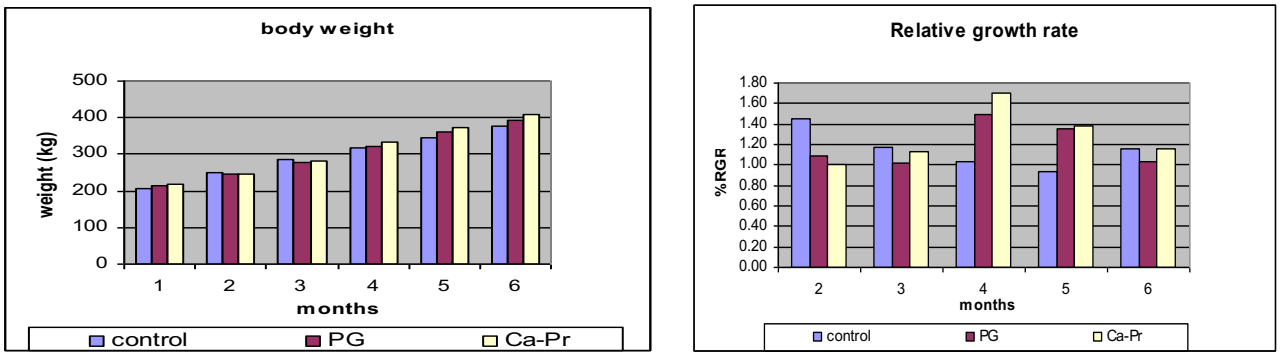

Fig (1): Body weight and relative growth rate of buffalo calves at different age months as affective treatments.

The results are in agreement with **(DeFrain *et al.*, 2005 and Richardson *et al.*, 2003**) stated that feed conversion decreased following to the inclusion of glycogenic precursors in diet. However, these results are contradictory to other studies, **Héctor *et al.*, (2012**); found that

feed intake, weight gain and feed conversion had no differences when finishing lamb fed on 10g per kg diet calcium propionate for 42 days. The variable response in food intake may be due to Ca-propionate levels and the proportions of concentrate: forage in the diet **(Liu *et al*., 2009).**

The economic evaluations of growing buffalo male calves are presented in (Table 3). Results showed that reduced daily feed cost (L.E) in Ca-pr, PG supplementation groups with rate of 3.97% (32.02 L.E) and 2.73 % (31.64 L.E) compared to the control (30.80 LE/day) while, total price of kg gain/d decreased of Ca-pr and PG groups than the control (29.22, 31.96 and 33.33 LE/day/calf), respectively therefore, Ca-pr and PG drenched groups improved the economic efficiency by 14.05 and 4.29%, respectively compared to the control.These findings are in agreement with **Héctor *et al.,* (2012**),

Table (3): Economic evaluation of growing buffalo calves fed glycogenic precursors.

Items	Control	PG	Ca-pr
Price/kg DM/d (LE)	**30.80**	**28.54**	**27.23**
DMI, h /d (kg)	**11.1**	**10.7**	**10.2**
Total feed cost /h/d (LE)	**30.80**	**31.64**	**32.02**
Daily weight gain kg/d	**0.924**	**0.990**	**1.096**
Price of kg daily gain, LE	**33.33**	**31.96**	**29.22**
Profit (LE) as total cost/calf	**0.206**	**0.239**	**0.304**
Economic efficiency, %	**126.0**	**131.4**	**143.7**
Economic efficiency, as control %	**0**	**4.29**	**14.05**

Based on the market price in 2017 of CFM=3.8 LE/kg; BH= 2.6 LE/kg; RS=0.3 LE/kg; PG= (300 mL (310 g) X 2)/7day; =35LE/L; calcium propionate (335g X 2)/7day =50LE/Kg and price of live body weight gain= 42 LE; Profit = (price of live body weight – cost of daily gain)/ price of live body weight; Economic efficiency% = (price of Daily gain –Daily feed cost/Daily feed cost) x 100 ; Ca-pr = calcium propionate; PG =Propylene glycol.

<u>Effect of drenched glycogenic precursors on rumen traits of buffalo calves:</u>

Rumen liquor parameters of calves' treatment are presented in (Table 4). Average rumen pH and calculated eNDF values were significantly lower in calves' drenched Ca-propionate than those drenched the control and propylene glycol groups, (being 5.64, 29.44% *vs*. 5.71, 30.39%

and 5.82, 36.30 %), respectively. The pH and eNDF values were the highest (P<0.05) at zero time (before feeding) and declined after 2hr then began to elevate again Fig (2).

