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# Upgrading Milk Productivity of Primiparous Buffaloes Using Glycogenic Precursors; Implications on Milk Production and Blood Biochemical Parameters

Abd Elfadeel A.A. Gabr[1], Salah A. Ebrahim[1], Ashraf F.A. El-Hawary[1], Mohamed M. Fathala[2], Emad S.H. EL-Gohary[1*], Saad ElDeen M. Ahmed[1] and Magdy A. Abdel-Latif[1]
[1]Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, El-Dokki, Giza, Egypt
[2]Animal Husbandry and Animal Wealth Development, Faculty of Veterinary Medicine Alexandria University, Egypt

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## Abstract

This study was performed to explore the effect of drenching propylene glycol (PG) and calcium propionate (CP) as a source of energy to primiparous Egyptian buffalo cows (*Bubalus bubalis*) on milk production and some blood biochemical parameters. Eighteen primiparous buffalo cows (8 weeks before calving) with an average live body weight (LBW) of 500±25kg and aged 35±5 months were used. Animals were classified to three comparable groups (6, each) based on (LBW), body condition scores and expected calving date. Animals in the 1$^{st}$group served as a control (C), were drenched 3L of saline solution (NaCl 0.9%) without any additives, the animals in the 2$^{nd}$ group (PG) were drenched 300 mL of propylene glycol dissolved in 3L of a saline solution. In the 3$^{rd}$ group (CP), animals were drenched 335g of calcium propionate dissolved in 3L of a saline solution. Milk production and milk composition of primiparous buffalo cows were measured. Blood samples were collected from all buffalos for biochemical analysis. Results showed significant effects on average daily and total milk yield but no significant difference on milk composition. All blood biochemical parameters revealed no significant variation between treated and control groups except for plasma beta-hydroxy butyrate (BHB) and both $T_3$ and $T_4$ hormones concentrations. The overall mean of BHB in treated (PG) and (CP) was also lower (17.67 and 14.67 vs. 26) than control group. Overall mean of $T_3$ concentration hormone was the lowest in control group represented 3.13 vs. 5.28 and 4.99 ng/ml) for (PG) and (CP) treated group. The highest overall mean of $T_4$ concentration hormone was recorded in (CP) treated group represented 19.55 ng/ml. Concisely, the present results indicate that drenching (PG) and (CP) have a positive effect on the productive traits of primiparous Egyptian buffalo cows while, did not affect the blood biochemical parameters.

**Keywords**: Egyptian buffaloes, Milk production, Propylene glycol, Calcium propionate, Blood parameters.

## Introduction

The transition period in lactating animal is usually demarcated as the three weeks before and post-parturition. It is characterized by extreme changes in the endocrine status to conciliate parturition and lactogenesis. It is an important period that affects the health state and milk yield of lactating animals. Providing the nutritional supplies of high producing dairy animals is considered a challenge. Dry matter intake may be decreased in so far as 30% during the last week before parturition [1]. Furthermore, lactating cows frequently continue to be in a state of negative energy balance at least the first 5 weeks of lactation [2]. Negative energy balance promotes fat recruitment from adipose tissues, subsequently an increase in the levels of blood non-esterified fatty acids (NEFA) and their uptake (NEFA) by the liver. Tremendous fat mobilization surpasses the metabolizing capability of the liver, leads to great accumulation of triglyceride and formation of ketone bodies [3]. Not only, appropriate nutrition is necessary to diminish calving troubles and metabolic syndromes but also augmenting the milk yield, reproductive performance and diseases resistance.

The lactating animals reached the peak of milk production and diet consumption at 5-8 and10-14 weeks post-partum, respectively.

***Corresponding author email: (emadelgohary739@yahoo.com), Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, El-Dokki, Giza, Egypt.**

Consequently, lactating cows are usually suffering from a negative energy balance nearly for the first 6-8 weeks of the postpartum period [4-7]. This status stimulates the catabolism of body tissue to match the energy demand, leading to decrease body condition score, rumen fermentation process, milk yield and increase the risk of metabolic disorder [8]. Oral supplementation with substances that provides extra energy during this critical transition period may be helpful to control the aforementioned complaints. Propylene glycol is a glucogenic compound for ruminants. It was used in ketosis treatment since 1950 and is still used until now. Propylene glycol can quickly provide the dairy cows with the required energy because it is resonant in energy (4.7 Mcal NE/L) and easily absorbed and metabolized in the rumen. Its metabolization reached approximately 50% within 1-2h post feeding, while at 3h after feeding approximately reached 80-90% [9].

