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EFFECT OF REFUSED SESAME SEEDS FOR MANUFACTURING SUPPLEMENT ON REPRODUCTIVE AND PRODUCTIVE PERFORMANCE OF DAIRY GOATS

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ABSTRACT

The objective of this study was to determine the effect of feeding refused sesame seeds (RSS) invalid for industry partially instead of concentrate feed mixture (CFM) on reproductive and productive performance, blood metabolism and economic efficiency of Zaraibi dairy goats. Fifteen healthy dairy goats aged 36.0 - 38.0 months and weighed 35.71± 0.38 kg body weight randomly divided into three equal groups (5 goats each). The 1st group fed control ration (R1) consisted of CFM and corn silage (CS), while the two tested groups fed the same control ration with substitute of 10% (G2) and 20% (G3) of CFM with RSS. The experimental rations adjusted to be isonitrogenous and isocaloric . The feeding trial continued from pre-breeding season up to 8 weeks of lactation. Results indicate that R2 and R3 diets improved fertility, where litter size were 2.40 and 2.80 compared to R1 diet (2.20), respectively. Body weight of goats during gestation, suckling and lactation periods and growth rate of kids were significantly higher with R2 and R3 than control one. Total milk yield was higher ($P<0.05$) in R2 (189.58kg) and R3 (182.14kg) than R1 (141.32kg) until peak of lactation (first 8 weeks). Furthermore, serum blood components as triglyceride (74.20, 72.60 and 71.40 mg/dI), LDL (137.93, 125.70 and 126.57 mg/dI) and cholesterol (180.33, 173.67 and170.33mg/dI) showed higher ($P<0.05$) values with R1 than R2 and R3 rations, respectively. On the contrary,the beneficial serum blood level of HDL recorded higher ($P<0.05$) rate for R2 (38.17mg/dI) and R3 (38.77mg/dI) than R1 (28.80mg/dI) rations. The highest economic efficiency associated with R3 (143.55%) followed by R2 (139.85%) relative to R1 (100.00%). Accordingly, we favorably encourage the producers to introduce RSS, up to 10 or 20% of CFM, because it help to reduce costs of feeding and accomplish a good reproduction and production performance for dairy goats.

Keywords: invalid sesame seeds for industry, economical efficiency and dairy goats.

INTRODUCTION

Good animal nourishment is a prerequisite for sound farm animal reproduction and production. In recent years, there is a considerable increase in prices of feedstuffs and in some cases fluctuations in availability. This problem has especially noticed with feeds containing high concentrates rich in protein and/or amino acids. There are great efforts to detect new feedstuffs that could decrease feeding cost of livestock. Moreover, these feedstuffs can maintain the integrity of animal health, welfare as well as good animal feeding. An important category of these feedstuffs is the agro-industrial by-product feeds, which usually not used for human nourishment, but potentially, can utilized as animal feed. Excessively sorted sesame seeds, refused by industry, could beneficially use as a potential ingredient for formulating ruminant rations. In this context, FAO (2013) recorded that world sesame seed production estimated at 3.84 million tons for year 2010, occupying more than 78.00 million acres. In addition, the worldwide seed production was 5.5 million tons in 2014 (FAO, 2016). In addition, sesame seeds and their products have healthy benefits due to high content of the natural antioxidants sesamin (like polyphenolic compounds, which makes it resistant to oxidation), sesamolin, sesaminol glucosides and tocopherol homologues, which considered healthy feedstuff for livestock (Kamal-Eldin *et al.*, 2011). On average, sesame seeds contained 44-58% oil, 18-25% crude protein, 13.5% carbohydrates and 5% ash; thus these seeds could utilized efficiently in ruminant nutrition (Obeidat and Gharaybeh, 2011). Moreover, the former authors found that sesame seeds oil contained in average 18.5% saturated fatty acids (SFA), 45.4% monounsaturated fatty acids (MUFA), 36.1% polyunsaturated fatty acids (PUFA) where oleic and linoleic acids being the main components. Furthermore, Hassan *et al.* (2013) confirmed that sesame meal protein has amino acids composition similar to those of soybean meal with the exception of lower lysine and higher methionine. Recent studies on the antioxidant (sesame lignans that may contribute to improved health) and anti-carcinogenic activities have greatly increased its applications as health food products that assert for liver, heart protection and tumor prevention (Nitipathak *et al.*, 2014). Regarding use of sesame by-products in livestock nutrition, Shirzadegan and Jafari (2014) reported that supplementation of sesame oil cake at levels 10% and 20% to dairy cow diet, could improve digestibility of protein and fiber, milk composition and yield while had no detrimental effect on growth performance. On growth of goat kids, Awawdeha *et al.* (2017) revealed that sesame seed hull (SSH) increased final body weight, total gain, daily gain and feed conversion ratio. In general, utilization of SSH in diets could achieve possible beneficial effects on lambs' growth performance by improving final body weight, fasting live weight, weight with empty rumen, hot and cold carcass weights and feed intake compared to control (Bonos *et al.*, 2017). On the other hand, Mijena (2017) reported that sesame is very good source of B-complex vitamins such as niacin, folic acid, thiamin pyridoxine, riboflavin and rich source of many essential minerals including calcium, iron, manganese, zinc, magnesium, selenium and copper in concentrated amounts.

Previous studies usage different parts of sesame plants such as sesame hull, sesame oil cake or sesame straws, but utilization of whole invalid sesame seeds in livestock nutrition is very limited especially with local dairy breeds of Zaraibi goats.

Therefore, this study designed to investigate the impact of replacing part of concentrate fed mixture with either 10 or 20% of invalid sesame seeds to focuse light on performance of Zaraibi dairy goats.

MATERIALS AND METHODS

This experiment was carried out in El-Serw Animal Production Research Station, Damietta Governorate, which belonging to Animal Production Research Institute (*APRI*), Agricultural Research Center (*ARC*), Ministry of Agriculture, Egypt. The experimental work commenced from September 2016 until August 2017.