The interaction between treatments and time of sampling was not significant for any ruminal traits. On the contrary, total rumen VFA's, NH_3-N concentrations and buffering capacity values tended to be greater (P<0.05) in calves' drenched Ca-pr than animals receiving other treatments.

NH_3-N and TVFA's concentration were elevated significantly differ (P<0.05) at 4hr post feeding and thereafter, declined gradually accordance with kinetic pH value, Fig (3). However, buffering capacity increased gradually at 8 hr post feeding. The fermentation pattern was similar to that reported with sheep fed high grain diets **(Swanson *et al.,* 2000**). The pH values had inversely relationship with ruminal VFA concentration **(Brown *et al.,* 2006)**. However, these results are contradictory with **Héctor *et al.,* (2012**) who recorded that the add Ca-pr had no effect on ruminal pH values.

The greater level of NH_3-N in Ca-pr group may be related to beneficial effects on fiber digestion, Ca soluble in ruminal concentrations and several rumen bacterial species activities particularly fibrolytic organisms **(Fellner and Spears, 2005).**

Moreover, there was insignificantly difference among groups in rumen molar proportions of propionate, acetate, butyrate and acetate to propionate ratio (Table 5). Ca-pr drenched group enhanced ruminal fermentation more than other treatments led to increase rumen total volatile fatty acids concentration, primarily of propionate and butyrate ruminal proportion so that, the lower acetate to propionate ratio was mainly due to the additional propionate provided in additives treatments **(Rigout *et al.,* 2003)**.

The results are in the same direction with those obtained by **(Trabue *et al.*, 2007)**. **Linke *et al.,* (2004)** they observed that, the administration of 1 kg glycogenic precursors as oral drenched or via rumen tube increased total rumen VFA and rumen molar proportions of propionate, but ratio of acetate to propionate decreased than control group. **Grummer *et al.,* (1994)** when add PG to heifers' diets indicating that declined ratio of acetate to propionate by PG conversion to propionate in rumen,

Table (4): Effect of drenched glycogenic precursors on rumen Liquor parameters of buffalo calves (Means±SEM).

Items	pH	eNDF%	NH_3-N (mg/100ml RL)	TVFA's (ml eq/100ml RL)	Buffering Capacity
Control	**5.71 [b] ±0.237**	**30.39 [b] ±0.81**	**30.29 [c] ±2.752**	**10.63 [c] +0.635**	**7.14 [b] ±0.182**
PG	**5.82 [a] ±0.214**	**36.30 [a] ±1.04**	**31.19 [b] ±3.513**	**10.84 [b] ±0.821**	**7.36 [a] ±0.241**
Ca-pr	**5.64 [c] ±0.245**	**29.44 [b] ±1.06**	**32.06 [a] ±3.928**	**11.07 [a] ±0.869**	**7.38 [a] ±0.270**
Sampling time (hr)					
0	**6.07 [a] ±0.108**	**38.66 [a] ±2.142**	**26.51 [e] ±0.416**	**10.01[e] ±0.152**	**8.67 [a] ±0.162**
1	**5.81 [b] ±0.101**	**33.22 [b] ±2.680**	**28.62[d] ±0.366**	**10.243[d] ±0.098**	**7.78 [b] ±0.945**
2	**5.66 [c] ±0.069**	**28.97 [c] ±1.741**	**34.02 [b] ±1.547**	**11.15 [b] ±0.419**	**6.89 [c] ±0.131**
4	**5.43[d] ±0.116**	**22.82 [d] ±0.913**	**35.80 [a] ±1.430**	**12.09 [a] ±0.272**	**6.43 [d] ±0.201**
8	**5.64 [c] ±0.098**	**26.37 [c] ±1.143**	**31.33 [c] ±0.699**	**10.75 [c] ±0.207**	**6.70 [c] ±0.143**

[a, b,c,d and e] lest square means in the same column with different superscript are significantly different(P<0.05) superscripts in the same row ; eNDF% = (pH-5.425)/0.04229 (fox *et al.* (2000).

Table (5): Effect of drenched glycogenic precursors on rumen fermentation variables of buffalo calves (Means±SEM).

