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Growth Rate, Some Plasma Biochemical and Amino Acid Concentrations of Barki Lambs Fed Ground Date Palm at Siwa Oasis, Egypt

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Abstract: The study was designed to evaluate the effect of partial substitution of ground yellow corn (GYC) in concentrate feed mixture (CFM) with ground date palm (GDP) at 50% level weight by weight, as cheaper energy source, on live body weight (LBW), thyroid activity and some plasma biochemical parameters of eighteen weaned male Barki lambs that were raised under Siwa Oasis conditions. Lambs were 100-120 days of age with average body weight 20.96±1.31 kg. Experimental lambs were allocated into two groups (9 in each), the first group served as control while the other served as the treated one. The study lasted 244 days during the period of April till December. Live body weight (LBW) was recorded monthly. In plasma, glucose, amino acids (AA) profile, ALT and AST enzymes, thyroid hormones (T_3 and T_4), total plasma proteins (TP) and plasma urea nitrogen (PUN) were determined monthly. The results indicated that, lambs fed diet containing GDP in CFM had lower ($P<0.01$) mean final body weight than control ones being 52.39 vs. 58.13 kg. The corresponding averages of daily gain were 129.67 vs. 151.15 g/d, respectively. As expected, the inclusion of GDP in CFM increased ($P<0.01$) plasma glucose concentration to be in average for the whole experimental period 63.80 mg/dl in treated lambs while was only 58.46 mg/dl in control ones. Plasma glucose level increased with advancing age and increasing live body weight in both control and treated groups, but the rate of change was 7.96 and 20.76% for control and treated groups, respectively. The value of alanine amino transferase and aspartate amino transferase might be considered normal and had little relationship with treatment. Results indicated that inclusion of GDP in CFM while caused little increase in final average of TP concentration, it resulted in significant decrease in PUN. There was a positive correlation between thyroid hormones (T_3 and T_4) and both the age of animal and body weight gain ($P<0.01$). However, treatment was found to have no effect on thyroid activity. The results revealed that plasma total essential amino acids (TEAA), total non-essential amino acids (TNEAA) and total amino acids (TAA) were higher ($P<0.01$) for treated lambs than control ones. These trends were clear during the med and end of experimental period. The differences recorded were 23.37, 28.5 and 26.25% at med period and were 15.62, 16.42 and 15.95% at end of experimental period. The effect of treatment was maximized at med and end of experimental period on some individual AA, like valine, leucine, phenylalanine, lysine, proline, glutamic and alanine.

Key words: Barki lambs · Date palm · Live body weight · Thyroid hormones · Liver function · Plasma glucose and amino acids

INTRODUCTION

Date waste contains carbohydrates and minerals and is a good source of energy, thus it may be possible to use date waste as an energy source for ruminants. The value of energy in the diet and the source of energy affect the animal's feed conversion efficiency [1]. Date fruit can provide 2.67 Mcal/kg of digestible energy. In comparison, barley provides 3.06 Mcal/kg of digestible energy. Dates contain approximately 78.5% dry matter, 2.2% crude protein, 0.5% fat, 2.3% crude fiber, 72.9% carbohydrate and 1.9% ash, So it can supply 87% of

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the digestible energy provided by the same unit of traditional grain feed [2]. The analysis of amino acids composition by HPLC instrument showed that the date palm extract contains a high concentration of Aspartic acid, Proline, Glycine, Histidine, Valine, Leucine and Arginine, but low concentration of Therionine, Serine, Methionine, Isoleucine, Tyrosine, Phenylalanine and Lysine and very low concentration of Alanine [3].

In addition, dates contain fat comprising 14 types of fatty acids [4]. The flesh of date contains 0.2-0.5% oil, where the seeds contain 7.7-9.7% oil. Unsaturated fatty acids include Palmitoleic, Oleic, Linoleic and Linolenic acids were found. The Oleic acid content of the seeds varies from 41.1 to 58.8% which suggest that the seeds and date could be used as a source of Oleic acid [5]. El-Nakhal *et al*. [4] stated that dates contain 15 types of salts and minerals, protein with 23 different amino acids, six vitamins and a high percentage of dietary fiber. Al-Dobaib *et al*. [6] stated that discarded dates are characterized by having high total digestible nutrients and being palatable for livestock. Feeding Sudanese desert lambs on 5 and 10% of date pits for 45 day period give a good animal performance as well as it had a lower cost [7].