Sesame seeds refused by industry procurement

The refused sesame seeds (RSS) provided from factories in New Damietta City, Damietta Governorate, Egypt. In these factories, whole sesame seeds rinsed and separated then, white sesame seeds used for manufacturing human food products. The remainder refused seeds collected. The concentrate feed mixture (CFM), refused sesame seeds (RSS) and corn silage (CS) analyzed according to the AOAC (2007) analysis guidelines. The chemical composition and metabolisable energy of these ingredients presented in Table (1).

Experimental animals

Fifteen dairy Zaraibi goats were used during experimental periods (pre- breeding season up to peak of lactation at week 8th of lactation), aged 36 months and had 35.71kg average body weight and 2.56 body condition scour (BCS). They individually and randomly allocated into three treatment groups. Each group marked by colored rope and individually housed in a separate pen equipped with appropriate feeder and fresh water through the experimental period. Goats handling and experimental procedures performed according

Table 1: Chemical analysis of diet ingredients as dry matter basis, %.

Items%	CFM	ISS	CS
DM	92.44	93.49	35.12
OM	93.85	96.05	88.43
CP	15.05	18.03	9.35
CF	16.11	6.37	26.29
EE	3.45	42.97	3.11
NFE	59.24	28.68	49.68
Ash	6.15	3.95	11.57
*ME	3213.95	3393.6	3169.06

***ME= metabolic energy (k cal/ kg DM), it determined by the formula (3260+0.455×CP+3.517×EE-4.037×CF) according to Canbolat and Karabulut (2010).**

to the principles of APRI Veterinary Services for the care of animals in experimentation.

Experimental diet and management

The control group fed basal ration (R1) consisted of CFM and CS, while the two tested groups fed the basal ration with replacing 10% (R2) or 20% (R3) of CFM by RSS based on protein content. Feed assigned according to NRC (2007) for dairy goats during different physiological and production phases. Rations were tested to be isonitrogenous and isocaloric. The CS provided in raw form while, RSS offered as seeds and CFM provided as pellets. The salt blocks and drinking fresh water provided *ad libitum* to all goats throughout experimental period.

Reproductive parameters

Before breeding, goats were nourished R1, R2 and R3 as a flushing period. Then, after mating season, goat groups resumption to receive R1, R2 and R3 up to 8 weeks of lactation. After parturition fertility rate calculated as following; conception rate (number of nanny goats gravid / number of mated nanny goats). Birth types; as single birth rate (number of nanny goats kid single/ total number of nanny goats kidded), twins birth rate (number of nanny goats kid twins/ total number of nanny goats kidded), triplet birth rate (number of nanny goats kid triplet / total number of nanny goats kidded), quaternary birth rate (number of nanny goats kidded quaternary/ total number of nanny goats kidded) and litter size (number of total born kids /number of nanny goats kidded).

Productive parameters

Live body weight (LBW) of goats

LBW observed at; pre-breeding season, after flushing, end of breeding season, at last trimester of pregnancy, at 140 days pre-gestation and post-parturition. In addition, LBW was recorded during suckling days at 7, 15, 30, 60 and 90 days and weekly during milking period from 1^{st} week to 8^{th} weeks of lactation.

Growth rate of suckling kids

After parturition, growth rate of kids recorded at birth, 30, 60 to 90 days, which depended on suckling milk from their dams, which fed R1, R2 and R3 rations.

Milk yield and composition

Milk yield and composition were evaluated. Samples of suckling milk from each goat collected at 15, 30, 60 and 90 days after parturition to estimate fat and protein contents and suckling milk energy value (SMEV, kcal/kg). In addition, samples of milk from each nanny goat collected and evaluated weekly up to 8 weeks of lactation. Suckling and milk samples analyzed using Milko-Scan (133B N. Foss Electric, Denmark). Meanwhile, the amount of suckling milk estimated at 7, 15, 30, 60 and 90 days by oxytocin method described by Khalifa *et al.* (2016). The milk yield recorded weekly up to eight weeks of lactation where hand milk yield / nanny goat /group assayed weekly by added morning cooled milk into the evening milk for 7 days then representative milk samples were taken for chemical analysis.

Nourishment measurements

Daily feed consumption as dry matter intake (DMI), total DMI, DM intake % BW, DM intake as g / kgw $^{0.75}$, and roughage: concentrate ratios, during each period of the experiment (flushing, trimester of gestation, suckling and lactation), were calculated.

Blood metabolites

Blood samples taken once at the final day of the experiment from the jugular vein before morning feeding. Randomly nine goats were used to collect blood samples as 3 samples /

nanny goat /ration. Samples left to coagulate at room temperature one hour. Separation of the serum carried out by centrifugation of coagulated blood at 3500 *g* for 20 min. The clear serum transferred carefully to clean and dry vials and kept at -20ºC until biochemical analysis. Serum total protein, albumin, glucose, alanine amino-transferase (ALT), aspartate amino-transferase (AST), creatinine, urea, triglyceride, cholesterol, high density lipoprotein (HDL) and total lipid were assayed colorimetrically using commercial kits (Randox, UK) and low density lipoprotein (LDL) was assayed kinetically using commercial kit (Bio Merieux, France). Globulin calculated by difference between total protein and albumin.

Economical efficiency

The economical efficiency determined according to the local market prices of diet ingredients and milk as following:

Money output (price of selling milk) ÷ input (total price of feed consumed) ×100.

In addition, the economical efficiency (%) relative to control was calculated for R2 or R3 as following:

The economical efficiency amount of R2 or R3 – economical efficiency amount of R1÷ economical efficiency amount of R1×100 +100 (considering economic efficiency of R1 100%).

Statistical Analysis

Data analyses done using The IBM SPSS Statistics Version 22.0 statistical package (SPSS Inc., Chigaco, IL, USA, 2013). Repeated measurement of ANOVA also carried out to determine the difference among means. Statistical analysis was undertaken using Duncan's test (Duncan, 1955) at $P < 0.05$ then, it was considered significant.

