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Impact of Glucogenic Mixture Supplementation on Performance of Transition Dairy Zaraibi Does

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ABSTRACT

At 135 days of gestation, twenty Zaraibi does (42.67±1.35 kg BW) were allotted into two dietary groups of 10 each to study glucogenic supplementation impact on feed intake, some blood parameters and productive performance of transition Zaraibi goats. Animals divided according to their body weight, parity and milk production in previous season. Control does (CON) received a diet without supplementation, whereas in treated group a solid feed supplement rich in glucogenic substances, colloidal silica and organic cobalt was used namely glucogenic mixture (GM) supplementation. The GM contained mainly of three major glucogenic additives (glycerin, propylene glycol and calcium propionate). The GM was incorporated daily as a rate of 50 g/head/d. The trial period lasted for 6 weeks, (2 weeks pre-parturition and 4 weeks post-parturition). Blood samples were collected week before parturition and week post-parturition for hematological and biochemical estimations. Milk yield was measured biweekly for each doe and milk samples were taken. Results revealed that the feed intake in terms of total DM was not clearly affected as compared between GM supplementation and control groups. With supplementing does the blood triglyceride, AST, ALT, β-hydroxybutyrate and cholesterol concentrations were significantly decreased. Higher significant concentrations of glucose, insulin and thyroid hormones were detected in supplemented group. Moreover, supplementing the does with GM improved most of tested blood hematological parameters during the transition period. Additionally, heavier weights of kids at birth, at 15 and 30 d of age were obtained, as well as no kids' mortality cases were recorded by supplementing does with GM. The GM supplementation resulted in about 15.89 and 16.43 % increases in daily milk yield at 15 and 30 days of does' lactation, respectively. At 30 days of lactation, supplemented group showed significantly higher milk fat, protein, ash and total solids percentages. Furthermore, as a result of GM supplementation the economic efficiency value was noticeably higher. The results demonstrated that glucogenic mixture supplementation not only supply sufficient energy, but also improve the general health status and milk yield of dairy Zaraibi does as well as modify the composition of their milk.

Keywords: *glucogenic supplementation, glycerin, propylene glycol, calcium propionate, colloidal silica, transition Zaraibi does*

INTRODUCTION

The dairy goats during the transition period between late pregnancy and early lactation are facing a huge metabolic challenge. During late pregnancy, nutrient requirements increased for the whole gravid uterus and mammary gland development (Rezaei *et al.,* 2016). At post-parturition period, the energy output in the form of milk yield exceeding energy intake, thus animals are in a negative energy balance with variations according to the management adopted for the animal. Therefore, several nutritional management strategies are required to improve the adaptation of transition dairy animals by providing more nutrients and energy supply sources.

Accordingly, because of the rising costs of energy-rich feedstuffs, alternatives energy sources have become a major focus for the livestock industry (Chanjula *et al.,* 2014). Although a range of alternative energy supplements to animals diets has been extensively investigated (Cieslak *et al.,* 2015; Szczechowiak *et al.,* 2016), an ongoing research focused on way that may manage the negative energy balance at post-parturition is required (Kuhla *et al.,* 2016). The energy supplements may contribute to reducing metabolic disturbances during the transition period, depending on their type and administration period (Klebaniuk *et al.,* 2016). Therefore, the attention is given to the impact of supplementing animals diets with different alternatives energy sources on their metabolism and performance, as well as on milk yield and composition (Klebaniuk *et al.,* 2016).