Variable	control	PG	Ca-pr
Total VFA (ml eq/100ml RL)	**10.63 [c] ±0.635**	**10.84 [b] ±0.821**	**11.07 [a] ±0.869**
Individual VFA, mol/100 mol			
Acetate	**53.3 ±0.351**	**51.9 ±0.440**	**50.7 +0.573**
Propionate	**35.9 ±0.264**	**36.6 ±0.293**	**37.5 ±0.234**
Butyrate	**10.8 ±0.116**	**11.5 ±0.157**	**11.8 ±0.136**
Acetate: propionate ratio (A/P)	**1.49 ±0.027**	**1.42 ±0.025**	**1.36 ±0.029**

[a,b,c] lest square means in the same row with different superscript differ significantly (P<0.05); Ca-pr = calcium propionate; PG =Propylene glycol.

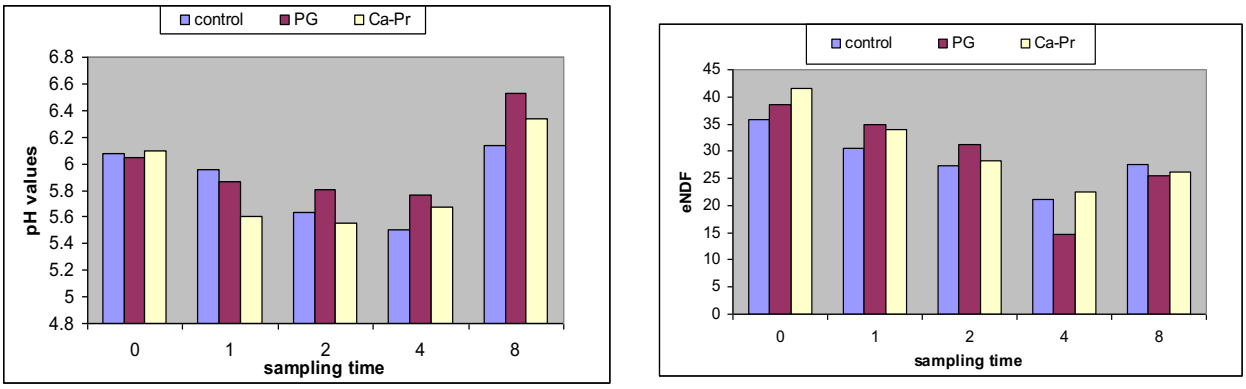

Fig.(2): Rumen pH value and eNDF% as affected by interaction between treatment and sampling time (0; 1; 2; 4; 8 hr) after feeding glycogenic precursors of buffalo calves.

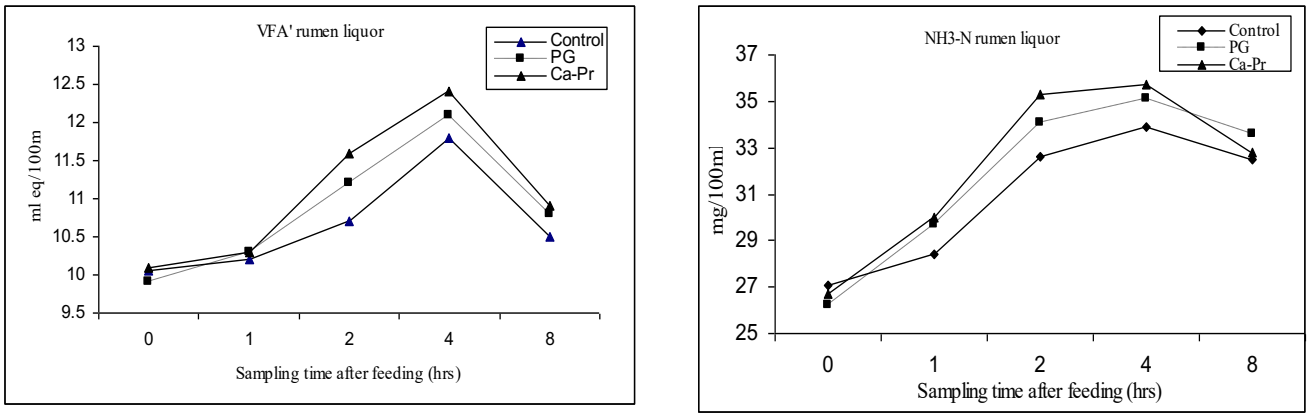

Fig (3): Rumen VFA's and NH3-N concentration as affected by interaction between treatment and sampling time (0; 1; 2; 4; 8 hr) after feeding glycogenic precursors of buffalo calves.

<u>Effect of drenched glycogenic precursors on plasma metabolites status of buffalo calves</u>.