Thus, the present study performed to evaluate the effect of partial substitution (50%, weight/weight) level of ground yellow corn (GYC) with ground date palm (GDP) in concentrate feed mixture (CFM) on live body weight, plasma metabolites profile and thyroid activity of male Barki lambs at Siwa Oasis, Egypt.

MATERIALS AND METHODS

Study Site: This study was performed at Siwa Research Station (Tegzerty Experimental Farm for Animal Production) which belongs to Desert Research Center (DRC), Egypt, during the period of April till December (244days). Geographically, Siwa Oasis lies between longitudes 25°16′ and 26 ° 12′ E and latitudes 29°06′ and 29°24′ N. It lies 330 km southwest of the Mediterranean shoreline and at 65 km east of Libyan borders. Siwa Oasis is characterized by desert climate.

Management and Experimental Design: Eighteen of weaned (100-120 days of age) male lambs of Barki breed with average live body weight (LBW) of 20.96±1.31 kg, were used. The animals were divided into two main groups (9 in each). Animals were separated in two sheltered enclosures and fed in group feeding system. The first group served as control group (C) and fed basal diet consisting of concentrate feed mixture (CFM), plus berseem hay (Alfalfa). The second group served as treated one (T) and fed date palm incorporated in CFM in addition to berseem hay. In Siwa Oasis, one of the date palm varieties (*Phoenix dactelyfera* L.) namely Azzawi is classified as unfit for human consumption or in the nutritional industries. It was used in feeding farm animals (sheep, goat, cattle and donkeys). Azzawi date was sun dried and given to the animals in intact form or crushed (with the seeds). In the present study, dried Azzawi date was ground and used in partial replacement (50%, weight/weight) of ground yellow corn (GYC) in CFM to be fed for treated group. Rations were prepared monthly for both control and treated groups and kept in containers made of jute-sack (50kg capacity). The two types of CFM contained essential nutrients recommended for growing lambs [8] and their compositions are shown in Table 1. The nutritional requirements were adjusted monthly according to Kearl [9]. Drinking water was offered *ad lib* twice daily. Control and treated groups were offered their type of CFM allowance in two parts at 09:00 a.m. and 04:00 p.m. daily.

Table 1: The composition of experimental CFM for male Barki lambs during the study period

Ingredients (%)	Control	Treated
Ground yellow corn	59.6	29.8
Ground dates	0.0	29.8
Cotton seed meal	21.5	21.5
Wheat bran	15.7	15.7
Limestone	1.3	1.3
Sodium chloride	1.3	1.3
Mineral mixture	0.6	0.6

Table 2: Chemical analysis (%) of experimental rations

Nutrients	C	T	hay
Dry matter (DM)	93.21	92.84	88.8
Organic matter (OM)	92.41	91.09	--
Crude protein (CP)	16.14	13.66	17.5
Ether extract (EE)	5.26	3.78	1.38
Crude fiber (CF)	7.92	8.91	28.2
Ash	7.59	8.91	11.61

C = control group T = treated group

Rations Chemical Composition: Composite feedstuffs samples were taken and undergone proximate analysis according to the methods of A.O.A.C [10]. The chemical analysis showed that Azzawi date contained 92.81 DM, 90.24 OM, 7.19 CP, 6.65 EE, 4.56 CF and 2.67 ashes. Data in Table 2 showed mean chemical analysis of the two types of rations.

Live Body Weight: Weaning weight (WW) was recorded for all lambs at the commencement of the study, then monthly animals were weighed to the nearest 100 gm and body weight gain (expressed in grams per head per day) was calculated.

Blood Collection and Biochemical Analysis: Blood samples were collected monthly via jugular venipuncture into 10ml test tubes contained potassium oxalate and sodium fluoride. Plasma samples were obtained by centrifugation at 3500 rpm for 20 min within an hour of collection. Plasma was stored at - 20 C until chemical analysis. For metabolites assay, total plasma proteins (TP, g/dl), plasma glucose (GLU, mg/dl), plasma urea nitrogen (PUN, mg/dl), alanine amino transferase (ALT, u/l) and aspartate amino transferase (AST, u/l) activities were analyzed using available kits supplied by bio Me'ricux-france. The amino acids were obtained by acid hydrolysis and determined by the method of Spackman *et al*. [11] using a Beckman 119 CL amino acid analyzer. The data were computed automatically [12]. Plasma amino acids were determined on the initial, med. (at 4 months) and end (at 8 months) of experimental period. Five plasma samples from each experimental group were intended to hormonal assay. The concentration of triiodothyronine (T_3, ng/ml) and thyroxin (T_4, µg/ml) in plasma were determined monthly according to Barker and Silverton [13] by using commercial kits supplied by Monobind Inc.

