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Effect of feeding prickly pear on productive performance of Maghrabian dromedary camel

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Abstract:

Fourty male Maghrabian camel aged 5-6 years days and weighted 350- 435 kgb± 2.20 on average were equally and randomly divided into four groups (10 in each were conducted to evaluate the effect of feeding on prickly pear fruits on the productive performance of Maghrabian dromedary camel. This study was conducted in a private camel, as Egyptian clover hay during the feeding period, on camel growth and blood constituent. The experimental diets contained different levels of prickly pear fruits (PPF). control (C), 10, 20 30 and 40%), respectively.The result showed significant effects on camel live body weight and feed intake during 24 weeks , The final live body weight, total weight gain and performance index were significantly (P<0.05) affected by PPf groups , The highest (P<0.05) values of live body weight, total weight gain and performance index were recorded by camels fed 30% PPf followed by received inclusion level of 20% PPf respectively, compared with the 10% PPf or control , respectively. Feed intake (g/ day), protein intake, were significantly (P≤0.05) increased with increasing PPf levels. The PPF are rich sources vitamins E (26, 27µg/100g), vitamin A (12,15µg/100g).and in vitamins C (3.1, 3.4µg/100g), There were significant increases detected for plasma total protein, albumin and globulin while blood plasma of total lipids was significantly decreased by increasing PPf inclusion level compared to control groups. Liver function as AST and ALT activity were not affected by dietary treatments with supplementing PPf. The best economic efficiency and relative economic efficiency values had been recorded with camels fed 30% PPf inclusion followed by camels received 20% and 10% treatment of PPf, respectively. It is concluded that prickly pear fruits (PPf) at the rate of 30 or 20 % of the diet improved growth performance and health status of Maghrabian camel

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Keywords: *Prickly pear fruits, Prickly pear residues, growth performance, Maghrabian camels.*

INTRODUCTION:

Prickly pear is a cactus plant that grows in dry places. It is very durable and has an amazing ability to resist drought due to its water-filled market. (**Buffa, *et al.*,2017)** Therefore, the market of this plant is considered the preferred food for camels in desert areas, despite its sharp thorns spread on the surface of the plant, so camels and camels can eat it.

Prickly pear plant is one of most important sources that used in agriculture sustainable development as a potential alternative crop for arid and semi-arid regions. Minimizing the feed cost could be achieved through the use of untraditional cheaper feed ingredients or improving utilization of common feeds by using some additives or supplements. (**Blache *et al.*, 2016)** Attention therefore should be drawn towards the use of some local by- products available in certain areas of Egypt (**Nipane, *et al.*,2021**). Plant sources including grains, vegetables, fruit and medicinal herb have potentially received increasing attention recently for their role in the prevention of human diseases. Prickly pear can be considered as an excellent and cheap source for diet supplementation (**El-Beltagi, *et al.*,2019).** Recently, there has been considerable interest to find naturally antioxidants to be use in foods, cosmetics, or medicinal materials in order to replacing synthetic ones, whose use is being restricted due to their carcinogenic effects (**Elhassaneen, *et al.* 2016a**). For instance, a relatively great quantity of prickly pear fruits (PPF) which is accumulating after harvesting its fruits that can cause environmental pollution. The nutritional and health benefits of prickly fruit are related to its antioxidant properties due to ascorbic acid, polyphenolics, flavonoid compounds (e.g., kaempferol, quercetin, and isorhamnetin) and the mixture of yellow betaxanthin and red betacyanin pigments (**Cardador-Martínez, *et al.* 2011 and Koubaa, *et al.*, 2015).** Meanwhile, the free radical scavenging activity of the red cactus pears was related to the concentration of total phenolic compounds and ascorbic acid **. (deWit, et al.,2021)**. (**Cardosoa, *et al* .,2019),** Prickly pear fruit is a berry typically weighs 100 to 200 g, and consists of a thick fleshy skin or peel (30-40% of total fruit weight), typically have high sugar (10% of total rind weight) content (**Sipango, *et al.*, 2022)**.