RESULTS AND DISSUSSION

Reproductive measurements

Data of reproductive performance traits presented in Table (2). Litter size was markedly better for tested rations R2 and R3 than control. Previously, Abdul-Rahman *et al.* (2009) suggested that sesame seeds increases follicle stimulate hormone (FSH) levels that may in turn enhance the ovarian follicle maturation and thereby improve physiological and productive parameters of hens. With credibility, sesame nutrition could ameliorate fertility function by enrichment unsaturated fatty acid (Ambrose *et al.*, 2016), provide antioxidant (Nawito *et al.*, 2016), goodness body weight (Gelasakis *et al.*, 2017), improvement follicular development (Jing *et al.*, 2017) and making available of either vitamins or minerals (Mijena, 2017).

Productive measurements

Live body weight (LBW) of goats

LBW and BCS at pre-breeding season, after flushing (began of breeding season), end of breeding season, at last trimester of pregnancy, 140 days pre-parturition and post-parturition presented in Table (3).

There was no- significant difference in LBW of goats among R1, R2 and R3 rations at pre-breeding season up to end of breeding season. While, LBW for goats either pre or post parturition were significantly higher with R2 or R3 rations than control. The highest LBW attributed to supplementing sesame seeds might be due to its rich contents of necessary ingredients as protein, energy, minerals and vitamins (Shirzadegan and Jafari, 2014). Obviously, antioxidant in sesame seeds plays an important role in scavenge free radicals and biochemical and physiological activities, which enhanced LBW thus, supplementation of sesame seeds to feeds was shown to improve LBW (Bonos *et al.*, 2017).

Table 2: Reproductive performance of dairy goats fed the experimental rations.

Specification	Experimental rations		
	R1	R2	R3
No. of nanny goats mated	5.00	5.00	5.00
No. of nanny goats gravid	5.00	5.00	5.00
Conception rate, %	100.00	100.00	100.00
No. of nanny goats kidding	5.00	5.00	5.00
Total No. of kids born	11.00	13.00	14.00
No. of a live kids at birth	11.00	13.00	14.00
Birth type of nanny goats			
No. of nanny goat born single	2.00	0.00	0.00
Single rate, %	40.00	0.00	0.00
No. of nanny goat born twins	1.00	2.00	1.00
Twins rate, %	20.00	40.00	20.00
No. of nanny goat born triple	1.00	3.00	4.00
triple rate, %	20.00	60.00	80.00
No. of nanny goat born quaternary	1.00	0.00	0.00
Quaternary rate, %	20.00	0.00	0.00
Litter size	2.20	2.60	2.80

Table 3: LBW (kg)of goats fed the experimental rations during different physiological phases.

Gravid phases	Experimental rations		
	R1	R2	R3
Pre-breeding season	35.86 ± 0.51^{a}	35.71 ± 0.75^{a}	35.57 ± 0.65^{a}
On breeding season	36.16 ± 0.50^{a}	36.50 ± 0.68^{a}	36.56 ± 0.61^{a}
End of breeding season	36.47 ± 0.52^{a}	37.34 ± 0.65^{a}	37.36 ± 0.59^{a}
At last trimester	39.87 ± 0.60^{b}	41.76 ± 0.66^{a}	41.87 ± 0.61^{a}
140 days pre-parturition	42.53 ± 0.66^{b}	44.73 ± 0.58^{a}	45.01 ± 0.57^{a}
post-parturition	36.93 ± 0.47^{b}	38.40 ± 0.58^{a}	38.89 ± 0.41^{a}

Means within the same row direction with different superscripts are significantly different (P<0.05).

Live body weight of goats throughout suckling period

LBW was significantly higher during all days of suckling with goats fed the two levels of RSS than control one (Table 4). Observations of, Taha *et al.* (2014) demonstrated that sesame seeds is a source of tyrosine which used to synthesize thyroid hormones and in turn affect metabolism and physiological functions of nearly all organs and growth performance. They added that elevation of serum T3, that essential for maintaining an optimal metabolic rate, and T4, which increases the basal metabolic rate via the metabolism of carbohydrate, lipids and proteins, may have been responsible of the protective effect of sesame seeds against weight loss. Hafez *et al.* (2015) reported that restriction of energy during the last third of gestation affected by LBW and that modifying any deficiency in energy sources during this stage disgraced LBW of maternal. Also the same authors suggested that enhancing energy of feeding during pre-partum caused an improvement in body weight condition and lactation at the first fifteen days, but energy reduction corresponded by great loss in body condition. Likewise on the present study, the amelioration of LBW attributed to the high nutritional status (like antioxidant in sesame seeds) supplied in R2 or R3 rations compared to the nutritional status in R1 ration (low or not antioxidants). These results are in line with the findings of Emami *et al.* (2017) who stated that it is possible to improve antioxidant status, milk production and milk fat of dairy goats by feeding seed oil as a natural antioxidants. It is worth noting that deficiency in antioxidants (Wang *et al.,* 2017) and vitamins (Balthazar *et al.,* 2017) can result in reproductive losses and reduced growth rate and therefore the use of antioxidants and vitamins in feedstuffs could consider as one of the most important ways to prevent loss of weight for animals.

Table 4: Live body weight of dietary treatments during suckling period.

Suckling times	Experimental rations		
	R1	R2	R3
At 7 days	36.41±0.50 [b]	38.06±0.61 [a]	38.50±0.44 [a]
At 15 days	36.16±0.49 [b]	37.86±0.61 [a]	38.30±0.45 [a]
At 30 days	35.94±0.51 [b]	37.67±0.60 [a]	38.06±047 [a]
At 60 days	35.63±0.49[b]	37.47±0.62[a]	37.84±0.48[a]
At 90 days	35.27±0.48 [b]	37.29±0.51 [a]	37.65±0.61 [a]

Means within the same row direction with different superscripts are significantly different (P<0.05).