Veterinary Care: Throughout the experimental period, animals proved to be free from internal and external parasites. All animals were kept under close clinical observation and were not exposed to either stresses or pathogens.

Statistical Analysis: Data was statistically analyzed using Completely Randomized Design Model (CRD) procedure by SAS [14]. Duncan's multiple range tests was used to determine the significance of differences between treatments means [15].

RESULTS AND DISCUSSION

Live Body Weight: Data presented in Table 3 summarizes the mean values ± SE of live body weight (LBW, kg) at respective age, total gain (TG, kg) and the average daily gain (ADG, g/h/d) for control and treated groups of male Barki lambs throughout the study period (244 days). The results showed that the average LBW at the beginning was 21.17±1.93 and 20.75±2.07 and reached to 58.13±2.82 and 52.39±3.57 at the end of study for control and treated groups, respectively. Accordingly, the computed ADG in LBW was 151.15 and 129.67g/h/d for control and treated groups, respectively. This result indicated that, control group was the better in TG and ADG compared with treated group. These results are not in line with a number of previous studies reported by Alhomidy *et al*. [16], Almitairy *et al*. [17], Al-Dabeeb [18] and El-Gasim *et al.* [19] this may be due to the difference in diet characteristics (Table 2). For example; the crude protein (CP) of the diet offered to control group was higher compared with the diet offered to treated group (16.14 vs. 13.66%). This reduce in CP of diet given to treated group was due to reduce of CP for GDP (7.91%) compared with CP for GYC (9.10%). The results indicated that the below level of crude protein in treated diets was no obstacle to improve the weight gain in treated group during the experimental period.

Another reason for this difference may be due to the difference in initial weight (weaning weight) between control and treated groups with around 420 grams. This difference in initial body weight resulted significant (P<0.01) increase with around 5.32 kg and 21.48 g/h/d in TG and ADG, respectively for control group compared with treated group. Therefore, the difference in monthly gain of LBW remained lower for treated group than control group throughout the experimental period (Table 3). Similar results for body weight at weaning were reported by Fehr [20], Ugur *et al*. [21] and Memisi *et al*. [22] who found that, kids weaned with higher weights did not show any halt of growth after weaning, while the weight gain of the lightest lambs lagged considerably.

Table 3: Means ± SE of live body weight (LBW) changes for male Barki lambs fed GDP in CFM at Siwa Oasis

	LBW (kg)		
Age	C	T	The difference, kg
4 months	21.17±1.93 ^{b}	20.75±2.07 ^{b}	0.420**
5 months	28.36±2.37^{a}	26.58±2.57^{b}	1.780**
6 months	33.06±2.72^{b}	32.89±2.78^{b}	0.170
7 months	39.33±3.31^{a}	36.69±2.84^{b}	2.64**
8 months	43.83±3.43^{a}	41.89±2.83^{b}	1.94**
9 months	46.78±3.40^{a}	44.17±2.53^{b}	2.61**
10 months	50.22±3.65^{a}	46.50±2.53^{b}	3.72**
11 months	53.50±4.26^{a}	48.72±2.89^{b}	4.78**
12 months	58.13±2.82^{a}	52.39±3.57^{b}	5.74**
TG,kg	36.96^{a}	31.64^{b}	5.32**
ADG, g/d	151.15^{a}	129.67^{b}	21.48**

C = control group; T = treated group, TG = total gain, ADG = average daily gain $^{a-b}$: Values marked with different letters in raw are significantly different (^{a}= P<0.01). ** =P<0.01 between C and T, GDP = ground date palm, CFM = concentrate feed mixture

Previous studies, Alhomidy *et al*. [16], Al-Dabeeb [18], El-Gasim *et al*. [19], Richter and Becker [23], Shubre [24], Al-Ani *et al*. [25], Hemeidan *et al*. [26] and Al-Yousef *et al*. [27] reported that, the inclusion of 11% and 35% discarded dates in the fattening ration of lambs and 20% and 60% dates in the feed of young camels [28] did not negatively affect animal health or productivity in sheep. Al-Dabeeb [18] replaced 10% and 20% of the concentrate of Najdi lamb diets with discarded dated and significant differences in the body weight of the lambs were not observed. The discrepancies between the results obtained in the present study and those reported in previous studies may be attributed to differences in the proportion of dates, varieties of dates and/or the individual components of feed concentrates in the diets used, as well as to differences in the breed of animals used and in the duration of study.