In this regard, the dairy livestock industry utilizes the glucogenic supplements to improve animals' energy balance, consequently productive and reproductive performance (Matras *et al.,* 2012; Mesilati-Stahy *et al.,* 2015; Porcu *et al.,* 2017). Generally, several studies on ruminant animals concluded that the glucogenic precursors as energy supplementations or as diets corn replacements have some positive effectiveness on feed intake, nutrients digestibility, carcass characteristics and meat quality as well as productive and reproductive performance of lactating animals (Carvalho *et al.,* 2011; Matras *et al.,* 2012; Omazic 2013; Kafilzadeh *et al.,* 2015; Khattab 2015; Porcu *et al.,* 2017). However, each of glucogenic precursors, such as glycerol (Syahniar *et al.,* 2016; White *et al.,* 2016), propylene glycol (Khattab 2015; Mesilati-Stahy *et al.,* 2015), glycerin (Chanjula *et al.,* 2014; Kafilzadeh *et al.,* 2015) and calcium salts of propionate (Liu *et al.,* 2010; Sanchez *et al.,* 2014), has a different route for conversion to glucose and causing a rapid and sustained rise of blood glucose.

However, there is little information available regarding the glucogenic supplementation influence on transition dairy goats. Therefore, the study aimed to investigate the impact of glucogenic mixture supplementation on feed intake, blood hematological and biochemical parameters, productive performance, milk yield and composition as well as economic efficiency during transition period of Zaraibi does.

MATERIALS AND METHODS

This study was conducted at El-Serw Experimental Research Station belongs to Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture and Animal Production Department, Faculty of Agriculture, Mansoura University, Egypt.

At 135 days of gestation, twenty Zaraibi does (42.67±1.35 kg BW) were randomly allotted into two dietary groups of 10 each. Animals divided according to their body weight, parity and milk production in previous season (high yielding, over 1.50 kg/h/d milk during suckling period). Control does (CON) received a diet without supplementation, whereas in treated group a solid feed supplement rich in glucogenic substances, colloidal silica and organic cobalt was used namely glucogenic mixture (GM) supplementation. The GM contained mainly of three major glycogen additives (glycerin, propylene glycol and calcium propionate) as shown in Table 1. The GM supplementation was provided by Norel-Misr Company of animal nutrition and animal health products. The GM supplementation was incorporated daily in a small amount of ground concentrate of each doe at a rate of 50 g/h/d, to study its effect on feed intake, some blood hematological and biochemical parameters as well as productive performance of transition Zaraibi does. The trial period lasted for 6 weeks, (2 weeks pre-parturition and 4 weeks post-parturition).

Table 1. Chemical composition (%) of feed stuffs consumed by transition Zaraibi does.

	Chemical composition	
	Concentrate Feed Mixture, CFM	Whole Corn Silage, WCS
DM	91.05	35.00
OM	93.95	91.71
CF	15.93	29.50
CP	15.50	9.55
EE	3.35	3.21
NFE	59.17	49.45
Ash	6.05	8.29

DM: dry matter, OM: organic matter; CF: crude fiber; CP; crude protein; EE: either extract and NEF: nitrogen free extract.

Amount of concentrate and roughage fed were based on feed allowance of NRC (1981) for lactating goats. The daily amount of concentrate feed mixture (CFM) and roughage as whole corn silage (WCS) were offered at 60:40 ratio. The CFM was consisted of 25% un-decorticated cotton seed meal, yellow corn (43%), wheat bran (25%), molasses (3.5%), limestone (2%), common salt (1%) and minerals mixture (0.5%). The chemical composition of feedstuffs is presented in Table 2. Diets were offered twice daily in the morning (8:00 am) and evening (3:00 pm) with free access to fresh water. Proximate chemical analysis of the feedstuffs was carried out according to A.O.A.C (1995).

Table 2. Ingredients and composition of glucogenic mixture.

Ingredient	1 kg glucogenic
Glycerin, g	200
Propylene glycol, g	200
Calcium Propionate, g	300
Colloidal Silica, g	289.98
Niacin, g	10
Cobalt Carbonate, g	0.02

Animals were weighted at the beginning of the experimental period and biweekly thereafter. Changes of live body weight were recorded individually for each doe and their born kids. Litter size (fetus/doe), kidding rate (litter size x 100) were calculated. Economic efficiency was also calculated, as total output/input according to the current local prices at the end of year 2016.