Live body weight of goats during lactation weeks

LBW of R1, R2 and R3 rations, throughout peak of lactation (first 8 weeks), presented in Table (5). Result showed that LBW during all weeks of lactation were significantly higher with R2 and R3 rations than control one (R1), while the difference between the two tested levels (R2 and R3) was not significant. Weight loss of control group, in this investigation, is in agreement with Haidari *et al., (*2016) who found that loss of weight could due to poor glycemic control and subsequently the excessive catabolism of proteins and muscle wasting arising from insulin deficiency and on the other hand, sesame seeds improved glycemic control and consequently prevent weight loss. Under energy condition (Koyuncu and Altınçekiç, 2013) found that when goats have low body energy reserves, they may have a greater probability of suffering from body weight, body condition score, metabolic activities, reproductive failure and poor growth. Under antioxidant condition, Wang *et al.* (2017) recommended that there are positive relationship between body weight and diet included antioxidant. According to the report of Balthazar *et al.* (2017) that vitamins concentrations in ration could be responsible of increased and improved body weight and body condition score. Furthermore, Ghani *et al.* (2017) showed that imbalance protein nutrition in experience animals can result in a marked decrease in milk yield and abrupt changes of body condition score.

Metabolic weight (MW) during gestation, suckling and at 8 weeks of lactation

Values of metabolic body weight during gestation, suckling and 8 weeks of lactation are presented in Table (6). Data showed no significant difference for MW during gestation, suckling and lactation among the dietary treatments. Earlier study conducted by Shirzadegan and Jafari (2014) demonstrated that sesame waste had no negative effects on the weight of dairy cows, so it could partially substitute soybean in diet of the cows. Furthermore, these findings are in good agreement with Bonos *et al.* (2017) who suggested that ingredients in sesame seeds, as rich feed resources in protein, minerals and energy, might be beneficial to increase the live body weight and body condition of lambs.

Table 5: Live body weight of dietary treatments during lactation.

lactation weeks	Treatments		
	R1	R2	R3
W1	35.26048 [b]	37.27±0.61 [a]	37.64±0.51 [a]
W2	35.16±0.48 [b]	37.21±0.59 [a]	37.61±0.51 [a]
W3	35.09±0.46 [b]	37.12±0.59 [a]	37.63±0.56 [a]
W4	34.96±0.45 [b]	37.04±0.58 [a]	37.53±0.57 [a]
W5	34.86±0.44 [b]	36.91±0.55 [a]	34.47±0.56 [a]
W6	34.73±0.43 [b]	36.80±0.59 [a]	37.37±0.55 [a]
W7	34.66±0.44 [b]	36.64±0.57 [a]	37.24±0.56 [a]
W8	34.46±0.61 [b]	36.40±0.58 [a]	37.00±0.58 [a]

Means within the same row direction with different superscripts are significantly different (P<0.05).

Table 6: Metabolic weight of R1, R2 and R3 rations at gestation, suckling and lactation.

*Metabolic weight (MW)	Experimental rations		
	R1	R2	R3
Gestation	20.09±0.20	20.45±0.24	20.40±0.25
Suckling	19.93±0.20	20.66±0.24	20.83±0.19
At 8 weeks of lactation	20.24±0.19	20.32±0.25	20.51±0.21

Means within the same vertical row direction are not significantly different (P>0.05).

***** Metabolic weight (MW) = (initial body weight (kg) + final body weight (kg) ÷ 2) $^{\mathbf{0.75}}$ according to Willems *et al.* (2013).

Growth rate of suckling kids up to weaning

In response to R2 and R3 rations, there were slight but not significant increase in R3 compared to R2 then control in respect of body weights of kids taken from birth up to weaning. This was reflected on daily gain. Which show higher weights ($P < 0.05$) for R2 and R3 than R1 at periods 1-30, 30-90 and 60-90 days, as shown in Table (7). Hence, it is safe to conclude that presence of sesame seeds in the diet did not have any negative effect on palatability of R2 and R3 rations. In harmony with the present results, Obeidat and Aloqaily (2010) found that feeding diet including 12.5 or 25% sesame hull led to an improvement in growth performance of Awassi lambs. In addition, results here are similar to the findings of Mulugeta and Gebrehiwot (2013) who indicated that sesame seed cake supplementation resulted in significant heavier body weight and feed conversion efficiency as compared to the control treatment. Moreover, Shirzadegan and Jafari (2014) found that calves weights improved when the ration of cows contained sesame hulls, which also improved milk yield, fat and protein percentages. Generally, the present study suggest that feeding RSS to pregnant nanny goats might be able to supply adequate energy, protein, minerals, vitamins and antioxidant materials which could support embryonic, fetal growth, maintenance of metabolic processes, mammary gland growth, colostrum and suckling milk yield. As well as, Bonos *et al.* (2017) suggested that the best nutritional condition during fetal life potentially have considerable effects on postnatal growth, reproductive performance and metabolism. Besides, Awawdeha *et al.* (2017) reported that heavier body weight gain for kids group supplemented with sesame hull than kids in control one.

Table (7): Growth performance of suckling kids up to weaning.

Specification	Treatments		
	R1	R2	R3
Body weight of kids, kg			
At birth	1.57±0.07	1.58±0.06	1.76±0.07
At day 30th	4.20±0.42	4.22±0.32	4.74±0.43
At day 60th	5.50±0.51	5.94±0.42	6.11±0.47
At day 90th	6.93±0.58	7.83±0.88	7.95±0. 70
Metabolic weight	3.24±0.24	3.25±0.36	3.48±0.29
Daily gain (g/d)			
1-30 days	83.33±11.25 [b]	94.25±11.01 [a b]	109.80±10.72[a]
1- 60 days	68.36±7.18	69.68±6.77	77.16±7.09
1- 90 days	61.42±5.60	71.85±6.53	73.34±8.29
30 - 60 days	43.33±7.23	45.61±5.82	48.14±7.24
30 - 90 days	45.56±5.26 [b]	53.51±6.06 [a b]	68.52±7.96 [a]
60-90 days	23.89±2.92[b]	30.70±4.28[a]	44.44±5.87[a]

Means within the same row direction with different superscripts are significantly different (P<0.05).