Propylene glycol may be used to diminish the negative energy balance after calving and limiting the risk of ketosis and fatty liver. It may also affect the glycogenic effect in distinctive process. Propylene glycol fraction is metabolized in the rumen and produced lactic and propionic acid that transformed to glucose through the hepatocytes [10]. Propionate plays a main glycogenic effect as a volatile fatty acid in the rumen and can reduce the BHB and non-esterified fatty acids (NEFA) during the first 2 days post-partum [11]. In the same way, PG administered orally can diminish the concentrations of NEFA and BHB [12] with raising the glucose and insulin concentrations pre-partum [13]. Calcium propionate affords a quick resource of absorbable calcium. Its propionate portion is transformed to blood glucose that will be used as an energy source. Calcium propionate considers an effective treatment for milk fever conditions (metabolic disorder) in dairy cows which characterize by hypocalcaemia, general muscular weakness and depressed consciousness [14]. Consequently, the objectives of the concurrent work were to evaluate the effect of drenching PG and CP orally (source of energy) to primiparous buffalo cows through the late gestation and early lactation periods on milk productivity and some blood biochemical parameters.

## Material and Methods

This experiment was performed at El-Gemmaiza Experimental Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture.

### *Animals and experimental groups*

A total of eighteen Egyptian primiparous buffaloes clinically free from diseases at the last 8 weeks of gestation were used in this study. The cows' average body weight was 500 ± 25 kg and aged 35±5 months. Cows were divided into three groups (6, each) based on their live body weight (LBW), body condition scores (BCS) and expected calving date [15]. Animals of the 1$^{st}$ group (control (C)) and 2$^{nd}$ group (PG) were drenched 3L of saline solution (NaCl 0.9%) without any additives and 300 mL of propylene glycol dissolved in 3 L of a saline solution, respectively. The 3$^{rd}$ group (CP) was drenched 335g of calcium propionate dissolved in 3L of saline solution [16] twice weekly through the esophagus using esophagus feeder tube to all animals. Each PG drench (300 mL) produced 4.08 mol. glucose precursors, while each CP drench (335 g) produced 81.6 g calcium and 4.08 mol. glucose precursors which gives (1.41Mcal NE/L) [9]. Animals were fed individually on concentrate feed mixture (CFM), which composed of (25% un decorticated cotton meal, 43% yellow corn, 25% wheat bran, 3.5% molasses, 2% limestone, 1% common salt and 0.5% minerals mixtures. Berseem hay and rice straw were adjusted consistent with the physiological and productive stage [17], whereas fresh water and mineral blocks were available as free choice. All animals were fed at 9a.m. and 4p.m. Chemical compositions of feed stuffs were illustrated in Table (1) based on the standard protocol [18] and the feeding values were calculated based on NRC [19].

**Table 1: Chemical composition (% on dry matter basis) of feed ingredients given to primiparous buffaloes along the period of experiment**

| Chemical analyses (% on DM basis) | Ingredients diet | | |
|---|---|---|---|
| | CFM | Hay | Rice Straw |
| **DM** | 91.20 | 86.70 | 88.40 |
| **OM** | 93.90 | 78.10 | 78.36 |
| **CP** | 15.70 | 15.50 | 2.96 |
| **CF** | 14.23 | 30.93 | 35.83 |
| **EE** | 3.13 | 2.13 | 2.23 |
| **NFE** | 60.84 | 38.54 | 37.34 |
| **Ash** | 6.10 | 12.90 | 21.64 |
| **Fiber fraction % of DM** | | | |
| **NDF** | 43.00 | 55.89 | 69.49 |
| **ADF** | 17.30 | 43.27 | 44.30 |
| **ADL** | 5.80 | 37.16 | 35.86 |
| **Feeding Value% of DM** | | | |
| **TDN %** | 58.68 | 63.96 | 60.47 |
| **DCP %** | 11.52 | 11.32 | -0.71 |
| **DE (M Cal/kgDM)*** | 2.587 | 2.820 | 2.666 |
| **ME (M Cal/kgDM)** | 2.1763 | 2.398 | 2.243 |
| **NE (M Cal/kgDM)** | 1.438 | 1.447 | 1.362 |

NFE = Nitrogen Free Extract  NDF = Neutral Detergent Fiber
ADF = Acid Detergent Fiber  ADL = Acid Detergent Lignin
Total Digestible Nutrients (TDN) = 129.39- 0.9419 (CF+ NFE);
Digestible Crude 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 (based on NRC, [19]).