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Prickly pears (Opuntia spp., Cactaceae) have a fundamental economic importance in many desert areas, which are produced in abundant quantities (**Díaz, *et al*., 2017).**

Prickly pear fruits are widely used as animal feed ingredient after a possible suitable processes (**Arba, 2020**). In Egypt, the total production of prickly pear are nearly 31671 ton, while the peel represents about 45% of the fruit weight, therefore, the total amount of peel being accounting by 14252 ton/ year **(Neupane, D, *et al*., 2021).** Peels represent a large proportion of the whole fruit (from 40% to 50%) and constitute a source of bioactive compounds, such as phenolics and flavonoids compounds (**Arrizon, *et al.*, 2006 and El-Beltagi, *et. al.*2019).**

The aim of this study to examine the effects of prickly pear fruits (PPF) levels in the diets of dromedary camel on the production performance.

MATERIALS AND METHODS:

The present study was carried out in private farm in North Coast, Egypt

Experimental animals:

fourty male Maghrabian camel aged 5-6 years days and weighted 350- 435 kgb± 2.20 on average were equally and randomly divided into four groups (10 in each).

Collection peels: Peels of prickly fruits (PPF) were collected from the sellers and then spread on a clean floor for sun drying

Chemical analysis

Chemical analysis of PPF, diets and dried faeces were performed as recommended by **AOAC. (2005).**) for determining moisture, crude protein (CP), crude fiber (CF), ether extract (EE), nitrogen free extract (NFE). Fiber fractions included neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) were determined sequentially **Van Soest, P.v. and Robertson, J.; Lewis (1991)**

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Feeding trial management:

Feed and water were offered ad libitum throughout the experimental period. All camels were nearly equal in live body weight at the beginning of the experiment. All nutrients, minerals and vitamins in the experimental diets were adjusted according to the camel requirements of **NRC (2001).** Passably all experimental animals were healthy and clinically free from internal and external parasites and were kept under the same management and hygienic conditions.

Table 1: Chemical composition (on dry matter basis) of concentrate feed mixture (CFM), rice straw and berseem hay to she camels

Feed stuff	DM	OM	CP	CF	EE	NFE	Ash	SEM
CFM	89.1	91.55	16.30	11.46	3.32	60.47	8.45	0.415
Rice straw	88.46	82.24	2.53	29.69	1.52	49.5	16.76	0.015
Breseem hay	89.74	84.62	13.25	28.61	1.74	41.02	15.38	0.032

CFM: Concentrate feed mixture. DM: Dry matter. OM: Organic matter. CP: Crude protein. CF: Crude fiber. NFE: Nitrogen free extract. SEM: Standard error of the means

Hematological parameters:

Five (5) ml of blood samples from the jugular vein of each were collected in tubes containing EDTA as anticoagulant. The samples was kept refrigerated until arrival at the laboratory for immediate measuring of hematological parameters including red blood cells (RBC), hemoglobin (Hb), hematocrit (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular hemoglobin (MCH), white blood cells (WBC), lymphocyte (LYM), monocytes (MON), granulocytes (GRA) and red cell distribution width-SD (RDW-SD). These parameters were analyzed with an automatic hematological analyzer (**Warnick, *et al.*, 1982).**

Statistical analysis:

Data were statistically analyzed by one-way ANOVA using the General Linear Model procedure of **SPSS (2012).** computer program using the following fixed model: $Yij=\mu + Ti + eij$,Where: Yij = the observation; μ = overall mean; Ti = effect of treatments; eij= random error component assumed to be normally distributed.

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RESULTS

Chemical composition of prickly pear peels (PPF):

Table (2) : Chemical analysis of prickly pear fruits (PPF) % (on DM basis).

Item	OM	CP	EE	CF	Ash	NFE	SEM	P-Value
Prickly pear Fruits	90.55	7.60	3.50	15.6	9.45	63.85	1.76	0.062

There are significant change in parameter with respect to experimental animal. P<0.05 is considered significant. SEM: Standard error of the means

Table (3): Chemical analysis of experimental diet of prickly pear fruits (PPF) % (on DM basis).

Item	**Experimental treatments**			SEM
	T1 (25%)	**T2 (50%)**	**T3 (75%)**	
DM	88.38	90.30	92.49	0.016
OM	90.27	93.24	96.21	0.020
CP	17.30	19.34	21.41	0.015
CF	13.93	12.17	10.45	0.413
EE	2.20	2.18	2.19	0.011
NFE	56.84	56.55	56.16	0.002
ASH	9.73	9.76	9.79	0.034

There are significant change in parameter with respect to experimental animal. P<0.05 is considered significant Substitution level of barley by prickly pear fruit. SEM: Standard error of the means

Table (4) : Analysis of prickly prickly pear fruits (PPF)

Item	**Control**	**Experimental treatments**			**SEM**
Ingredients	**C**	**T1**	**T2**	**T3**	**-**
DE, Kcal/ Kg	2510	2509	2514	2516	0.523
Ca %	1.31	1.40	1.49	1.52	0.412
Total P %	0.42	0.46	0.49	0.50	0.081
Lys %	0.39	0.41	0.47	0.55	0.015

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Meth %	0.15	0.13	0.12	0.13	0.001
Price/ton L.E	4106	4050	4120	4200	0.198

There are significant change in parameter with respect to experimental animal . P<0.05 is considered significant.