Suckling milk yield and its composition

Date presented in Table (8) indicated that suckling milk composition as fat, protein concentrations and energy value (SMEV, kcal/kg) were significantly higher with the two tested rations than control one over all sampling times (15 up to 90 days), while no significant differences between the two tested rations (R2 and R3) in these items. Similar trends of milk constituents' concentrations (Table 9) observed among the dietary treatments. The increase in milk fat content of R2 and R3 rations may be due to the improvement of digestibility of ether extract and in turn increase the percentage of acetic acid than proponic acid and acetate: propionate ratio that consequently increase percentage of milk fat (Qussay *et al.,* 2015). Generally, our results are in agreement with the finding of Hejazi and Abo-Omar (2009) that feeding sesame seeds oil cake at 5%, 10% and 15% of ration to dairy goats had significant higher milk fat (4.8, 5.1 and 5.1%) than milk fat in control goats (4.3%), respectively. About 60 % of long chain fatty acids in milk fat generated with diets contained sesame seeds, which can arises milk fat as proved by Shirzadegan and Jafari, (2014) who found significant increase in milk fat, up to 3.65, 3.75, 3.78 and 3.88%, when sesame waste supplemented at levels 0, 5, 10 and 15% of rations, respectively. Similar trends of the current results observed on cows (Qussay *et al.,* 2015) who shown significant increase in milk protein (2.92, 3.27 and 3.36%), milk fat (3.18, 3.69 and 3.82%), total solid (11.42, 12.18 and 12.35%) while non-significant differences in lactose levels (4.61, 4.49 and 4.43%) when cows received 0, 10 and 20% of sesame meal, respectively. Generally, the improvement in nutritional status, especially for energy succeeded to improve milk production, as

Table 8: Suckling milk composition for goats fed the experimental rations.

Specification	Evaluation days	Experimental rations		
		R1	R2	R3
Fat ,%	15	5.19±0.08^{b}	**6.30±0.06^{a}**	**6.33±0.07^{a}**
	30	5.07±0.11^{b}	**5.81±0.12^{a}**	**5.94±0.06^{a}**
	60	5.03±0.09^{b}	**5.73±0.05^{a}**	**5.84±0.11^{a}**
	90	4.14±0.18^{b}	5.35±0.04^{a}	5.70±0.11^{a}
Protein, %	15	2.67±0.04^{b}	3.26±0.06^{a}	3.33±0.05^{a}
	30	2.43±0.03^{b}	2.73±0.08^{a}	2.84±0.07^{a}
	60	2.13±0.05^{b}	2.50±0.06^{a}	2.57±0.07^{a}
	90	2.05±0.05^{b}	2.30±0.06^{a}	2.3±0.06^{a}
SMEV (kcal/kg)	15	263.95±0.56^{b}	276.95±0.42^{a}	277.64±0.67^{a}
	30	261.47±0.73^{b}	269.57±1.31^{a}	271.36±0.45^{a}
	60	259.72±0.64^{b}	467.41±0.51^{a}	268.82±1.14^{a}
	90	251.35±1.19^{b}	264.48±0.52^{a}	266.45±1.21^{a}

Means within the same row direction with different superscripts are significantly different (P<0.05).

Table 9: Milk composition for goats fed the experimental rations during lactation.

Specification (%)	Experimental rations		
	R1	R2	R3
Fat	3.39±0.03^{b}	4.11±0.04^{a}	4.81±0.03^{a}
Protein	3.10± 0.03^{b}	3.15±1.00^{a}	3.17±0.08^{a}
Lactose	4.50±0.02	4.53±0.03	4.55±0.05
Ash	0.69±0.04	0.71±0.05	0.72±0.03
Solids not fat (SNF)	8.35±0.07^{b}	8.42±0.06^{a}	8.44±0.05^{a}
Total solids (TS)	11.81±0.10^{b}	12.55±0.11^{a}	13.16±0.12^{a}

Means within the same row direction with different superscripts are significantly different (P<0.05).

suckling and lactation, and has positive effect on increasing milk production and its components of fat or protein (Balthazar *et al.*, 2017).

Suckling milk yield and post suckling milk yield

Milk amount during suckling (Figure 1) and post suckling milk yield (Figure 2) were significantly (P<0.05) higher with R2 and R3 groups than R1 treatment. Current results clear that sesame seeds is a lactogenic feedstuff because it can increase milk production and the healthy polyunsaturated fatty acids, which describe sesame seeds a very nutritious. Hence, the significant improvement in nutrients intake from different types of protein and energy, with supplement of sesame seed in R2 and R3 compared to R1, perhaps consider the cause of variation in the level of daily milk production during suckling and lactation. Hejazi and Abo-Omar (2009) found a significant increase in daily milk yield of Anglo-Nubian Goats when their rations supplemented by 10% and 15% sesame oil cake. In addition, the present results are in accordance with Shirzadegan and Jafari (2014) who found that protein and energy provided with sesame intake improved milk yield when dairy cows fed diets contained 5, 10 and 15 % sesame hulls. Moreover, Qussay *et al.*

(2015) found that feeding dairy cow rations containing 10% or 20% sesame seeds meal caused significant increase in daily milk yield up to 10.87 and 11.94 kg as compared to 9.71kg for those fed the basal ration (0% sesame seeds), respectively.

Nourishment measurements

Data of daily dry matter intake (DDMI) during the different physiological phases of the experiment presented in Tables (10). Goats in the R2 and R3 groups had decrease in total DDMI and DDMI g/ kg of LBW$^{0.75}$, compared to R1 ration during flushing and trimester periods. Actually, health condition during gestation of lactating goats depends strictly on feeding systems. Hence, replacing CFM by RSS could improve the nutritional status through increasing energy, protein, mineral and vitamin intake and consequently optimizing the efficiency of feed utilization for growth and gestation for cows (Shirzadegan and Jafari, 2014). In support to the results here, Friesian dairy cows fed 10% or 20% sesame seeds consumed less CFM than those fed diet free of sesame seeds, while group fed 10% consumed higher amount of CFM than those received 20% (Qussay *et al.*, 2015).