### *Experimental measures and sample collection*

Daily milk yield of each animal was recorded. Representative milk sample (2X/day) were well mixed and analyzed weekly for estimating the fat %, protein %, lactose and some mineral concentrations as Ca, Pi, Na and K in milk. Blood samples were collected from jugular vein in heparinized test tubes at 28 days pre-partum, at calving and 56 days post-partum from all buffalo cows and then centrifuged at 4000 r.p.m./15m for plasma separation, and stored at -20$^{o}$C until performing biochemical analysis. Protein fractions (total protein, albumin and globulin), kidney function parameters (creatinine and urea-N), liver function enzymes (aspartate aminotransferase (AST) and alanine aminotransferase (ALT)), plasma beta-hydroxy butyrate (BHB) concentration and some minerals concentrations (Na, K, Ca and Pi) were estimated in the plasma using commercial chemical reagent kits (Sigma kit 310-A, Sigma Diagnostics). While, the plasma concentrations of triiodothyronine ($T_3$) and thyroxin ($T_4$) hormones were evaluated by the radioimmunoassay (RIA) procedure using the coated tubes kits (Diagnostic Products Corporation, Los Angeles, CA, USA).

### *Statistical analysis*

Average weekly milk yield was statistically analyzed by General Linear Model's procedures of SAS GLM [20] and the model included the effect of treatments (three levels). Means were tested using Duncan’s multiple Range test procedure [21]. Milk composition traits, blood biochemical, hormonal and mineral parameters were statistically analyzed by General Linear Model's procedures of SAS GLM [20] and the model included the effect of treatments (three levels) and sampling time (three times). Means were compared via the LSMEANS/PDIFF of the same procedure. Values were considered significant at $p \leq .05$.

**Table 2: Impact of drenching glycogenic precursors on milk yield of primiparous buffaloes during the lactation period**

| Average weekly milk yield (Kg) | Experimental groups | | |
|---|---|---|---|
| | C | PG | CP |
| **1st week** | 14.25±4.6 | 17.9±2.30 | 19.25±4.46 |
| **2nd week** | 16.50±5.20 | 21.50±4.36 | 22.75±2.056 |
| **3rd week** | 16.92±4.37 | 22.17±5.08 | 23.00±1.74 |
| **4th week** | 17.17±4.48 | 23.42±4.68 | 23.50±2.65 |
| **5th week** | 17.42±4.81 | 24.50±5.17 | 27.75±0.86 |
| **6th week** | 16.25±5.61[b] | 25.08±0.87[ab] | 28.92±1.80[a] |
| **7th week** | 15.33±5.39[b] | 25.58±4.33[ab] | 29.83±1.91[a] |
| **8th week** | 15.00±5.21[b] | 26.42±2.37[ab] | 32.15±3.29[a] |
| **Average / head /day** | 2.3±0.69[b] | 3.33±0.19[ab] | 3.70±0.19[a] |
| **Total milk yield (1st to 8th week)** | 128.33±38.88[b] | 186.58±10.5[ab] | 207.14±10.5[a] |

C = control group; PG = propylene glycol supplemented group; CP = calcium propionate supplemented group Means denoted within the same row with different letters were significant (P<0.05). Means ± standard errors.

## Results

### *Impact of drenching glycogenic precursors on milk yield of primiparous buffaloes*

Results presented in Table (2) indicated that there was no significant difference in the average weekly milk yield of primiparous buffalo cows under the current study during the lactation period except at 6th, 7th and 8th week that recoded a significant difference between the CP treated group and the control group. Moreover, the average weekly milk yield was the highest in CP group during the lactation period. The average daily milk gain was also higher in CP group (3.70kg/head) when compared with PG and control group (3.33 and 2.3 kg/head, respectively). There was a significant difference between CP treated group and the control group regarding the average and total milk yield during the lactation period.

### *Impact of drenching glycogenic precursors on milk composition of primiparous buffaloes*

Table (3) exhibited the results of drenching glycogenic precursors on milk composition of primiparous buffalo cows. It was clear that the drenching of glycogenic precursors showed no significant variation between treated and control groups regarding fat % except during the 8th week of lactation period. Protein % revealed no significant variation between treated and control groups except for PG group during 1st and 8th week (4.81 vs. 4.19 and 4.69 vs. 3.59%, respectively) and CP during the 8th week of lactation period (4.44 vs. 3.59%). On the other hand, percentages of other milk constituents as lactose, calcium, phosphorus, sodium and potassium in treated groups (PG and CP) were significantly ($P < 0.05$) higher when compared with the control group during the 1st, 4th and 8th week of lactation.