The chemical composition of PPf content presented in Table (2) where in the peel was contained 7.6 .55%, 3.50 %, 15.6 %, 63.85% and 9.45% for CP, EE, CF, NFE and ash, respectively. While, (**Ragab,2007**) found that PPF contains 10.21 % CP, 3.85% EE, 48.89% NFE and 10.45 % CF.

Table (4): Vitamins content C, E and A and non-nutritional compounds content of prickly pear fruit (on dry matter basis) :

Vitamins content		**SEM**
Vit C (mg/100g)	2.4	1.25
Vit E (µg/100g)	25	1.38
Vit A (B-carotene) (µg/100g)	10	0.34
Non-nutritional compounds content Phenolic compounds (ppm as gallic acid equivalent)	11745	0.057
Phytic acid (g/100 g Dry matter)	0.53	0.0102
Tannins (%)	2.23	0.0033

* P<0.05 is considered significant , SEM: Standard error of the means

PPF rich in vitamins A and E and free from alkaloids that are well-known antinutritional factors. Moreover, **Tafere, G *et al.* (2016**) stated that total phenol content of prickly fruit pulp (Opuntia ficus-indica) is 218.8 mg/100 g.

Fiber fraction of prickly pear peels (PPF):

PPF rich in water and digestible fiber can represent an important dietary component for the nutrition of camel's ruminants.

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Table (5): Fiber fraction of of the experimental diets

Item	Control	Experimental treatments			SEM
Ingredients	**C**	**T1 (25%)**	**T2 (50%)**	**T3 (75%)**	
NDF %	36.15	38.84	40.15	41.33[a]	0.024
ADF %	21.46	23.48	25.16[a]	25.67	0.008
Hemicellulose	14.69	15.32	14.91	15.54	0.006
Cellulose	10.98	12.70	14.20	15.56	0.008

there are significant change in parameter with respect to experimental animal . P<0.05 is considered significant**.**

Growth performance:

According to the experimental design, initial body weights of the experimental camels were similar. The fattening performance of the experimental camels was significantly (P<0.05) affected by dietary treatments (Table 5). This result agrees with (**Dubeux, *et al*.,2021).**

Table (5): Growth performance of camels fed experimental diet

Item	Control	Experimental treatments				
		T1 (25%)	**T2 (50%)**	**T3 (75%)**	**SEM**	
Number of camels	10	10	10	10	0.001	
Experimental period	180	180	180	180	0.004	
Average of initial live body weight	322	319 ±0.81	320 ±0.81	301 ±0.81	0.005	
Average of final live body weight	360	375[a] ±26.32	403a 26.32	415 ± 26.32	0.015	
Average daily gain	60 ±0.68	75[a]±0.68	103[b]±0.68	115[a] ±0.68	0.017	

*there are significant change in parameter with respect to experimental animal. P<0.05 is considered significant.

The average daily weight gain of this group are comparable with the results obtained by **Dabiri *et al*. (2003)** who reported 0.688 kg body weight gain for camels at 1-2 years old.