Thyroid Gland Activity: The main hormones secreted by the thyroid gland are Thyroxin (T_4) and Triiodothyronine (T_3). These hormones have a versatile role in regulation of tissue differentiation, basal metabolic rate via the metabolism of carbohydrates, lipids and proteins [29]. As a result, thyroid hormones are among the important factors that have great impacts on metabolism and growth. The means ± SE of plasma T_3 and T_4 concentrations throughout the experimental period are presented in Table 4. The results indicated that plasma T_3 and T_4 concentration began with similar values, being 1.38±0.29 vs. 1.26±0.32 ng/ml for T_3 and 5.46±0.44 vs. 4.94±0.45 µg/ml for T_4 in control and treated groups, respectively. Concentrations of both hormones were within the range of published values for mammals [30, 31]. The rate of change from start to the end of experimental period (Table 4) in T_3 concentration was 31.88 and 32.05% for control and treated groups, respectively. The corresponding values for T_4 were 17.95 and 20.65%, respectively. This increase in T_3 might be due to the deiodination of T_4 into T_3 which would have an additive effect on T_3 concentrations. These results are in accordance with Whisnant *et al*. [32] who found that higher serum T_3 concentrations are proportionally positive with growth in lambs. Time course changes in plasma T_3 and T_4 concentrations of control and treated groups are shown in Figures 1 and 2 and indicated that T_3 concentration peaked at the eleventh month of age (November) with average 2.7±0.58 ng/ml for control group, while treated group had a bi-phase pattern with peaks at the seventh and eleventh (July and November) months of age (2.46±0.46 and 2.36±0.32 ng/ml, respectively).

Table 4: Means ± SE of triiodothyronine (T_3, ng/ml) and thyroxin (T_4, µg/ml) concentrations for male Barki lambs fed GDP in CFM at Siwa Oasis

	Hormone concentration			
	T_3 (ng/ml)		T_4 (µg/ml)	
Age	C	T	C	T
4 months	1.38±0.29^b	1.26±0.32^b	5.46±0.44^b	4.94±0.45^b
5 months	1.2±0.18^b	1.18±0.22^b	5.6±0.37^a	4.68±1.01^b
6 months	1.5±0.39^a	1.14±0.23^b	4.64±0.39^b	4.9±0.48^b
7 months	1.58±0.30^b	2.46±0.46^a	5.34±0.87^b	6.3±0.54^a
8 months	1.5±0.14^b	2.24±0.75^a	9.8±0.71^a	9.38±1.65^a
9 months	1.66±0.33^a	1.32±0.18^b	3.36±0.30^c	4.08±0.50^b
10 months	2.4±0.19^a	2.3±0.48^a	4.76±0.19^b	5.1±0.19^a
11 months	2.7±0.58^a	2.36±0.32^a	7.6±0.60^a	7.48±0.20^a
12 months	1.82±0.09^a	1.76±0.40^a	6.44±0.39^a	5.96±0.46^a
Change %	31.88^b	32.05^b	17.95^b	20.65^a

C = control group; T = treated group; $^{a-c}$: Values marked with different letters in raw are significantly different (^{a} =P<0.05). GDP = ground date palm, CFM = concentrate feed mixture

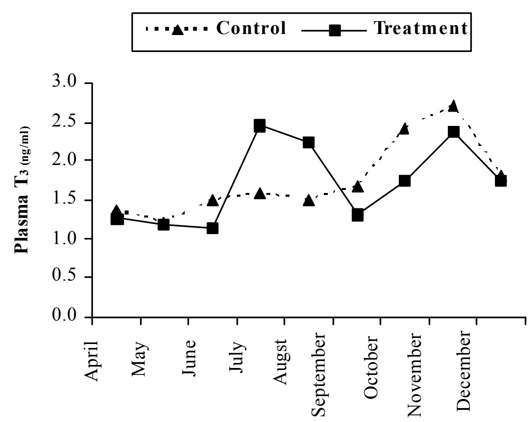

Fig. 1: Effect of partial replacement of CDP in CFM on plasma T_3 concentration of male Barki lambs at Siwa Oasis