Blood samples were collected through the jugular vein just week before parturition and week post-parturition from 4 does of each group. Whole blood was immediately used for hematological estimation. Another blood samples were centrifuged at 4000 rpm for 20 minutes, separated serum was used for enzymes determination, while the remained part was frozen at -20°C until other biochemical analysis. All blood parameters concentrations were determined using appropriate commercial kits. Hematological analyses including hemoglobin (Hb), red blood cells (RBCs), hematocrit (Hct), mean cell hemoglobin (MCH), mean cell hemoglobin concentration (MCHC), mean cell volume (MCV), white blood cells (WBCs), neutrophils, lymphocytes, monocytes and platelets count were conducted on the heparinized samples. The serum samples used to determine the concentrations of total protein, albumin, globulin, blood urea nitrogen, calcium, phosphorus, magnesium, triglycerides, β-hydroxybutyrate, cholesterol, glucose and insulin. The serum activity of aspartate aminotransferase (AST) and alkaline phosphatase (ALP) is also measured. Moreover, serum samples were assayed for triiodthyronine (T3) and thyroxine (T4) hormones concentrations using radioimmunoassay (RIA) technique.

Milk yield was measured biweekly by hand milking and milk yield was recorded for each doe. Milk samples (about 0.5% of total milk produced) were taken biweekly for each doe, at both milking time. The average amount of residual milk after kids suckling was measured daily and sold. Composite samples were analyzed for contents of total solid (TS) and protein according to procedures of Ling (1963). Fat content was determined by using Lactoscan. The equation express milk production in terms of 4% fat-corrected milk (FCM) for goat: FCMg=Milk(0.411+0.147fat) (Mavrogenis and Papachristoforou, 1988). Somatic cell count's, pH value and acidity % in milk was measured. Lactose was determined according to Barnett and Abd El-Tawab (1957). Ash content was determined as reported in A.O.A.C. (1995).

The data were analyzed according to statistical analysis system using the General linear Model (SAS, 2014) for complete randomized design. Differences among means were carried out by using Duncan multiple range test method (Duncan, 1955).

RESULTS

The effects of glucogenic mixture supplementation on average daily feed intake during pre-parturition and post-parturition periods are presented in Table (3). The feed intakes in terms of total DM intake (% BW and g/kg BW0.75) were not clearly affected as compared between control and tested diet. The average total DM intakes during the pre-parturition and post-parturition periods were numerically higher in glucogenic mixture supplemented group. While, it remains unclear whether the increased total DM intakes were due to either the mechanism influence or the amount of dietary glucogenic mixture supplementation or both.

Generally, after parturition for both groups (Table 4), almost all the biochemical parameters observed significant decline ($p<0.05$), except for total protein, calcium, glucose and insulin concentrations that increased significantly. However, with supplementing does diet with GM at pre-parturition and post-parturition periods, the blood triglyceride, AST, ALT, β-hydroxybutyrate (BHBA) and cholesterol concentrations were significantly decreased ($p<0.05$). By contrast, higher significant ($p<0.05$) concentrations of glucose, insulin, T3 and T4 were detected in supplemented group with comparison to control group. Ultimately, the glucogenic mixture supplementation effect on does' serum biochemical parameters was remained steady across transition period.

Table 3. Effect of glucogenic mixture supplementation (GMS) on average daily dry matter (DM) intake (mean±SE) of Zaraibi does.

Items	Pre-parturition		Post-parturition	
	CON	GMS	CON	GMS
Daily DM intake (g/d)				
Concentrate feed mixture (CFM)	731	740	981	997
Whole Corn silage (WCS)	495	501	665	676
Glucogenic mixture (GM)	-	50	-	50
Total DM intake, g	1226	1291	1646	1723
DM intake, % BW	2.86	2.97	4.79	4.92
DM intake, g/kg $^{0.75}$	73.19	76.35	115.92	119.57

Table 4. Effect of glucogenic mixture supplementation (GMS) on serum biochemical parameters (mean±SE) of Zaribi does.