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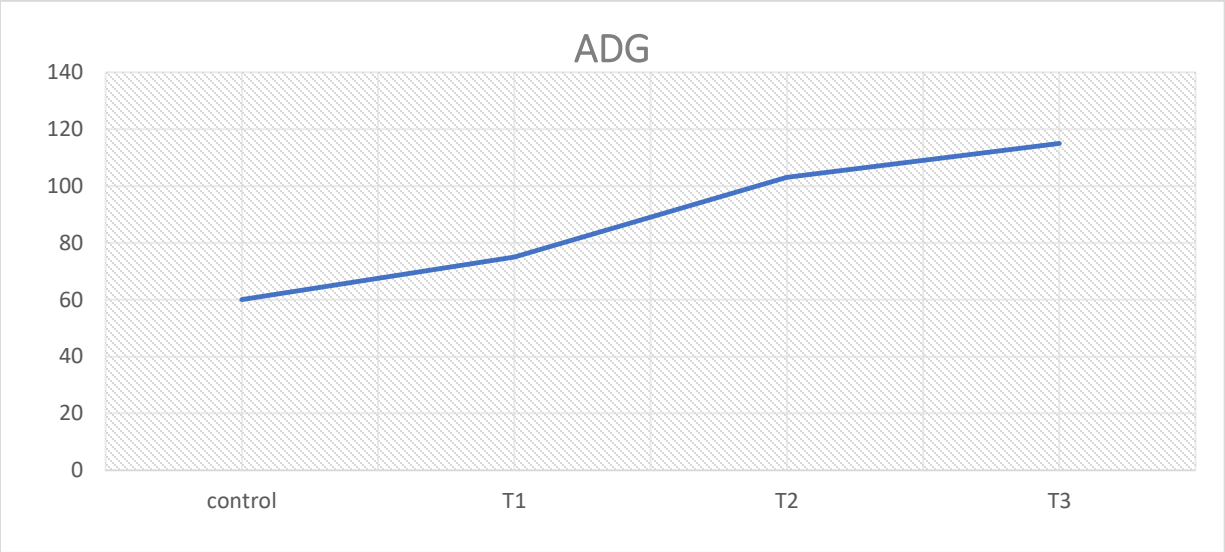
Fig (1): Average Daily Gain of camels fed experimental diet



Blood constituents:

The additive and synergistic effects of phytochemicals in prickly pear are responsible for its antioxidant's activity. The antioxidative ability of the prickly pear could neutralize reactive oxygen species (ROS) **Inácio, J.G.et al., (2020**). These ROS exert a multiplicity of biological effects across a wide range from physiological regulatory functions to damaging alterations strongly related with the pathogenesis of an increasing number of diseases **Todaro, M.et al. (2020).** The present study showed that prickly pear fruits and peel enhanced the antioxidative status of camel and protected against oxidative damage because of the presence of several antioxidants such as ascorbic acid, which is an important antioxidant and its content in prickly pear fruits considerably higher (2.4 and 2.8 mg/100 g), vitamin E (25 and 28, µg/100 g), B-carotene (10 and 13 µg/100 g) and phenolic acids (11745 and 14585 ppm as gallic acid equivalent).

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Table (6): Mean serum chemistry of experimental camels fed on PPF.

Parameter	Experimental treatments				SEM
	Control	T1 (25%)	T2 (50%)	T3 (75%)	
ALP (u/l)	76.36 ±8.13	73.34±7.10	75.41 ±8.9	74.37 ±8.12	0.123
ALT (HDL) (u/l)	11.03 ±4.2	10.2 ±2.1	10.00 ±3.9	11.01 ±3.3	0.147
AST (LDL) (u/l)	101.10 ±12.7	102.4 ±9.1	100.11 ±12.7	99.9 ±11.5	0.134
GGT (u/l)	11.80 ±0.83	10.94±0.82	11.93±0.81	12.90 ±0.81	0.112
Total protein (g/dl)	7.32 ±0.79	6.99 ±0.68	7.11 ±0.68	7.20 ±0.78	0.144
Albumin (g/dl)	4.00 ±0.37	4.02 ±0.29	5.05 ±0.22	5.08 ±0.31	0.147
Total bilirubin (g/dl)	0.3±0.05	0.2 ±0.04	0.3 ±0.03	0.1 ±0.05	0.139

significant change in parameter with respect to experimental animal . P<0.05 is considered significant.

Almost constant trend was observed in case of that result in considerable normal in ALP, ALT, AST and GGT. On the other hand, total protein and albumin was no significant differences to experimental camels. **Bazie, B.et al ., (2019)**

Table (7): Mean hematological values ±S.D of experimental camels fed on PPF

Parameter	Experimental treatments				
	Control	T1 (25%)	T2 (50%)	T3 (75%)	SEM
Packed cell volume (%)	31.47 ±1.82	30.32 ±1.82	32.56 ±1.90	33.21 ±1.85	1.027
Haemoglobin (g/dl)	11.37 ±0.41	10.25 ±0.50	11.43 ±0.52	12.37 ±0.33	1.28

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Red blood cell count (10^6/mm^3)	8.93 ±0.43	8.94 ±0.32	8.89 ±0.38	8.86 ±048	1.04
Total leukocytic count (10^3/mm^3)	12.88 ±0.69	12.78 ±0.69	12.85 ±0.69	12.87 ±0.69	0.71
PLT (x10^9/L)	271.7 ±17.54	274.9 ±13.38	272.8 ±15.67	269.9 ±16.54	1.97

significant change in parameter with respect to experimental animal. P<0.05 is considered significant.