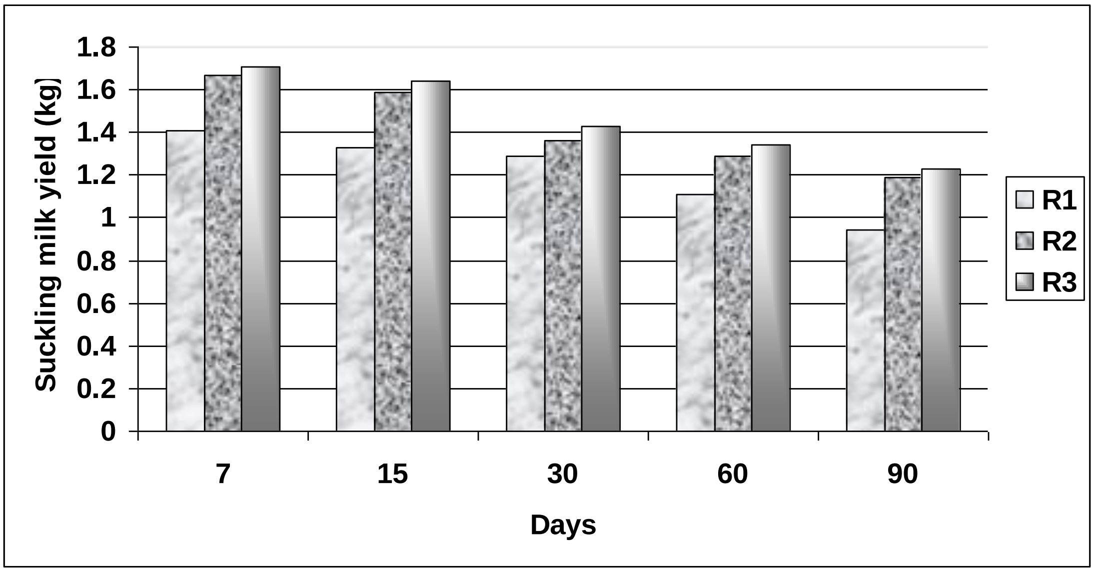

Fig. 1: Suckling milk for nanny goats fed the experimental rations.

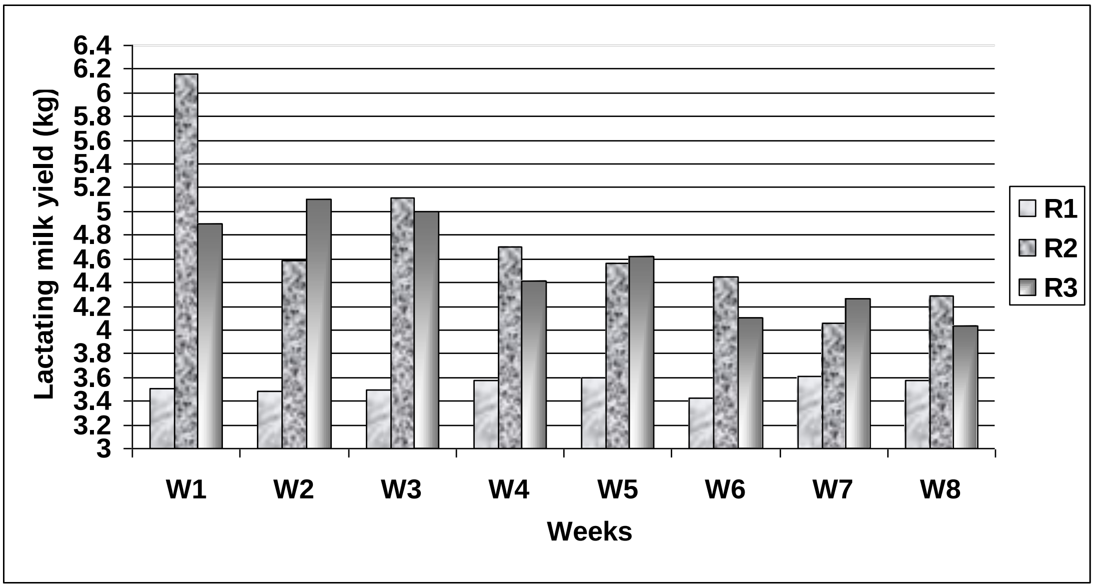

Fig. 2: Lactating milk of goats fed the experimental rations, during 8 weeks of lactation.

Table 10: Daily dry matter intake during flushing and trimester periods for goats fed the experimental rations.

Specification	Experimental rations		
	R1	R2	R3
***DMI from flushing to final mating up to 9 weeks**			
CFM, g/h	667	600	534
CS, g/h	641	641	641
RSS, g/h	-	58	116
Total DMI, g/h	1308	1299	1291
DMI, g/ kg of LBW$^{0.75}$, g/h	89.35	89.00	88.60
Roughage :concentrate	49:51	49:51	40:50
****DMI during trimester period up to 7 weeks**			
CFM, g/h	990	891	729
CS, g/h	428	428	428
RSS, g/h	-	85	170
Total DMI, g/h	1418	1404	1327
DDMI, g/ kg of LBW$^{0.75}$, g/h/d	89.35	85.50	80.62
Roughage :concentrate	30:70	30:70	32:68

*Its included three weeks as flushing plus six weeks as mating season.
**It means seven weeks pre-parturition.

Data in Table (11) indicate that total DMI and DMI per metabolic body unit ($w^{0.75}$) during pregnancy and lactation were slightly lower with the two tested rations (R2 & R3) than control (R1). Although, the protein consumed with R1, R2 and R3 treatments was comparable, the improvement accompanied R2 and R3 diets could refer to the improve in biological values of protein in sesame seed meal and its favorable effect on live weight of dairy goats during suckling (Tables 4) and milking (Tables 5). The goodness of LBW observed with R2 and R3 rations may related to the boosting effect of vitamins (Balthazar *et al.*, 2017), antioxidants (Wang *et al.*, 2017) and balance of protein in these tested rations (Ghani *et al.*,2017).

Table 11: Daily dry matter intake during suckling and lactation for goats fed the experimental rations.