Treatments	Pre-parturition		Post-parturition	
	CON	GMS	CON	GMS
Total protein, g/dl	7.05±0.065^{b}	7.13±0.063^{b}	7.28±0.048^{a}	7.40±0.058^{a}
Albumin, g/dl	3.70±0.041	3.75±0.048	3.78±0.042	3.83±0.041
Globulin, g/dl	3.35±0.072	3.40±0.075	3.45±0.071	3.51±0.068
Urea-N, mg/dl	43.25±0.750	43.00±0.913	44.25±0.707	44.00±0.629
Triglyceride, ml/dl	51.00±0.742^{a}	48.75±0.645^{b}	41.75±0.754^{c}	40.00±0.577^{d}
AST, μl	93.25±0.586^{a}	90.00±0.586^{b}	91.50±0.586^{ab}	87.75±0.586^{c}
ALT, μl	25.00±0.315^{a}	22.75±0.315^{b}	21.50±0.315^{c}	19.50±0.315^{d}
Calcium, mg/dl	8.10±0.065^{b}	8.20±0.071^{b}	9.53±0.066^{a}	9.50±0.075^{a}
Phosphorus, mg/dl	5.18±0.091^{a}	5.25±0.065^{a}	4.45±0.084^{b}	4.60±0.073^{b}
Manganese, mg/dl	2.81±0.17	2.80±0.16	2.84±0.11	2.85±0.11
β-hydroxybutyrate (BHBA)	0.55±0.014^{a}	0.49±0.015^{b}	0.51±0.017^{b}	0.47±0.019^{c}
Glucose, mg/dl	57.75±0.629^{d}	61.00±0.650^{c}	64.25±0.661^{b}	66.00±0.645^{a}
Cholesterol, mg/dl	94.00±0.804^{a}	92.15±0.754^{b}	80.50±0.750^{c}	73.75±0.726^{d}
Insulin, mg/dI	6.25±0.089^{d}	6.90±0.077^{c}	7.58±0.087^{b}	8.60±0.082^{a}
T3-hormone	156.2±0.845^{b}	158.0±0.823^{a}	86.0±0.710^{d}	89.00±0.816^{c}
T4-hormone	7.20±0.053^{b}	7.35±0.049^{a}	6.45±0.065^{d}	6.73±0.063^{c}

a-d: Means in the same row with different superscripts are significantly different at p<0.05

The results in Table (5) summarized the blood hematological variables in Zaribi does during the transition period as affected by glucogenic mixture supplementation. At pre-parturition period, the blood hematological concentrations of Hb, RBC's, Hct, MCH, MCHC and lymphocytes were increased significantly ($p<0.05$) by supplementing goats' diets with the glucogenic mixture. In contrast, the WBC and neutrophils concentrations were significantly decreased, compared with control group. Generally, supplementing the does diets with glucogenic mixture resulted in significant improvement in most of tested blood hematological parameters during the transition period.

Table 5. Effect of glucogenic mixture supplementation (GMS) on blood hematological parameters (mean±SE) of Zaribi does.

Treatments	Pre-parturition		Post-parturition	
	CON	GMS	CON	GMS
Hemoglobin (Hb), g/dl	9.90±0.071^{d}	10.28±0.048^{c}	10.98±0.048^{b}	11.35±0.065^{a}
Red blood cell (RBC's), 10^6/μl	12.60±0.087^{d}	13.08±0.087^{c}	13.35±0.087^{b}	13.68±0.087^{a}
Hematocrit (Hct), %	32.40±0.177^{b}	33.05±0.167^{a}	32.90±0.173^{b}	33.45±0.171^{a}
Cell hemoglobin (MCH), pg	6.35±0.073^{d}	6.53±0.071^{c}	6.80±0.072^{b}	6.96±0.074^{a}
Cell hemoglobin conc. (MCHC), %	30.33±0.093^{d}	31.05±0.092^{c}	33.30±0.098^{b}	33.98±0.095^{a}
Cell value (MCV), fl	20.53±0.193^{b}	20.70±0.191^{b}	20.90±0.192^{b}	21.70±0.193^{a}
White blood cells (WBC), 10^3/μl	14.33±0.063^{a}	13.65±0.064^{b}	13.60±0.065^{b}	13.03±0.063^{c}
Neutrophils, %	23.56±0.394^{a}	22.28±0.497^{b}	23.36±0.568^{a}	21.30±0.738^{b}
Lymphocytes, %	57.60±0.916^{c}	61.44±0.454^{b}	61.75±0.488^{b}	64.87±0.566^{a}
Monocytes, %	19.08±0.372^{a}	18.68±0.456^{a}	16.13±0.414^{b}	16.12±0.299^{b}
Platelets count, x10^3/μl	479.0±4.937^{b}	488.8±5.543^{b}	499.0±4.301^{a}	496.5±4.052^{a}