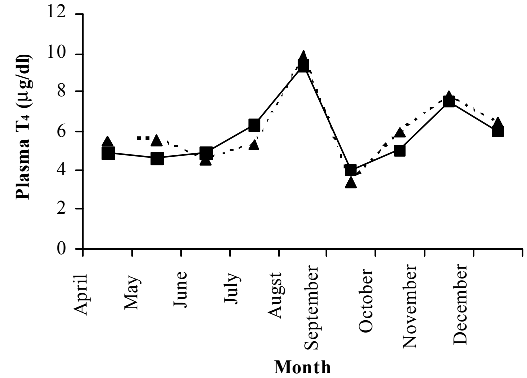

Fig. 2: Effect of partial replacement of CDP in CFM on plasma T_4 concentration of male Barki lambs at Siwa Oasis

Plasma T_4 concentration peaked at the same age (eight months, August) with similar values (9.8±0.71 and 9.38±1.65 µg/ml) for control and treated groups, respectively.

From these results, there was a positive correlation between thyroid hormones (T_3 and T_4) and both the age of animal and body weight gain (P<0.01). Similar results were reported by Mousa and Al-Saiady [30] who found that there was a positive correlation between thyroid hormones levels in serum and body weight during the growing period of Somali camels fed different levels of commercial feeds and in sheep [33].

Plasma Glucose Concentration (GLU, mg/dl): The mean values ± SE for plasma glucose concentration for control and treated groups presented in Table 5. Regardless the effect of treatment, time course changes in plasma concentrations of GLU was found to reduce abruptly after one month (May) from the beginning of study for control and treated groups, then began to rapidly increase in both groups till the end of experimental period (244 days). This result is in agreement with those obtained by El-Barody *et al*. [34] who reported that plasma GLU level increased with the increases in live body weight during the months from birth to maturity in lambs. Also, Kempton and Leng [35] found that glucose entry rates that associated with higher plasma glucose concentration were linearly related to the rate of body weight gain in growing lambs. Occasionally, the same trend was found in thyroid hormones (Table 4).

Concerning the effect of treatment, the treated group had higher (P<0.01) increase along the experimental period in plasma GLU concentration compared with control one. The rate of change was 7.96 and 20.76% for control and treated groups, respectively. Many researchers reported that the differences in diet composition could affect blood glucose levels [36, 37, 38]. Inclusion of GDP which rich in carbohydrates in treated lambs' diet increased circulating glucose, which in turn could be expected to increase releasing of insulin hormone and inhibiting the release of glucagons from the pancreas gland [39]. Characteristic effects of insulin are stimulation of uptake and utilization of glucose by peripheral tissues; inhibition of gluconeogenesis and glucose release by the liver and stimulation of uptake and incorporation of amino acids into protein [40]. Thus, increasing plasma GLU (either by infusion or after-rumen fermentation to propionate and subsequent propionate conversion to glucose after absorption) could be expected to increase the release of insulin (anabolic hormone) for amino acid transport into tissues.

Table 5: Means ± SE of plasma glucose concentration, (GLU, mg/dl) for male Barki lambs fed GDP in CFM at Siwa Oasis

	GLU (mg/dl)	
Age	C	T
4 months	56.52±1.29^a	53.36±2.97^b
5 months	48.03±1.86^b	51.57±0.90^a
6 months	62.43±1.32^b	66.37±1.03^a
7 months	57.11±0.96^b	62.48±0.90^a
8 months	57.69±2.44^b	63.36±1.28^a
9 months	62.81±2.16^b	72.42±2.53^a
10 months	61.11±1.59^b	65.70±2.32^a
11 months	59.44±3.18^b	74.47±0.79^a
12 months	61.02±0.93^b	64.44±0.90^a
Group mean	58.46±1.51	63.80±2.53**

C = control group; T = treated group, ** =P<0.01 between C and T ^{a,b}: values marked with different letters in raw are significantly different (^{a} =P<0.05). GDP = ground date palm, CFM = concentrate feed mixture

Table 6: Means ± SE of plasma total proteins (TP, g/dl) and plasma urea nitrogen (PUN, mg/dl) concentrations for male Barki lambs fed GDP in CFM at Siwa Oasis