Specification	Experimental rations		
	R1	R2	R3
DMI from suckling to weaning at 12 weeks			
CFM, g/h	525	473	420
CS, g/h	1230	1230	1230
RSS, g/h	-	45	90
Total DMI, g/h	1755	1748	1740
DMI, g/ kg of LBW$^{0.75}$, g/h	117.12	113.29	111.75
Roughage :concentrate	70:30	70:30	71:29
DMI during lactation period up to 8 weeks			
CFM, g/h	691	622	533
CS, g/h	695	695	695
RSS, g/h	-	59	118
Total DMI, g/h	1386	1376	1346
DMI, g/ kg of LBW$^{0.75}$, g/h	92.52	89.06	86.45
Roughage :concentrate	50:50	51:49	52:48

Table 12: Feed conversion ratio for goats fed the experimental rations.

Specification	*Experimental rations*		
	R1	*R2*	*R3*
Metabolic body size, $BW^{0.75}$	*15.52*	*15.43*	*15.58*
Feed intake (8 wks of lactation period)			
CFM, g/h/d	*691*	*622*	*533*
CS, g/h/d	*695*	*695*	*695*
RSS, g/h/d	*-*	*59*	*118*
Total feed intake, g/h/d	*1386*	*1376*	*1346*
DMI, g/ kg of $LBW^{0.75}$, g/h/d	*92.52*	*89.06*	*86.45*
Roughage :concentrate	*50:50*	*51:49*	*52:48*
CP intake, g/h/d	*169*	*166*	*167*
Milk yield, g/h/d	*0.36*	*0.48*	*0.47*
Feed utilization			
Kg feed intake: kg milk	*3.85*	*2.86*	*2.86*
LBW at lactation, kg	*0.47*	*0.35*	*0.36*

Data of feed conversion ratio of the experimental dietary treatments summarized in Table (12). These data revealed that, goats received 10% or 20% RSS instead of CFM yielded 0.48 and 0.47 kg/day/h milk versus those received 0 % RSS (R1) (0.36 kg /day /h), respectively. In the current study, feed utilization during lactation for R2 and R3 goats was better than goats in R1, being 2.86, 2.89 and 3.8 kg feed/kg milk, respectively. However, no significant difference between R2 and R3 treatments noticed respecting feed utilization during lactation period. The present results are in agreement with those recorded by Awawdeha *et al.* (2017) who found that sesame hulls incorporated in ration of growing kids could accomplish goodness of feed conversion ratio.

Blood metabolism

Table (13) illustrate the effect of introducing RSS partially instead of CFM at 10% (R2) or 20% (R3) rates, compared to basal diet 0% RSS (R1), on some blood parameters. Results indicate that blood total protein, globulin and HDL concentrations were significantly higher with the two tested rations than control, while the opposite occurred with total lipid, triglyceride, cholesterol and LDL contents, where the control group had significantly higher levels than tested ones. Meanwhile, the concentrations of blood albumin, glucose, ALT, AST, creatinine and urea did not significantly affected by the dietary treatments. These increases in total protein and globulin might due to the presence of monounsaturated and polyunsaturated fats in sesame seeds that might improve the digestibility of CP, which considered the main resin for increasing the levels of total protein and globulin. Similarly, Qussay *et al.* (2015) indicated that daily feed intake of dairy cows with rations contained 0, 10 and 20% sesame seeds meal increased significantly the total protein, 8.15, 8.68 and 8.75mg/100ml and globulin 4.31, 4.79 and 4.83 mg/100ml, respectively. On the contrary, Njidda and Isidahomen (2011) found no significant effect on serum albumin and total proteins, while there was significant effect on serum globulin between sesame and control treatments. The non-significant change of blood glucose concentrations among R1, R2 and R3 may refer to that inclusion of sesame seeds in the diet of goats have no adverse effects on insulin receptors or glucogenesis, glycolysis and glucose oxidation processes. These observations are in agreement with the findings of Shirzadegan and Jafari (2014) who found no-significant change in glucose concentration in dairy cows, where it reached 52.50, 53.75, 54.50 and 55.00 mg/dl for rations contained 0, 5, 10 and 15 % sesame waste, respectively. Indeed, aminotransferase enzymes as ALT and AST play an important role in intermediate metabolic processes as they provide a mean for the synthesis and degradation of amino acid in cells. The liver cells damage leads to an increases of serum level of both enzymes (ALT and AST), but in general, ALT elevation is more specific for liver damage than AST. The serum ALT and AST activities in the three dietary treatments were not differ and they were within the physiological normal ranges for goats. Definitely, sesame seeds contain two unique substances: sesamin and sesameolin, the later has shown to protect liver from oxidative damage and sesame seeds contain some powerful antioxidants, which may prevent the free radical formation that already formed (Kali *et al*., 2017). In the present investigation, the serum levels of creatinine and urea not affected significantly by dietary treatments despite that total protein significantly increased with the tested rations. Similarly, Saleh and Amer (2009) noticed that in spite the increase of total protein level, at 6.13, 7.77 and 7.97mg/dl, creatinine level decreased, as 0.94, 0.89 and 0.88 mg/dl, and urea levels decreased, as 26.4, 25.7 and 23.1mg/dl, in serum blood of lambs fed sesame seeds at 0, 4 and 8%, respectively. Meanwhile, Qussay *et al.* (2015) defined that total protein in serum blood was 8.15, 8.68 and 8.75 mg/100ml and serum urea levels were 56.91, 57.66 and 58.19 mg/100ml in meals supplemented with sesame seeds at rates 0, 10 and 20%, respectively. Noticeably, serum urea and creatinine concentrations are a useful indicator for regular filtration in the kidney and that the experimental goats were not in a catabolism situation, consequently, being in a good nutritional condition. The best kidneys function may be attributed to the antioxidant nature of vitamin E, that present in sesame seeds, which acts as a protective agent by breaking the chain reactions of both hydroxyl and peroxyl radicals and by regulating the antioxidative defense enzyme system in the kidney tissues (Ajayi Olubumi *et al.*, 2015). Total lipid was lower in goats received R2 or R3 rations than those fed R1 ration. This decrease may be due to that sesame seeds ingestion regulates the transcription levels of hepatic metabolizing enzymes for lipids and alcohol and increase the activity of various hepatic enzymes involved in fatty acids oxidation, thereby reducing serum and liver lipids (Taha *et al.*, 2014). Sesame seeds also deliver vitamin E and selenium (two powerful antioxidants) that have ability to protect against diseases. As well as, Aslam *et al.* (2017) found that both selenium and vitamin E are essential and highly efficient antioxidants, which protect rabbits against lipid and protein oxidation. In spite of the fact that sesame contains 44-58% oils, the present data came to ensure the hypolipidemic effects of sesame in R2 or R3 which reduced levels of triglycerides, cholesterol and LDL (the bad cholesterol) meanwhile, the level of HDL (the best cholesterol) was increased compared to control (R1). This observation confirmed by Qussay *et al.* (2015), who reported decrease in triglyceride, 39.79, 27.86 and 29.72 mg/100ml, and cholesterol, 126.71, 112.32 and 114.25 mg/100, when dairy cows received 0, 10 and 20% sesame seeds in meals, respectively. Actually, sesame seeds contains polyunsaturated fatty acids like linoleic acid, monounsaturated fats, cellulose, two unique substances (sesamin and sesame oil) and lignin that can reduce triglycerides, cholesterol levels and LDL. On the other hand, Nishant *et al.* (2008) reported that when sesame seed powder was administered to rats at 5% and 10% levels along with either normal or hyper-cholesteraemic diet for four weeks it resulted in a significant decline in plasma total lipid, cholesterol and LDL levels with an increase in plasma HDL and cholesterol levels.