a-d: Means in the same row with different superscripts are significantly different at p<0.05

Milk yield, composition and quality at 15 and 30 days of lactation are presented in Table (6). In general, does fed on glucogenic mixture supplementation had significantly higher ($p<0.05$) daily milk yield compared with control group. There were an improvement by about 15.89 and 16.43 % in daily milk yield at 15 and 30 days of lactation, respectively, as a result of does' glucogenic mixture supplementation. At 15 days of lactation, there were no significant differences between studied groups for milk composition concentrations, somatic cell counts, pH and acidity values. Whereas, at 30 days of lactation, the milk fat, protein, ash and total solids percentages were significantly increased ($p<0.05$) by supplementing dairy does with GMS.

Table 6. Effect of glucogenic mixture supplementation (GMS) on milk yield and milk composition (mean±SE) at 15 and 30 days of Zaraibi does lactation.

	15 day		30 day	
Treatments	**CON**	**GMS**	**CON**	**GMS**
Milk yield, kg/h/d	1.80±0.089^b	2.14±0.065^a	1.73±0.067^b	2.07±0.092^a
Milk corrected fat, kg/h/d	1.66±0.078^b	1.93±0.055^a	1.59±0.055^b	1.85±0.072^a
Fat, %	3.40±0.033^a	3.42±0.020^a	3.31±0.038^b	3.43±0.026^a
Protein, %	2.96±0.032^a	2.91±0.072^a	2.87±0.037^b	3.02±0.043^a
Lactose, %	4.62±0.088	4.74±0.034	4.66±0.038	4.75±0.035
Ash, %	0.71±0.002^b	0.71±0.003^b	0.71±0.003^b	0.72±0.003^a
Total solids, (TS), %	11.69±0.087^b	11.78±0.076^b	11.55±0.068^b	11.92±0.072^a
Solids non fat, (SNF), %	8.29±0.171	8.35±0.118	8.25±0.063	8.48±0.082
Somatic cell count's, x10^3	538.2±18.67	515.0±17.51	516.2±18.47	500.0±18.13
pH value	6.63±0.011	6.65±0.011	6.64±0.008	6.65±0.009
Acidity	0.163±0.001	0.165±0.001	0.164±0.001	0.166±0.001

a-b: Means in the same row with different superscripts are significantly different at p<0.05

The effects of glucogenic mixture supplementation on productive performance of transition Zaraibi does are summarized in Tables (7). Results presented no significant differences were observed in transition Zaraibi does live body weights at any tested intervals. The does initial weight was approximately equal and increased to the maximum before parturition then sharply decreased to the minimum at day 30 post-parturition in both studied groups. However, results indicated that the glucogenic mixture supplementation during the last two weeks of does pregnancy and four weeks post-parturition afford significantly (p<0.05) heavier weights of kids at birth, at 15 and 30 d of age. Likewise, the kids average daily body gain and total body gain increased significantly (p<0.05) by does supplementation. As for kids mortality cases, results cleared that no mortality cases recorded for the supplemented transition does compared with control group. Accordingly, does' productive performance output (as kilograms kids produced per doe) was improved by glucogenic mixture supplementation.

Table 7. Effect of glucogenic mixture supplementation (GMS) on productive parameters of Zaraibi does.