DISCUSSION

The chemical composition of PPF in comparison to barley grains is illustrated in Table 3. The results as shown in Table 2. indicated that PPF had higher CF, Ash, contents and lower CP content compared to barley. While, It is worthy to notice that EE content in PPF was higher than that of barley (3.5 vs. 2.0%). It could be noticed that PPF had a higher content of vitamin E and phytic acid content. results showed that PPF had a higher content of vitamins C, vitamin A, phenolic compounds, tannins and saponin contents. The main components of prickly pear are carbohydrate-containing polymers, which contain a mix of mucilage and pectin **Elshehy, H.R.et al. 2020).** About 60% of the total energy requirements of the animals could be supplied by prickly pear .

The present results are somewhat coincided with those obtained by Rodriguez-Garcia et al. (2007) and Atef et al. (2013) who reported that prickly pear pulp contained 7.61% CP, 3.88% Ash, 85.75% Total carbohydrates, and 1.92% EE. **Di Bella, G.et al. (2021)** have already demonstrated that PPP and PPF are rich in vitamins A and E and free from alkaloids that are well-known antinutritional factors. Moreover **Andreu, L.et al. (2018)** stated that total phenol content of prickly fruit pulp (Opuntia ficus-indica) is 218.8 mg/100 g. Total antioxidant activities of differently colored PPF were strongly correlated with total phenolics, betalains and ascorbic acid concentrations **Blando, F et al (2019)**. Prickly pear possesses antioxidant, anti-lipidemic and antimicrobial properties **De Santiago, E.et al. (2021).** Prickly pear has antioxidant properties due to the existence of several compounds like vitamins E and C,

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phenolic compounds and other no nutritional substances. **Chbani, M.et al (2020).** Phenolic compounds are effective antioxidants, since they can delay prooxidative impacts on proteins, DNA and lipids by the generation of stable radicals **Morales, N.X.C.et al. (2021).** Furthermore, it must be taken into consideration that higher phenolic compounds are found in the prickly pear peel, rather than the pulp **Morshedy, S.A.et al. (2020)** and that is already found in the current work. Hence, from a nutritional point of view

Likewise, **Albuquerque, I.et al. (2020)** recorded moderate values of CP and ash in PPP being 8.30% and 12.13%, respectively. **Reyes, V.C. et al (2020)** showed that the chemical composition of PPP content is as follows: moisture 75.8 %, protein 4.56%, lipid 3.66%, fiber 7.72%, ash 8.66, total sugar 60.65%, total dietary fiber 32.67%, Ascorbic acid 87.82% and pectin 14.25%. Also, they added that prickly pear peel had high contents of fiber, pectin, Ascorbic acid and phenolic components. One of the main characteristics of these ingredients is the relatively high-soluble carbohydrate content, rendering them more fermentable by lactic acid bacteria, these results agree with **Badr et. al. (2017a).** showed that PPPs is a source of protein (4.75%), carbohydrates (59.25%), calcium (2.04%), iron (80.35 mg/kg), zinc (37.49 mg/kg), copper (1.92 mg/kg), phosphorous (0.9%), betaglucan **Cardoso, D.B.et al. (2019)** (27.25%) and β- carotene (141.4µg/100g). PPPs content of hemicellulose, cellulose and lignin were 0.5, 10.92% and 1.2%, respectively These contradictions of results about CP, CF, and ash contents of PPP indicated that chemical composition of PPP are very heterogeneous depending on surrounding environmental conditions

Total antioxidant activities of differently colored PPF were strongly correlated with total phenolics, betalains and ascorbic acid concentrations **Alhanafi, F.et al (2019).** Prickly pear possesses antioxidant, anti-lipidemic and antimicrobial properties**.** Prickly pear has antioxidant properties due to the existence of several compounds like vitamins E and C, phenolic compounds and other nonnutritional substances **Tosto, M.S.L.(2021)** Phenolic compounds are effective antioxidants, since they can delay prooxidative impacts on proteins, DNA and lipids by the generation of stable radicals **Ordaz, G.et al. (2021).** Furthermore, it must be taken into consideration that higher phenolic compounds are found in the prickly pear peel, rather than the pulp **Amer, F. et al. (2019)** and that is already found in the current work. Hence, from a nutritional point of view

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This study showed that the properties of FR could be improved by increasing fiber volume fraction. Modulus of elasticity, toughness, and load bearing capacity seem to follow the law of ratio of quantity of fibers and volume of the polymer matrix more precisely than flexural strength when high fiber-density is used.