Influences of supplementing (PG) and (Ca-pr) on blood metabolites of buffalo male calves during the experimental period are shown in (Table 6). Blood concentrations of glucose and insulin were greater (P<0.05) in calves received PG (70.78mg/dl and 48.73µg/dl) and Ca-pr (68.22mg/dl and 44.29µg/dl) when compared to their counterparts with control group (47.11mg/dl and 38.93 µg/dl), respectively Also, the ratio of glucose to insulin was greater (P<0.05) in calves drenched PG and Ca-pr groups than control group (1.54 and 1.46 *vs*. 1.21 mg/µg)). Higher serum insulin concentrations were observed during the first 1hr after PG administration calves compared with the other treatments and gradually similar among treatments at around 2hr after feeding Fig.(4). Blood glucose concentration increase numerical in propylene glycol and Ca propionate supplementation groups may be depending on animals

physiological state and energy balance; Also the insulin resistance responsible for the hypoketamic and hypolipidemic effects is probably related to blood sampling relative to the time of PG supplementation **(Klebaniuk *et al*., 2009)**. Insulin response to add PG and Ca-pr was related to available amount of propionate with sampling time and might have masked a greater response influence on pancreatic release of insulin **(Chung *et al.,* 2004)**. The elevation of concentration propionate acted to stimulate secretion of insulin hormone or might be due to glucagon release and neuro receptors **(Rigout *et al.,* 2003),** hepatic propionate removal **(Sano *et al*., 1995).**

The present results are consonant with those obtained by **(Hoedemaker *et al*., 2004; Nielsen and Ingvarsten**, **2004; Butler *et al.,* 2006; and Moallem *et al.,* 2007), Kristensen and Raun, (2007)** found that 1 kg of PG drenched cows increased significantly blood glucose and insulin with relatively decreased in NEFA and liver lipids levels. Also, plasma glucose and insulin increased rapidly by 30 min and continued to increase gradually at 90th min after drenching with propylene glycol **(Grummer *et al*., 1994 and Miyoshi *et al*., 2001).**

Table (6): Effect of supplementing glycogenic precursors on plasma metabolites of buffalo calves (Means±SEM).

Items	Glucose, mg/dl	Insulin, µg/dl	Glucose: Insulin, mg/µg	BHBA umol/L	NEFA µeq/L
Control	**47.11 ^{b} ±1.88**	**38.93 ^{b} ±1.54**	**1.21 ^{b} ±0.031**	**643 ^{a} ±47.02**	**277.78 ^{a} ±30.45**
PG	**70.78 ^{a} ±2.22**	**48.73 ^{a} ±1.32**	**1.54 ^{a} ±0.042**	**479 ^{b} ±32.25**	**271.73^{ab} ±25.07**
Ca-pr	**68.22 ^{a} ±2.70**	**44.29 ^{a} ±1.81**	**1.46 ^{a} ±0.053**	**545^{ab} ±30.11**	**247.11 ^{b} ±26.36**
Sampling time (hr)					
0	**49.05 ^{d} ±4.54**	**41.93 ^{d} ±3.18**	**1.26 ^{d} ±0.054**	**458.33 ^{c} ±57.11**	**265 ^{a} ±27.74**
1	**99.73 ^{a} ±7.02**	**68.31 ^{a} ±5.78**	**1.46 ^{a} ±0.068**	**580.00 ^{b} ±40.19**	**252 ^{b} ±18.74**
2	**76.63 ^{b} ±5.24**	**53.59 ^{b} ±3.25**	**1.43 ^{b} ±0.052**	**588.00 ^{b} ±47.32**	**236 ^{c} ±23.88**
3	**80.47 ^{b} ±6.15**	**55.12 ^{b} ±4.12**	**1.46 ^{a} ±0.044**	**616.67 ^{a} ±53.1**	**248 ^{b} ±25.96**
4	**69.14 ^{c} ±3.09**	**50.62 ^{b} ±3.54**	**1.37 ^{c} ±0.031**	**443.33 ^{c} ±34.87**	**253 ^{b} ±20.97**

$^{a, b, c, d}$ lest square means in the same column with different superscript are significantly different (P<0.05); PG= propylene glycol supplemented group, Ca-p= calcium propionate supplemented group; BHB= beta-hydroxy butyrate; NEFA= Non-esterified fatty acid.