	Groups	
	CON	**GMS**
Initial does weight at 135 d of pregnancy, kg	42.30±1.25	42.85 ±1.14
Does weight at 150 d of pregnancy, kg	44.90±1.32	46.05 ±1.22
Does weight at kidding, kg	35.35 ±1.09	35.85 ±0.97
Does weight at 15 d post-parturition, kg	34.25 ±1.03	35.1 ± 0.88
Does weight at 30 d post-parturition, kg	33.40±1.03	34.25 ±1.03
Born kids	23	23
Still birth	2	-
Alive kids at 0 day	21	23
Alive kids at 15 days	20	23
Alive kids at 30 days	19	23
Litter size, %	2.3	2.3
Kidding rate, %	230	230
Mortality of kids, No	2	-
Mortality of kids, %	9.52	-
Average kids birth weight, kg	1.95±0.156^b	2.31±0.052^a
Kids weight at 15 d, kg	3.74±0.343^b	4.50±0.156^a
Kids weight at 30 d, kg	4.91±0.514^b	5.90±0.194^a
Kids total body gain, kg	2.96±0.333^b	3.59±0.177^a
Kids average daily body gain, g	98.7±0.13^b	119.7±0.14^a
Kg of kids at 30 d/doe	9.33	13.58

a-b: Means in the same row with different superscripts are significantly different at p<0.05

Table (8) illustrated the effect of glucogenic mixture supplementation on economic efficiency of transition Zraibi does. The cost of consumed feed increased in supplemented group compared with the control group. However, the corresponding values of glucogenic mixture supplementation return (as price of kilograms kids produced per doe and price of sold milk) were greatly increased. Thus, the economic efficiency value as a result of glucogenic mixture supplementation was noticeably higher in comparison to control group. Generally, the high economic efficiency of supplemented group was due to the high total gain and no mortality cases recorded for kids in one hand, and the high does' milk production obtained in the other hand (Table 6, 7).

Table 8. Effect of glucogenic mixture supplementation (GMS) on economic efficiency of Zaraibi does.

	Groups	
	CON	**GMS**
No. of does	10	10
No. of alive kids at 30 d	19	23
Kg of kids at 30 d/doe, kg	9.33	13.58
Price of kg kids/ doe, LE	373.2	543.2
Average sold milk/d/doe, kg	-	0.219
Price of total sold milk/doe, LE	-	58.80
Cost of consumed feed/doe, LE	163.09	201.68
Economic efficiency, %	2.29	2.98

The prevailing prices, per kg, at time of the study were 3.80 LE-CFM, 0.35 LE-WCS and 18 LE-GHP. The selling prices were 40 LE/kg live body weight and 8.95 LE/kg milk.

DISCUSSION

The transition period in goats has received very little attention, unlike the transition period in cattle. However, the effect of transition period on a few metabolic parameters, including hormones, glucose and lipids, has been reported in goats (Skotnicka *et al.,* 2011; Tharwat *et al.,* 2015). While, unfortunately, very little literatures were available discussing the effects of glucogenic supplements on feed intake, hematological and biochemical status, milk production and composition as well as productive performance in dairy Zaraibi does, although it was extremely studied with dairy cattle.

The both groups of does in the present experiment were submitted to good nutritional management during the transition period. This can be demonstrated from the no obvious effects of glucogenic mixture supplementation regarding DM intake. Similar results were reported in goats (Chanjula *et al.,* 2014), lambs (Gunn *et al.,* 2010; Avila-Stagno *et al.,* 2013), buffalos (Hussein *et al.,* 2015) and dairy cows (Lomander *et al.,* 2012; Omazic *et al.,* 2013; Wilbert *et al.,* 2013; Kafilzadeh *et al.,* 2015). While, other studies reported that using glycerol with dairy cows resulted in either an increase (Kass *et al.,* 2012) or a reduction in DM intake (Boyd *et al.,* 2013). However, the use of glycerol, propylene glycol and calcium propionate as glucogenic mixture precursors is based on *in vivo* and *in vitro* studies reporting that the supplementation increased the ruminal propionic concentration (Chanjula *et al.,* 2014; Sanchez *et al.,* 2014; Mesilati-Stahy *et al.,* 2015; Syahniar *et al.,* 2016; Yao *et al.,* 2017). Post-absorption, the elevated propionate increases plasma glucose concentration, which has also been shown to lead to concomitant increases in blood insulin and reduced BHBA concentrations (Mesilati-Stahy *et al.,* 2015).