	TP (g/dl)		PUN (mg/dl)	
Age	C	T	C	T
4 months	8.84±0.60^b	9.56±0.65^a	40.75±3.50^b	43.75±1.64^a
5 months	8.06±0.43^b	7.98±0.35^b	57.87±1.39^b	58.77±1.31^b
6 months	7.33±0.22^b	7.34±0.14^b	50.75±1.53^b	49.73±1.99^b
7 months	6.63±0.53^b	6.73±0.16^b	53.41±1.12^b	53.45±1.56^b
8 months	8.94±0.46^b	8.98±0.35^b	54.49±3.85^b	54.94±5.06^b
9 months	8.76±0.24^b	8.92±0.25^b	46.44±4.07^a	40.57±1.98^b
10 months	8.27±0.24^b	8.77±0.30^b	39.91±3.71^a	38.04±3.81^b
11 months	8.32±0.28^b	8.68±0.19^b	40.82±4.70^a	33.60±1.79^b
12 months	8.99±0.36^b	8.96±0.08^b	58.46±2.73^a	51.51±3.75^b
Group mean	8.24±0.27	8.43±0.30^{NS}	49.21±2.48**	47.15±2.84

C = control group; T = treated group, GDP = ground date palm, CFM = concentrate feed mixture ^{a,b}: Values marked with different letters in raw are significantly different (^{a} =P<0.05) ** =P<0.01 between C and T

Total Plasma Proteins (TP) and Plasma Urea Nitrogen (PUN): Table 6 summarizes the means ± SE of plasma total proteins (TP, g/dl) and plasma urea nitrogen (PUN, mg/dl) concentrations during the study period. The results revealed that, plasma TP decreased (P<0.01) in both control and treated groups from weaning age (4 months) to 7 months of age and increased (P<0.01) at 8 months of age then remained unchanged till the end of experimental period. Treatment did not have any effect on TP. Treated lambs were able to maintain their plasma TP concentration similar to those of control lambs from the 8^{th} month of age till the end of experimental period (Table 6). This result suggests the occurrence of adaptation process in rumen to the tested diet. Regarding, the effect of treatment on PUN, the results presented in Table 6 indicated that initial concentrations of PUN established

Table 7: Means ± S.E of alanine amino transferase (ALT, u/l) and aspartate amino transferase (AST, u/l) concentrations for male Barki lambs fed GDP in CFM at Siwa Oasis

	Liver function enzymes			
	ALT (u/l)		AST (u/l)	
Age	C	T	C	T
4 months	4.35±0.21[b]	6.42±0.65[a]	10.67±1.65[b]	15.90±0.39[a]
5 months	5.03±0.57[b]	5.24±0.68[b]	7.78±0.27[b]	8.94±0.44[a]
6 months	4.34±0.16[b]	4.23±0.16[b]	7.31±0.15[b]	7.89±0.38[a]
7 months	4.18±0.09[b]	4.04±0.04[b]	10.03±0.59[a]	8.79±0.54[b]
8 months	4.57±0.24[b]	4.73±0.25[b]	10.93±1.05[b]	11.39±1.22[a]
9 months	5.55±0.59[b]	7.77±1.02[a]	11.44±1.67[b]	15.60±1.86[a]
10 months	5.08±0.45[b]	5.55±0.25[a]	10.82±0.46[b]	14.19±0.97[a]
11 months	4.05±0.04[b]	5.23±0.57[a]	14.43±1.00[b]	19.38±1.39[a]
12 months	4.36±0.15[b]	4.27±0.13[b]	12.49±1.04[a]	10.85±0.46[b]
Group mean	4.55±0.16	5.28±0.40**	10.66±0.69	12.55±1.23**

C = control group; T = treated group, ** =P<0.01 between C and T [a,b]: Values marked with different letters in raw are significantly different ([a]=P<0.05). GDP = ground date palm, CFM = concentrate feed mixture

40.75±3.50 and 43.75±1.64 mg/dl for control and treated groups, respectively. However, at the end of experimental period treated lambs had lower (P<0.05) value of PUN. The rate of change in PUN along the experimental period was 43.46 and 17.74% for control and treated groups respectively. In spite of that the values of PUN were within the normal range of sheep as reported by Radostitis *et al*. [41]. Plasma urea nitrogen induced by the increase in the conversion of ammonia into urea in the liver. Changes in serum urea concentration reflect the changes in dietary nitrogen and dietary protein utilization [42]. Serum urea concentration is a good indicator of protein status in sheep [43]. Accordingly, the present results of PUN being within the normal values signified the good ability of treated ration to supply the protein requirements for lambs.