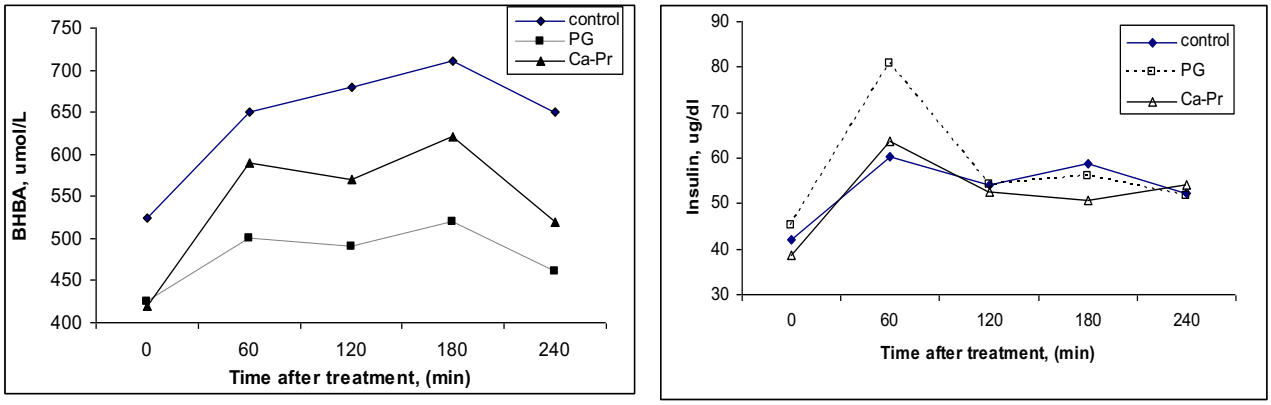

Fig. (4): Concentrations of Insulin and beta-hydroxy butyrate (BHB) for male buffalo calves drenched of propylene glycol or calcium propionate compared with control during 0, 60, 120, 180 and 240 hr after administration.

Bobe *et al.*, (2004) stated that increasing plasma glucose concentrations depends on the dosage and the mode of administration propylene glycol effectiveness.

However, these results are contradictory with **(McNamara and Valdez,2005)** propionate infusion had no impact in blood glucose, but increased insulin in cows **(DeFrain *et al.*,2005).**While, insulin resistance induced by increased glycol and propanol concentrations with decreased ratio of ketogenic and glycogenic metabolites in arterial blood plasma, **Kristensen and Raun (2007)**.

Results in (Table 6) revealed that, the overall mean in plasma ß-hydroxybutyrate (BHB) levels during the first 4hr after administration reduce incidence significant variation ($P<0.05$) between PG and Ca-pr treated groups compared with the control (479, 545 *vs*. 643 µmol/L), respectively, also PG supplementing decreased plasma BHB concentrations more than Ca-pr drenched group with over various time intervals, Fig. (4). Plasma BHB levels reduced in PG and Ca-pr groups, related to increase blood propionate concentrations and blood insulin stimulate levels that was available at the time of sampling and maintain high plasma levels for a long period as opposed to slow-release **(Kristensen and Raun, 2007). Chung *et al.*, (2004)** suggested that infusion of 650g PG into rumen decreases BHB by decreasing fat mobilization or increasing tissue BHB affinity directly via PG itself or indirectly via an endogenous PG metabolite and subsequent hepatic ketogenesis.

These results were supported in previous experiment **(Rigout *et al.* 2003 and Hoedemaker *et al.*, 2004) Liu *et al.*, (2009**) have shown PG and Ca-p supplementation increases insulin concentration and subsequent linearly decreases in NEFA and BHB plasma concentrations**.**

On the contrary, **Moallem *et al.*, (2007)** found that no significant differences in BHB concentration between the control and 500 g/d PG dry diet supplemented groups in cows. **DeFrain *et al.*, (2005)** found that, BHB plasma was not affected with feeding 0.25 lb/d propionate.

Animals receiving Ca-pr was noticeably decreased significantly differences ($P<0.05$) of NEFA levels than those receiving PG and control treatments (247.11 *vs*. 271.73 and 277.78 μeq/L), respectively. The results agree with those obtained by **(Chung *et al.*, 2004; DeFrain *et al.*, 2005 and Butler *et al.*, 2006),** Ca-pr additive rise NEFA level in blood plasma, it may be related to the inhibition of adipose acetylate cycles activity and lipolysis by elevated insulin concentration **(Juchem *et al*., 2004)**, or a result of hormonal changes stress associated and reduced dry matter intake **(McNamara *et al.*, 2003).** Propionate is anti-ketogenic and has been documented to decrease liver oxidation of NEFA **(Armentano *et al.*, 1991)**.