In this aspect, the present results obtained low concentrations of BHBA and high concentrations of glucose in glucogenic mixture supplemented dairy does during the transition period. These results could be as indicator that goats were not suffered from subclinical ketosis, and were in a normal energy status. Thereafter, this may be the possible reason for no deleterious effects on feed intake or the metabolism of the goats (Chanjula *et al.,* 2014). However, similar results as those revealed in the present study were found, whereas the glucogenic dietary inclusion decreasing plasma triglyceride and β-hydroxybutyrate concentrations (Mulliniks *et al.,* 2011; Husseni *et al.,* 2015; Klebaniuk *et al.,* 2016; Porcu *et al.,* 2017), while increasing plasma glucose and insulin concentrations (Husseni *et al.,* 2015; Kafilzadeh *et al.,* 2015; Porcu *et al.,* 2017). Besides, as detected herein, all data concerning liver enzymes suggested that glucogenic supplementation has the ability to reduce AST and ALT values and in consequence reduced liver lesions (Bros *et al.,* 2014; Husseni *et al.,* 2015).

While, the present study confirming the significant decrease in triglyceride, β-hydroxybutyrate, cholesterol, AST and ALT concentrations from one hand and increase in glucose and insulin to the other, also showed that the increases in thyroid hormones (T3 and T4) concentrations found in supplemented does were greater than the control group. In this way, a positive relationship between energy intake and the thyroid hormones concentration was also reported by Zanouny (2011) and Kassab and Hamdon (2014). Partially, thyroid hormones are in close contact with carbohydrate, fat, protein and energy metabolism, thus they play a major role in animal performance (Kassab and Hamdon, 2014). Additionally, cholesterol synthesis is being regulated by thyroid hormones along with cholesterol receptors, and the cholesterol degradation rate (Medrano *et al.,* 2016). Furthermore, T3 and T4 encourage the enrichment of insulin-dependent entry of glucose into cells and increased production of new and free glucose (Medrano *et al.,* 2016). Consequently, the thyroid hormones have fundamental role in the milk glands development and the control of milk production. Generally, the significance variations obtained herein in the haematological and biochemical indices are realistic reflection of glucogenic mixture supplementation important for the general health status.

In the present study, results showed that the does' milk yield increased significantly with the glucogenic mixture supplementation. Such effect could be attributed to that glucogenic mixture supplementation increased the energy for milk production. However, supplementation showed no significant differences in milk components at 15 d of lactation, while milk fat, protein, ash and total solids percentages were increased significantly at 30 d of lactation. Similarly, Lomander *et al.* (2012), Matras *et al.* (2012), Omazic *et al.* (2013) and Husseni *et al.* (2015) reported an increase in milk production when dairy animals were fed glucogenic additives. Conversely, other studies in which dry glycerol was fed to dairy cows during early lactation reported no significant effects on milk yield and components (Carvalho *et al.,* 2011; Kass *et al.,* 2012; Wilbert *et al.,* 2013; Bros *et al.,* 2014; Kafilzadeh *et al.,* 2015). Generally, in the present study, the increased milk yield and composition without subsequent increase in BHBA concentrations might indicate that the glucogenic supplementation improved the metabolic status (Husseni *et al.,* 2015).

Additionally, present results cleared that glucogenic supplementation afford significantly heavier weights of kids at birth, at 15 and 30 d of age, with no mortality cases recorded during the experimental period compared with control group. Accordingly, glucogenic mixture supplementation established high economic efficiency, due to the improved does' productive performance output (as kilograms kids produced per doe) and the high milk production obtained.