**Table 3: Impact of drenching glycogenic precursors on milk composition of primiparous buffaloes**

| Variable | Experimental group (treatment) | Lactation period | | | P value | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 4 | 8 | Treatment | Period | Interaction |
| **Fat (%)** | C | 6.08±0.31$^{a}$ | 6.63±0.19$^{ab}$ | 5.46±0.13$^{b}$ | 0.0030 | 0.0555 | 0.1018 |
| | PG | 6.28±0.25$^{a}$ | 6.24±0.30$^{b}$ | 6.26±0.26$^{a}$ | | | |
| | CP | 6.49±0.21$^{a}$ | 7.00±0.27$^{a}$ | 6.75±0.18$^{a}$ | | | |
| **Protein (%)** | C | 4.19±0.12$^{b}$ | 4.37±0.15$^{a}$ | 3.59±0.12$^{b}$ | 0.0001 | 0.0349 | 0.0038 |
| | PG | 4.81±0.09$^{a}$ | 4.58±0.14$^{a}$ | 4.69±0.06$^{a}$ | | | |
| | CP | 4.31±0.16$^{b}$ | 4.56±0.12$^{a}$ | 4.44±0.12$^{a}$ | | | |
| **Lactose (%)** | C | 4.21±0.16$^{b}$ | 4.07±0.17$^{b}$ | 4.36±0.15$^{b}$ | 0.0001 | 0.0003 | 0.0043 |
| | PG | 5.15±0.12$^{a}$ | 6.10±0.14$^{a}$ | 5.63±0.11$^{a}$ | | | |
| | CP | 5.13±0.17$^{a}$ | 5.83±0.11$^{a}$ | 5.49±0.13$^{a}$ | | | |
| **Calcium (%)** | C | 20.10±0.44$^{b}$ | 21.56±0.38$^{b}$ | 19.34±0.25$^{b}$ | 0.0001 | 0.0001 | 0.0002 |
| | PG | 23.14±0.34$^{a}$ | 24.05±0.44$^{a}$ | 24.91±0.31$^{a}$ | | | |
| | CP | 22.72±0.43$^{a}$ | 24.68±0.40$^{a}$ | 25.13±0.30$^{a}$ | | | |
| **Phosphorus (%)** | C | 32.04±0.70$^{b}$ | 34.37±0.61$^{b}$ | 30.83±0.40$^{b}$ | 0.0001 | 0.0001 | 0.0002 |
| | PG | 36.87±0.55$^{a}$ | 38.33±0.71$^{a}$ | 39.70±0.49$^{a}$ | | | |
| | CP | 36.22±0.69$^{a}$ | 39.34±0.63$^{a}$ | 40.06±0.47$^{a}$ | | | |
| **Sodium (%)** | C | 1.38±0.03$^{b}$ | 1.48±0.03$^{b}$ | 1.33±0.02$^{b}$ | 0.0001 | 0.0001 | 0.0001 |
| | PG | 1.59±0.02$^{a}$ | 1.65±0.03$^{a}$ | 1.71±0.02$^{a}$ | | | |
| | CP | 1.56±0.03$^{a}$ | 1.69±0.03$^{a}$ | 1.72±0.02$^{a}$ | | | |
| **Potassium (%)** | C | 54.93±1.2$^{b}$ | 58.92±1.04$^{b}$ | 52.84±0.68$^{b}$ | 0.0001 | 0.0001 | 0.0002 |
| | PG | 63.22±0.94$^{a}$ | 65.71±1.21$^{a}$ | 68.06±0.84$^{a}$ | | | |
| | CP | 62.09±1.18$^{a}$ | 67.45±1.09$^{a}$ | 68.67±0.81$^{a}$ | | | |

C = control group; PG = propylene glycol supplemented group; CP = calcium propionate supplemented group; Values denoted within the same column with different letters were significant (P<0.05). LS Means ± standard errors.

### *Impact of drenching glycogenic precursors on some blood parameters of primiparous buffaloes*

Regarding to the impact of drenching glycogenic precursors on immunity parameters and liver enzymes that presented in Table 4, there was no significant distinctions between treated and control groups throughout the experimental period. The overall mean estimates for total protein, albumin, globulin, AST and ALT were higher in the control group than that in the treated (PG and CP) groups. The overall mean of AST was 61.79, 58.67 and 59.89 µ/L and of ALT was 30.11 vs. 28.33 and 27.67 µ/L for control, PG and CP, respectively. The overall mean of urea and creatinine was higher in the control group when compared with the treated groups (PG and CP). Statistical results of urea and creatinine recorded no significant distinctions among treated and control groups. In contrast, results of BHB revealed a significant variation between treated and control group. The overall mean of BHB in treated groups (PG and CP) were also lower (17.67 and 14.67 mg/dL) than that in control group (26 mg/dL).