DM intake, average daily weight gain were significantly (P<0.05) different among each of the three dietary treatments Camels fed pricly pears fruits diet had a higher daily weight gain, daily DM intake and final live body weight than the other two groups. This work showed a higher value for average daily weight gain than that recorded by **El-Neney, B.A.*et al.* (2019)** average daily weight gain during 90 days when camels fed T1 . However, the result for average daily gain was nearly similar to the findings of this study. Animals offered PPF were intermediate in daily weight gain and DM intake.

Camels fed diet of control diet had a lower (P<0.05) feed intake and lower daily weight gain with poor feed average daily gain Generally, feeding camels on diets contained PPF resulted in noticeable improvement in average BWG in comparison to the control group during the whole period. This improvement may be attributed to that prickly pear is palatable **Ortiz, R.et al . (2021**) and is characterized by high sugar (glucose and fructose) content (Feugang et al. 2006 and Bouzoubaâ et al., 2016). Prickly pear is also rich in water, minerals, vitamins and antioxidants as well as amino acids (8 of which are essentials) and fatty acids especially palmitic acid and Omega-6 **Moula, N. et al (2019)**. In addition, the high water content of prickly pear serves in nutrient accumulation and transportation , These nutrients could accelerate metabolism and increase energy digestibility and hence improve growth performance. **Zeedan et al. (2015)** attributed the improved growth performance of rabbits fed prickly pear to its mode of action that included maintenance of a beneficial microbial population and improvement of feed digestibility. The same authors added that dietary prickly pear supplementation improved feed

Blood analysis in present study revealed that feeding PPF in camels results in normal Haemoglobin (g/dl), Red blood cell count (106/mm3), and PLT values. On the other hand, serum analysis revealed normal no significant different in ALT, AST, ALP and GGT. Regarding blood constituents, The results demonstrated that plasma total protein, albumin, A/G ratio and HDL cholesterol of camels fed diets containing PPF tested level (25 or 50%) were non significantly (P<0.05) than those of the control

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group (High levels of ALT may indicate liver damage from hepatitis, infection, cirrhosis).Plasma triglycerides, total cholesterol and LDL cholesterol concentrations were no significantly ($P<0.05$) in camels groups fed PPF compared to the control group. Different results were obtained by **Vastolo, A. et al (2020**) who stated that rabbits fed diets contained 10, 20 and 30% cactus opuntia cladodes were lower ($P<0.05$) in cholesterol and LDL compared to the control group. In this work, all tested levels of prickly pear dietary supplementation reduced triglycerides, cholesterol and LDL.

Prickly pear contains pectin, which interferes with cholesterol and lipids synthesis, through binding cholesterol to bile acids and then when the concentrations of these compounds increase, they accelerate the catabolism of cholesterol. Moreover, the interaction among flavonoids, betalaines and vitamin E seems to be responsible for the hypolipidemic activity of prickly pear (**Al-Sultan, S. I. (2008**).

Economy aspect:

Prickly pear fruits will be available as alternative energy sources for rabbit nutrition especially when corn and barley are expensive or unavailable. Due to concerns about global desertification and declining water sources, Opuntia spp. are gaining in importance as an effective energy source of feed

Conclusion

This study reports a preliminary data and envisages for the further studies with a larger population and sample. , the inclusion of the prickly pear fruits in camels diets as a replacement of barley had positive effects on average daily gain ,Although a non-significant effect of blood constitute has been noticed in the present work but other factors such as physiological state of the animal, environment, husbandry practices etc may be incorporated in future investigations. the performance of camels and moreover, prickly pear fruits are the excellent sources of dietary antioxidants components which may have beneficial effects on camel's health, being rich in bioactive antioxidant compounds (vitamin A, E, ascorbic acid and polyphenols) which make it a worth and viable feeding strategy. From the economical point of view especially within a sustainable animal production system, prickly pear could be promising energy feedstuff. The findings obtained could be used as a base line data for future research in feeding of camels in various camel breeds of Egypt.

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