Liver Enzymes Activity: The results obtained in Table 7 shows the liver function through ALT and AST values. The overall means of the whole period showed highly significant (P<0.01) increase in both enzymes for treated lambs. Oni *et al*. [44] mentioned that liver enzymes are known to be higher in the blood when the nutrient intake is low. However, the obtained results were congruent with the reference values given by Jerry *et al*. [45], Daramola *et al*. [46] and Tambuwal *et al.* [47]. The pattern of changes in the value of alanine amino transferase (ALT) and aspartate amino transferase (AST) might be considered normal and had little relations with the animal health particularly liver function as stated by Kaneko [48]. Accordingly, inclusion of CDP in CFM did not affect the activities of ALT and AST and subsequently on liver function of growing lambs.

Plasma Individual Amino Acids Profile: In veterinary medicine the free amino acids concentrations were used to detect deficiencies and excesses of dietary amino acids. Table 8 shows means ± SE of essential (EAA, µmol/dl), non-essential (NEAA, µmol/dl) amino acids and total amino acids (TAA, µmol/dl) concentrations for lambs fed GDP in CFM at Siwa Oasis. The results stated that, overall EAA, NEAA and TAA concentrations at the initiation of the experimental period were similar between control and treated groups. The results indicated that the absorption of amino acids in plasma apparently was proceeding rapidly at med and the end of experimental period.

Concerning the effect of treatment on individual AA, like valine, leucine, phenylalanine and lysine (EAA), proline, glutamic and alanine (NEAA) for treated group were maximized at med and the end of experimental period compared with control group. Therefore, there were highly (P<0.01) significant effect due to treatment and treatment x period interactions on EAA and NEAA.

Plasma individual amino acids pattern reflected amino acid composition of the treated diet. These results are in agreement with those obtained by Nordstrom *et al*. [49]. Previous studies performed by Dean and Scott [50] and Longennecker and Hause [51] had established the relationship between plasma amino acid concentrations and weight gain or growth rate. Two explanations are possible for these large differences between control and treated groups in overall EAA, NEAA and TAA concentrations at med and the end of experimental period. Firstly, treated group might were fed ration containing high levels of available amino acids for absorption from the small intestine, or secondly, these differences were probably due to a greater availability of energy in forms of glucose and fructose which is faster in absorption from the alimentary tract to be used for amino acid utilization. Therefore, it could be concluded that GDP had strong effect (P<0.01) on plasma EAA, NEAA and TAA concentrations. In contrast, Bergin *et al.* [52] reported that in ruminants, plasma amino acid patterns can not be directly related to the dietary amino acid content because of ruminal fermentation and microbial protein re-synthesis. Accordingly, assessment of protein status using plasma amino acid as the sole parameter appears fruitless in ruminants under normal circumstances. Moreover, Goetsch *et al*. [53] stated that arterial levels of essential amino acids influenced by interacting factors of amino

Table 8: Means ± SE of essential (EAA); non-essential (NEAA) and total amino acids (TAA) concentrations (µmol/dl) for male Barki lambs fed GDP in CFM at Siwa Oasis