### *Impact of drenching glycogenic precursors on thyroid hormones and plasma minerals concentrations of primiparous buffaloes*

Drenching glycogenic precursors to primiparous buffalo cows during the transition period revealed a significant difference on $T_3$, $T_4$ and their ratio between treated (PG and CP) and control group (Table 5). The overall mean of $T_3$ hormone concentration was the lowest in the control group (3.13 ng/mL) when compared with the PG (5.28 ng/mL) and CP (4.99 ng/mL). The highest overall mean of $T_4$ hormone concentration was recorded in CP treated group (19.55 ng/mL). For all estimated plasma minerals, there were no significant distinction among the treated (PG and CP) and the control group. The highest overall mean estimates for calcium, phosphorous, sodium and potassium concentration in blood plasma were recorded in the control group (10.58, 6.64, 156.43 and 3.92%) when compared with the PG and CP groups (10.14 and 10.46, 6.36 and 6.57, 149.75 and 154.58 and 3.75 and 3.87%, respectively).

**Table 4: impact of drenching glycogenic precursors on protein fractions, liver enzymes, Kidney functions and BHB of primiparous buffaloes**

| Variable | Time of sampling | Experimental groups | | |
|---|---|---|---|---|
| | | C | PG | CP |
| **Protein fractions** | | | | |
| **Total protein (g/dI)** | Pre-partum | 7.84±0.40 | 7.11±0.49 | 7.34±0.45 |
| | At-birth | 7.62±0.44 | 7.64±0.43 | 7.68±0.30 |
| | Post-partum | 7.62±0.44 | 7.38±0.47 | 7.82±0.40 |
| | Overall mean | 7.70±0.22 | 7.38±0.24 | 7.61±0.21 |
| **Albumin (g/dI)** | Pre-partum | 4.21±0.25 | 4.15±0.20 | 3.91±0.26 |
| | At-birth | 4.38±0.49 | 3.96±0.27 | 4.03±0.30 |
| | Post-partum | 4.32±0.50 | 4.06±0.32 | 4.29±0.29 |
| | Overall mean | 4.30±0.22 | 4.06±0.14 | 4.08±0.15 |
| **Globulin (g/dI)** | Pre-partum | 3.63±0.28 | 2.96±0.29 | 3.43±0.28 |
| | At-birth | 3.25±0.13 | 3.68±0.26 | 3.65±0.55 |
| | Post-partum | 3.30±0.12 | 3.32±0.28 | 3.53±0.13 |
| | Overall mean | 3.39±0.11 | 3.32±0.17 | 3.54±0.19 |
| **Albumin/Globulin ratio** | Pre-partum | 1.17±0. 11 | 1.42±0.08 | 1.15±0.11 |
| | At-birth | 1.36±0.18 | 1.08±0.09 | 1.19±0.30 |
| | Post-partum | 1.32±0.18 | 1.24±0.12 | 1.22±0.06 |
| | Overall mean | 1.28±0.08 | 1.25±0.07 | 1.19±0.09 |
| **Liver functions** | | | | |
| **AST (μ/L)** | Pre-partum | 63.33±4.41 | 63.67±1.86 | 60.67±1.20 |
| | At birth | 64.33±4.10 | 56.33±6.01 | 59.00±4.36 |
| | Post-partum | 57.67±1.20 | 56.00±3.06 | 60.00±1.53 |
| | Overall mean | 61.79±2.05 | 58.67±2.37 | 59.89±1.4 |
| **ALT (μ/L)** | Pre-partum | 30.00±2.89 | 31.33±0.88 | 27.67±1.45 |
| | At birth | 31.00±2.08 | 27.00±3.51 | 28.00±1.73 |
| | Post-partum | 29.33±1.86 | 26.67±3.18 | 27.33±2.96 |
| | Overall mean | 30.11±1.18 | 28.33±1.58 | 27.67±1.08 |
| **Kidney functions** | | | | |
| **Urea-N (mg/dL)** | Pre-partum | 69.51±3.51 | 62.98±4.36 | 65.05±3.97 |
| | At birth | 67.56±3.89 | 67.73±3.78 | 68.06±2.66 |
| | Post-partum | 67.56±3.91 | 65.43±4.14 | 69.30±3.51 |
| | Overall mean | 68.21±1.92 | 65.38±2.16 | 67.47±1.82 |
| **Creatinine (mg/dL)** | Pre-partum | 0.71±0.04 | 0.64±0.05 | 0.66±0.04 |
| | At birth | 0.69±0.04 | 0.69±0.04 | 0.69±0.03 |
| | Post-partum | 0.69±0.04 | 0.67±0.04 | 0.70±0.04 |
| | Overall mean | 0.69±0.02 | 0.67±0.02 | 0.68±0.02 |
| **BHB (mg/dL)** | Pre-partum | 26.00±3.06[a] | 19.33±2.33[ab] | 14.67±2.19[b] |
| | At-calving | 26.33±4.41[a] | 18.00±2.52[ab] | 16.33±0.88[b] |
| | Post-partum | 25.67±0.67[a] | 15.67±1.67[b] | 13.00±1.15[b] |
| | Overall mean | 26.00±1.56[a] | 17.67±1.24[b] | 14.67±0.90[b] |

C = control group; PG = propylene glycol supplemented group; CP = calcium propionate supplemented group; AST = aspartate aminotransferase; ALT= alanine aminotransferase; BHB= beta-hydroxy butyrate; Values denoted within the same row with different letters were significant (P<0.05). LS Means ± standard errors.