Nielsen and Ingvartsen, (2004) reported smaller reductions in plasma NEFA and BHBA levels when supplementing cows diets on 308 g/d PG. Insulin is a potent antilipolytic factor that reduces lipolysis in adipose tissue, thereby reducing NEFA releases from adipocytes to the liver **(West and Passey, 1967)**. Moreover, **(Moallem *et al.*, 2007 and Kristensen and Raun, 2007),** observed no differences in plasma NEFA of PG treated groups to TMR complete ration. Also, propylene glycol seemed to exert a greater effect on NEFA via insulin during extensive body fat mobilization or feed restriction **(Grummer *et al.*, 1994)**.

CONCLUSION

Calcium propionate and propylene glycol as oral drenched have a positive valuable impact on productive performance traits, BHB, NAFE and glucose concentration blood parameters in calves. Therefore, the results indicated that, the propylene glycol and Ca propionate can be used partially as a glycogenic source supplementation to effective energetic ability of buffalo calves without negative influence on health and performance.

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الاستجابة الانتاجية وقياسات الكرش والدم لاضافة مشتقات الجليكوجين للعجول الجاموسى

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الملخص العربى

اجريت هذه التجربة بهدف دراسة تاثير تجريع عجول الجاموس المصرى بالبروبيولين جليكول وبروبيونات الكالسيوم كمصدر للطاقة على الكفاءة الانتاجية وبعض تقديرات سائل الكرش وكذلك بعض القياسات البيوكيميائية للدم ,وقد تم استخدام 15عجل جاموسى بمتوسط وزن (212.27 ± 8.684 كجم وزن حى) تم تقسيمهم عشوائيا لثلاث مجاميع متماثلة على اساس وزن الجسم بكل مجموعة خمسة حيوانات , المجموعة الاولى (كونترول) تم تجريعها ب3 لتر محلول ملحى (0.9 % كلوريد صوديوم) وبدون اضافات , المجموعة الثانية تم تجريعها ب3 لتر محلول ملحى مذاب فيه 300مل بروبيولين جليكول (310 جم) , والمجموعة الثالثة تم تجريعها ب3 لتر محلول ملحى مذاب فيه 335جم بروبيونات الكالسيوم بالتجريع مرتين اسبوعيا خلال الفترة الكلية للتجربة (6 اشهر) . وتم تقدير معدل الزيادة اليومية والكلية لوزن الجسم كذلك تم تجميع عينات سائل الكرش والدم من الحيوانات لتقدير بعض القياسات. وقد اظهرت مجموعة بروبيونات الكالسيوم زيادة معنوية فى معدل الزيادة اليومية والوزن الكلى للجسم, كما زادت معدلات التحويل الغذائى (كجم مادة جافة ماكولة/ كجم زيادة فى وزن الجسم) لمجموعة بروبيونات الكالسيوم وبروبيولين الجليكول بالمقارنة بالكونترول وذلك بالرغم من عدم وجود فروق معنوية بين المجاميع فى كمية المادة الجافة الماكولة. كذلك اظهرت مجموعة بروبيونات الكالسيوم انخفاضا معنويا فى قيم حموضة الكرش وكفاءة الالياف المتعادلة بالمقارنة بالمعاملات الاخرى , وكانت تركيزت الاحماض الدهنية الطيارة الكلية وتركيزات امونيا الكرش وكفاءة منظمات الكرش مرتفعة معنويا لمجموعة بروبيونات الكالسيوم بالمقارنة ببقية المعاملات, كما اظهرت مجموعة بروبيونات الكالسيوم زيادة فى نسبة الاحماض الدهنية الطيارة خاصة البربيونات والبيوترات والنسبة بينهما ولم يكن لنسبة الاستيات اى تاثيرمعنوى نتيجة المعاملة,وكان هناك انخفاضا معنويا لمجموعة بروبيونات الكالسيوم لمستويات الNAFA بالدم, فى المقابل كان هناك انخفاض معنويا لل BHB لمجموعة البروبيولين جليكول وارتفاعا معنويا لتركيزات الجلوكوزوالانسولين والنسبة بينهما لمجموعة البروبيولين جليكول وبروبيونات الكالسيوم بالمقارنة بالكونترول. لذلك فيمكن استخدام بروبيونات الكالسيوم اوبروبيولين الجليكول بالنسب السابقة كاحد مصادرالطاقة بالغذاء وبدون اثارجانبية على العجول الجاموس.