	Time of experimental period					
	Initial (4months)		Med.(8months)		End (12months)	
Amino acid	C	T	C	T	C	T
			Essential amino acids (EAA)			
Valine	26.31±1.78^a	25.33±1.33^b	36.11±1.67^b	39.09±1.98^a	37.33±1.66^b	39.91±1.68^a
Methionine	4.97±1.08^a	3.93±1.06^b	4.71±1.07^a	3.82±1.08^b	4.51±1.06^b	4.91±0.98^b
Leucine	7.97±1.33^b	9.38±1.45^a	13.91±1.66^b	15.76±1.73^a	14.21±1.77^b	16.92±1.74^a
Histidine	3.57±0.78^b	4.1±0.96^a	4.3±0.99^b	4.60±0.78^b	4.9±0.89^b	5.99±0.78^a
Threonine	3.69±1.28^b	4.93±1.13^a	5.33±1.41^b	5.84±1.38^b	5.29±1.36^b	5.93±1.44^a
Phenylalanine	4.11±1.18^b	3.71±1.06^b	6.77±1.33^b	8.54±1.78^a	7.22±1.27^b	10.05±1.29^a
Lysine	6.61±1.02^a	5.9±1.01^b	9.36±1.21^b	10.55±1.18^a	9.94±1.22^b	12.72±1.48^a
Total EAA	57.23	57.28^{NS}	71.49	88.20**	83.40	96.43**
Difference	0.05		16.71 (23.37%)		13.03 (15.62%)	
			Non essential amino acids (NEAA)			
Aspartic	5.41±0.77^a	4.91±0.98^b	7.21±1.04^b	8.10±1.07^a	7.22±1.01^b	8.40±1.07^a
Glutamic	10.33±1.37^a	9.84±1.01^b	13.26±1.14^b	17.10±1.16^a	14.24±1.33^b	18.26±1.77^a
Serine	4.19±1.07^b	5.9±1.02^a	6.14±1.31^b	7.16±1.77^a	6.33±1.12^b	7.15±1.05^a
Arginine	13.25±1.14^b	12.96±1.31^b	21.33±1.81^b	31.5±2.17^a	UEL	UEL
Glycine	13.98±1.77^a	12.22±1.09^b	16.33±1.93^b	24.±1.57^a	UEL	UEL
Alanine	4.98±1.47^b	4.76±1.33^b	8.97±1.67^b	9.09±1.77^a	13.96±1.82^b	15.69±1.97^a
Proline	6.55±1.37^b	6.72±1.66^b	9.13±1.87^b	10.76±1.97^a	9.33±1.44^b	10.68±1.77^a
Tyrosine	4.53±1.77^b	4.63±1.43^b	6.96±1.24^b	7.12±1.37^a	8.13±1.43^b	8.75±1.77^a
Total NEAA	63.22	61.94^{NS}	89.33	114.83**	59.21	68.93**
Difference	1.28 (2.02%)		25.50 (28.50%)		9.72 (16.42%)	
Total AA	120.45	119.22^{NS}	160.82	203.03**	142.61	165.36**
Difference	1.23 (1.02%)		42.21 (26.25%)		22.75 (15.95%)	

a,b Means with different superscripts letters in same raw within main effect differ (^{a}= P<0.01) UEL = underestimate level, NS: not significant (P>0.05), **: (P<0.01) between C and T GDP = ground date palm, CFM = concentrate feed mixture

acid intake and ruminal microbial degradation, energy intake, the profile of all amino acids absorbed and capacity of the animal to utilize amino acids in synthesis of protein.

As shown in Table 8, a pronounced effect of lambs maturity has been observed on plasma arginine and glycine amino acids (NEAA) at the end of the experimental period for control and treated groups where both two amino acids were underestimate. This probably related in part to the relatively high stage of maturity of lambs. Firstly, the disappearance of arginine might be explained by the fact that this amino acid transported in red blood cells into genitalia where it is a major component of ejaculate (seminal fluid and sperm) and it is important for maintaining healthy ejaculate volume and to help in stimulating and maintaining penile erection [54]. Thus, net plasma arginine appearance might underestimate level. Secondly, the disappearance of plasma glycine at the end of experimental period might be due to its presence in greater concentration in erythrocytes than in plasma [55]. In accordance, Lobley *et al*. [56] reported that if amino acid movements across the liver involved removal from plasma and/or addition to the erythrocytes then disappearance from plasma should exceed that from blood.

There was apparent increase in the levels of valine, leucine and lysine (EAA), Glutamic and Alanine (NEAA) at med and the end of experimental period for both control and treated groups. This result indicated that the absorption of these amino acids perhaps was the faster compared with the others and proportions of absorbed of these amino acids would be used in other functions than protein synthesis including hepatic deamination regardless of quantities absorbed. We can conclude that substitution of GYC with GDP in CFM at 50% level (wet/wet) improved the quality and quantity of amino acids reaching the small intestine for absorption and utilization for growth.

CONCLUSION

Generally, the values obtained of plasma constituents indicated normal physiological and healthy status of lambs fed ration containing ground date palm (GDP) at 50% level (wt/wt). Therefore, the use of GDP as an energy source can be recommended for use by local farmers for lamb production under Siwa Oasis conditions to reduce nutritional costs.

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