## Discussion

### *Impact of drenching glycogenic precursors on milk yield and composition of primiparous buffaloes*

Drenching glycogenic precursors revealed a significant difference on the average daily milk yield and total milk yield during the lactation period than that in the control group; in contrast, supplementing PG did not reveal a significant difference on average of both daily and weekly milk yield and total milk yield when compared with the control group. This result was in accordance with those recorded previously [6,22-27]. They indicated that cows enhanced with PG or CP close to the parturition and/or in early lactation had either unaffected or a predisposition for increasing milk production. This may be owing to the PG supplementation reduced the feed and dry matter intake and this could also clarify the insignificant increases in milk production. Accordingly, non-significant increased of milk yield in commercial Holstein herd (multiparous cows) received a lower dose (352 g per drench) of CP as a paste delivered at parturition and again at 24 hours post-partum was observed [11]. In contrast, Stokes and Goff [27] stated that milk production of cows on a commercial dairy herd was improved by administration of PG on the first 2 days after calving. Moreover, there was no influence of adding CP on milk production but milk protein was increased (3.16% vs. 3.32%) [25,28].

The obtained values of fat %, protein % and lactose % were comparable to that recently reported of Egyptian buffaloes [5,6]. Administration of glycogenic precursors showed an improvement in the level of fat and protein percentages in milk but the variations were non-significant among the treated and the control groups. These findings were not in agreement with those reported by Liu *et al*., [26] and Nielsen and Ingvartsen [29]. They detected a significant decrease in the fat % when supplementing the dairy cows with PG. Moreover, other researchers reported that milk fat reduced linearly with the supplementation of CP [30,31]. In contrast, the obtained result come in the same direction with those obtained by DeFrain *et al*. [25], who recorded a rise of milk protein % when supplementing PG and CP, which may be due to the PG reduced the amino acid necessities for gluconeogenesis and the spared amino acids might be limiting for enhanced protein creation in the udder. Moreover, increased the energy level of the feed by drenching PG would motivate the raise of milk protein % [32]. Other milk constituents (lactose, calcium, phosphorus, sodium and potassium) in treated groups (PG and CP) were significantly higher than that in the control groups. The concurrent results were in accordance with the results of Fisher *et al*. [33], who stated that milk lactose level raised significantly by 0.2 % when early lactating animals were fed 495 g of PG/day.

**Table 5: impact of drenching glycogenic precursors on plasma hormone Levels of $T_3$ and $T_4$ and minerals concentrations of primiparous buffaloes**

| Variable | Time of sampling | Experimental groups | | |
|---|---|---|---|---|
| | | C | PG | CP |
| **Thyroid hormones** | | | | |
| **$T_3$, ng/mI** | Pre-partum | 3.36±0.36[b] | 5.08±0.53[a] | 4.80±0.16[a] |
| | At-birth | 3.09±0.22[b] | 5.36±0.38[a] | 5.02±0.11[a] |
| | Post-partum | 2.93±0.05[b] | 5.40±0.26[a] | 5.14±0.12[a] |
| | Overall mean | 3.13±0.14[b] | 5.28±0.21[a] | 4.99±0.08[a] |
| **$T_4$, ng/mI** | Pre-partum | 15.65±0.66[b] | 19.13±0.59[a] | 18.86±0.56[a] |
| | At-birth | 16.69±0.42[b] | 18.18±0.88[ab] | 19.22±0.51[a] |
| | Post-partum | 16.65±0.74[b] | 20.67±0.88[a] | 20.56±0.34[a] |
| | Overall mean | 16.33±0.36[b] | 19.53±0.49[a] | 19.55±0.35[a] |
| **$T_3$/$T_4$ ratio** | Pre-partum | 0.22±0.03 | 0.27±0.02 | 0.25±0.01 |
| | At-birth | 0.18±0.01[b] | 0.28±0.01[a] | 0.26±0.01[a] |
| | Post-partum | 0.18±0.01[b] | 0.26±0.02[a] | 0.25±0.01[a] |
| | Overall mean | 0.19±0.01[b] | 0.27±0.01[a] | 0.26±0.01[a] |
| **Mineral concentration** | | | | |
| **Calcium, mg/dL** | Pre-partum | 10.78±0.54 | 9.77±0.67 | 10.09±0.62 |
| | At birth | 10.48±0.6 | 10.51±0.58 | 10.55±0.41 |
| | Post-partum | 10.48±0.61 | 10.15±0.64 | 10.75±0.55 |
| | Overall mean | 10.58±0.3 | 10.14±0.33 | 10.46±0.28 |
| **Phosphorus, mg/dL** | Pre-partum | 6.76±0.34 | 6.13±0.42 | 6.33±0.38 |
| | At birth | 6.57±0.38 | 6.59±0.37 | 6.62±0.26 |
| | Post-partum | 6.57±0.38 | 6.37±0.40 | 6.75±0.34 |
| | Overall mean | 6.64±0.19 | 6.36±0.21 | 6.57±0.18 |
| **Sodium, mmoL/L** | Pre-partum | 159.41±8.17 | 144.07±10.08 | 149.18±8.87 |
| | At birth | 154.72±8.06 | 155.15±8.56 | 156.00±6.04 |
| | Post-partum | 155.15±8.9 | 150.04±9.8 | 158.56±8.12 |
| | Overall mean | 156.43±4.39 | 149.75±5.01 | 154.58±4.13 |
| **Potassium, mmoL/L** | Pre-partum | 3.99±0.20 | 3.60±0.25 | 3.73±0.22 |
| | At birth | 3.87±0.22 | 3.88±0.21 | 3.91±0.15 |
| | Post-partum | 3.88±0.22 | 3.75±0.25 | 3.96±0.20 |
| | Overall mean | 3.92±0.11 | 3.75±0.13 | 3.87±0.10 |