Generally, the glucogenic supplementation results obtained in present study regarding the effects on plasma compounds, the increased milk yield and no differences observed in does body weight during the experimental period. Taken together, these results indicate that there were improvements in the does' mobilizations of body reserves and in negative energy balance by supplementation. This improvement may be explained by the way that glucogenic mixture supplementation is a good source of energy. Moreover, the beneficial effects of the used glucogenic mixture on tested parameters could be a result of combination treatment of major components (glycerin, propylene glycol, calcium propionate and colloidal silica).

CONCLUSION

In conclusion, supplementation transition Zaraibi does diets with 50 g/h/d of glucogenic mixture did not affect DM intake, but tended to improve metabolic status. The glucogenic mixture supplementation not only supply sufficient energy but also plays a pivotal role in health maintenance, enhancement milk yield and modifies milk composition. Generally, the glucogenic mixture supplementation could be recommended for dairy managers as an interesting nutritional management strategy for improve the economic efficiency of transition dairy goats.

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تأثير إضافة مخلوط جليكوجيني على أداء العنزات الزرايبي الحلابة خلال المرحلة الإنتقالية

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اجريت هذه الدراسة على 20 عنزة زرايبي عند عمر 135 يوم من الحمل وذلك لدراسة تأثير تدعيم العليقة بمخلوط من المواد الجليكوجينية (جلسرين ، بروبلين جليكول ، كالسيوم بروبيونيت) بالاضافة لسليكا غروية و كوبلت عضوي على كمية المأكول والأداء الإنتاجي وبعض خصائص الدم. قسمت العنزات إلى مجموعتين من حيث وزن الجسم وموسم الحلابة و إنتاج اللبن في الموسم السابق لبداية التجربة. كانت فترة التجربة ستة أسابيع (اسبوعين قبل الولادة وأربعة اسابيع بعد الولادة). جمعت عينات الدم من العنزات قبل وبعد الولادة بأسبوع لتقدير تركيزات مكونات الدم المختلفة. تم تقدير كمية اللبن وأخذ العينة من كل عنزة عند 15 يوم و 30 يوم من الولادة. أوضحت النتائج أنه لا يوجد تأثير ملموس لإضافة مخلوط الجليكوجين على كمية المادة الجافة المأكولة. اشارت النتائج انه إضافة مخلوط الجليكوجين خلال الفترة قبل وبعد الولادة ادى إلى وجود انخفاض معنوي في تركيزات الدهون الثلاثية وانزيمات الكبد AST , ALT والبيتا هيدروكسي بيوتيريت والكوليسترول. بينما زاد تركيز كلاً من الجلوكوز والانسولين وهرمونات الثيروكسين ، بالإضافة لتحسن في بعض مكونات الدم الأخرى التي تم دراستها مع انخفاض معنوي في تركيز كرات الدم البيضاء. أظهرت الدراسة أيضاً أن وزن الجداء المولودة للعنزات التي تم تدعيمها بالمخلوط كانت أثقل وزناً عند الميلاد وعند 15 يوم و 30 يوم من الميلاد مع عدم تسجيل حالات نفوق في الجداء خلال فترة التجربة وذلك مقارنة بنظيرتها في المجموعة الأخرى الغير مدعمة بالمخلوط. أدت إضافة المخلوط للعنزات إلى تحسن في انتاج اللبن اليومي بمعدل 15.86 و 16.43% عند 15 يوم و 30 يوم من موسم الولادة ، على التوالي. سجلت إضافة المخلوط كذلك زيادة معنوية في تركيز نسبة الدهن والبروتين والرماد والمواد الصلبة الكلية في اللبن عند 30 يوم من الولادة. أوضحت النتائج ارتفاع قيمة الكفاءة الإقتصادية نتيجة لإستخدام مخلوط الجليكوجين في تغذية العنزات. يستخلص من الدراسة إلى أن استخدام مخلوط الجليكوجين مع العنزات الزرايبي الحلابة خلال الفترة الإنتقالية لم يكن فقط داعماً للعنزات بمصدر جيد للطاقة ولكن أيضاً لوحظ تحسن في الحالة الصحية للحيوانات وزيادة في إنتاج اللبن ومكوناته.