C = control group; PG = propylene glycol supplemented group; CP = calcium propionate supplemented group; $T_3$= triiodothyronine hormones; T4= thyroxin hormones; Values denoted within the same row with different letters were significant (P<0.05). LS Means ± standard errors.

### *Impact of drenching glycogenic precursors on some blood parameters of primiparous buffaloes*

Supplementing glycogenic precursors (PG and CP) revealed non-significant differences between treated and control groups of protein fractions and liver enzymes. The total protein, albumin, globulin, AST and ALT values were within the normal range, which indicated that the animals were in a normal health condition and the treatment did not affect both immunity status and liver function. The present statistical results were in accordance with those obtained by Adamski *et al*. [34] who recorded no significant difference when supplementing PG to Simmental cows pre and post-partum for total protein, albumin and ALT enzyme. Moreover, Hoedemaker *et al*. [35] reported no significant difference for AST enzyme between PG treated Holstein dairy cows and the control group during pre and post-partum period. In the same time, Klebaniuk *et al*. [36], reported that the glycogenic supplementation did not exert any significant impact on the level of ALT enzyme and total protein concentration when supplemented dairy cows with loose mixture of calcium propionate and propylene glycol at two levels (300 and 450 g/head/day) for different periods of time. In contrast, Adamski *et al*. [34] founded a significant difference for pre and post-partum activity of AST when supplementing Simmental cows with PG. As well as, Klebaniuk *et al*. [36] revealed that both the glycogenic supplementation and duration of its use had a significant influence on the reduction of AST activity in blood plasma when supplemented dairy cows with loose mixture of calcium propionate and propylene glycol at two levels (300 and 450 kg) for different periods of time.

Urea and creatinine showed no significant variations among treated and control groups. In contrast, results of BHB revealed a significant variation between treated and the control groups. The concentration of BHB in treated groups (PG and CP) was lower than that in the control group. These results were supported by the results obtained by Kristensen and Raun [37] who stated that infusion of 650g of PG into rumen reduced the plasma levels of BHB. Moreover, the plasma concentration of BHB was decreased linearly with supplementing PG and CP [26,30,38]. In the same time, Klebaniuk *et al*. [35] showed that the glycogenic supplementation did not show any significant impact on the urea concentration when supplemented dairy cows with loose mixture of calcium propionate and propylene glycol at two levels (300 and 450 g/head/day) for different periods of time. On the other hand, the concurrent results did not match with those obtained by Moallem *et al*. [39] who found no distinctions in plasma NEFA and BHB levels between the control and the PG groups. On the other hand, Ballard *et al*. [40] recorded a significant difference between animals provided with energy supplementation (beet pulp, sugar cane, propylene glycol and calcium propionate) and the control group for blood creatinine concentration.

Regarding to the values of triiodothyronine (T3) and thyroxin (T4) hormones which is considered a good indicator of thyroid gland activity, drenching glycogenic precursors (PG and CP) increased the level of T3 and T4 and these finding evidenced by an increase in feed intake and milk yield when compared with the control group. Drenching PG and CP did not change significantly the plasma minerals concentration and did not interfere with their balance in blood of primiparous buffalo cows.

## Conclusion

Orally drenching of PG and CP to primiparous Egyptian buffalo cows during the late gestation and early lactation period would have a positive influence on the productive traits (milk yield and composition) with no change on the blood parameters as, protein fractions, liver enzymes activity, kidney functions, BHB, T3, T4 and plasma minerals concentrations.

## Conflict of interest

All the authors have no conflict of interest to declare.

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## الملخص العربي

### تطوير انتاجيه اللبن في عجلات الجاموس التي تلد لأول مره باستخدام بعض مشتقات الجليكوجين، الآثار المترتبة على إنتاج الحليب وقياسات الدم البيوكيميائيه



عبد الفضيل عبد الحفيظ جبر[١] ، صلاح السيد ابراهيم[١]، أشرف فرج السعيد الهوارى[١]، محمد محمود فتح الله[٢]،عماد صلاح حسن الجوهري[١*]، سعد الدين محمد أحمد[١] ومجدى عبد الرحمن عبد اللطيف[١]

[١]معهد بحوث الانتاج الحيواني- مركز البحوث الزراعية وزاره الزراعة-الدقي- الجيزه-مصر

[٢]قسم تنمية ورعاية الثروة الحيوانية -كلية الطب البيطري –جامعة الإسكندرية



أجريت هذه التجربة بهدف دراسة تأثير التجريع بالبروبيولين جليكول و بروبيونات الكالسيوم كمصدر للطاقة لعجلات الجاموس المصري على انتاج اللبن وبعض القياسات البوكيميائيه في الدم. استخدمت ١٨ عجله جاموس (قبل ٨ أسابيع من أول ولادة) بمتوسط وزن جسم حي (٥٠٠ ± ٢٥ كجم) وبمتوسط عمر (٣٥ ± ٥ شهر). تم تقسيم الحيوانات إلى ثلاث مجموعات متماثلة (٦ في كل منها) على أساس وزن الجسم وحاله الجسم و تاريخ الولادة المتوقع . اعتبرت المجموعة الاولى هي الضابطة بدون أى معامله حيث تم تجريعها ب ٣ لتر محلول ملحى بتركيز (٠,٩ % كلوريد صوديوم) بينما في المجموعة الثانية تم تجريع العجلات ب ٣٠٠ ملى بروبيولين جليكول مذاب في ٣ لتر محلول ملحى بنفس التركيز السابق وجرعت عجلات المجموعة الثالثة ب ٣ لتر محلول ملحى بنفس التركيز مذاب بها ٣٣٥ جم بروبيونات كالسيوم. تم تقدير إنتاج الحليب وتركيبه الكيميائي وتم جمع عينات دم للتحليل. أظهرت النتائج ان التجريع كان له تأثير معنوي على متوسط انتاج اللبن اليومي وكذلك إجمالي انتاج اللبن ولم يكن له تأثير معنوي على مكونات اللبن . وأظهرت جميع القياسات البيوكيميائية للدم عدم وجود فروق معنويه بين المعاملات ومجموعه الضابطة فيما عدا بيتا هيدروكسي بيوتريت كذلك كل من هرمونات الغده الدرقية. أظهرت النتائج وجود فروق معنويه في تركيز الهيدروكسي بيوتريت بين مجموعه الضابطة و مجموعه بروبيبونات الكالسيوم ولم يكن هناك فروق معنويه بين مجموعه بروبيبونات الكالسيوم و مجموعه البروبيولين جليكول وكذلك بين مجموعة الضابطة ومجموعة البروبيولين جليكول حيث كان المتوسط العام لتركيزه منخفض في مجموعه البروبيولين جليكول وكذلك كالسيوم بروبيونات مقابل مجموعه الضابطة (١٧,٦٧ ، ١٤,٦٧ ، مقابل ٢٦ مجم/ديسيلتر. كان المتوسط العام لتركيز هرمون $T_3$ الاقل في مجموعه الضابطة ٣,١٣ مقابل ٥,٢٨ و ٤,٩٩ نانوجرام/مل لمجموعه البروبيولين جليكول والكالسيوم بروبيونات علي التوالي. كان المتوسط العام لتركيز هرمون $T_4$ هو الاعلى في المجموعة التي تم تجريعها ب كالسيوم بروبيونات ١٩,٥٥ نانوجرام/مل. والخلاصة تشير النتائج الحالية الى ان تجريع العجلات الجاموسى ببروبيبونات الكالسيوم أو بروبيولين جليكول كان له تأثير إيجابي على الصفات الإنتاجية لعجلات الجاموس المصري ولم يكن له تأثير سلبى على القياسات البيوكيميائية في الدم.