Economic efficiency

Data in Table (14) indicate a considerable cost saving with using RSS in R2 and R3 compared to the control treatment R1. The differences in milk yield during lactation showed that diet containing 10% (R2) or 20% (R3) of RSS had the better values of milk production where it raised up to 189.58 kg (31.36%) and 182.14 kg (26.21%) for R2 and R3 compared to R1 (144.23 kg), respectively. At all events, this study has shown the economic advantage of using RSS in the diets of Zaraibi dairy goats, which due to the lower cost of RSS compared with CFM. So, using RSS at 10% or 20% instead of CFM can gave the lowest cost per one kg milk production. This reflected on increasing the economic efficiency relative to control, where it was 139.85 % and 143.55% from milk production of goats in R2 and R3, respectively relative to R1. So, these results encourage use of RSS as protein source instead of CFM in rations to achieve good performance for dairy goats. The obtained results are in accordance with those reported on dairy cows by Qussay *et al.*, (2015), on growing kids (Awawdeha *et al.*, 2017) and on fattening lambs (Bonos *et al.*, 2017).

Table (13): Blood metabolite parameters of goats fed the experimental rations.

Specification	Experimental rations		
	R1	R2	R3
Total protein, g/dI	6.47±0.09^{b}	7.80±0.17^{a}	7.93±0.26^{a}
Albumin, g/dI	3.47±0.12	3.67±0.08	3.73±0.19
Globulin, g/dI	3.00±0.10^{b}	4.13±0.13^{a}	4.20±0.10^{a}
Glucose, mg/dI	60.43±0.50	59.70±0.52	59.70±0.35
ALT, IU/L	19.20±0.17	18.60±0.06	18.50±0.51
AST, IU/L	32.27±0.34	32.17±0.26	31.73±0.12
Creatinine, mg/dI	0.93±0.04	0.86±0.02	87.00±0.01
Urea-N, mg/dI	25.13±0.18	23.77±0.17	23.97±0.12
Total lipid, mg/dI	266.33±0.33^{a}	227.33±0.88^{b}	226.67±0.87^{b}
Triglyceride, mg/dI	74.20±0.0.64^{a}	72.60±0.36^{b}	71.40±0.29^{b}
Cholesterol, mg/dI	180.33±2.19^{a}	173.67±0.88^{b}	170.33±0.89^{b}
HDL, mg/dI	28.80±0.81^{b}	38.17±0.47^{a}	38.77±0.88^{a}
LDL, mg/dI	137.93±1.07^{a}	125.70±0.70^{b}	126.57±0.55^{b}

Means within the same row direction with different superscripts are significantly different (P<0.05).

Table 14: Economic efficiency of the experimental rations.

Feed consumptions / g /eight wks/ 5does	Experimental rations		
	R1	R2	R3
CFM	209.44	188.44	161.58
CS	554.12	554.12	554.12
ISS	-	17.36	34.72
Total feed intake ^{A}	763.56	759.92	750.42
Cost of CFM , LE	879.65	791.45	678.64
Cost of CS , LE	249.35	249.35	249.35
Cost of sesame, LE	-	43.40	86.80
Total price of feed consumed , LE^{B}	1129.00	1084.20	1014.79
Total milk yield, kg ^{C}	141.32	189.58	182.14
price of sold milk, LE^{D}	565.28	758.32	728.56
Economic efficiency			
Feed efficiency $^{C/B}$	0.13	0.17	0.18
Feed conversion $^{A/C}$	5.40	4.00	4.12
***Feeding cost of produced milk $^{B/C}$**	7.99	5.72	5.57
Economic efficiency (EE) amount, $^{D/B}$	0.5001	0.6994	0.7179
Economic efficiency (EE), %	50.01	69.94	71.79
EE (%) relative to control	100.00	139.85	143.55

Price of sold kg of goat milk was 4.0 (LE).

Price in year 2016-2017 for CFM, CS and RSS were 4200, 450 and 2500 LE /ton, respectively.

*** Feed cost of producing 1 kg milk /doe = Feeding cost of produced milk / does ÷ 5.**

CONCLUSION

In conclusion, refused sesame seeds industrial by-product is relatively low in price and high in CP content, so it could use as efficient alternative source to CFM up to 20%, for its positive effects on reproductive and productive performance of dairy goats.

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الملخص العربى

تأثير التغذية على بذور السمسم الغير صالحة للتصنيع على الأداء التناسلى والإنتاجى للماعز الحلابة

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****قسم بحوث المخلفات الزراعية معهد بحوث الإنتاج الحيوانى**

*****قسم بحوث تكنولوجيا الألبان معهد بحوث الإنتاج الحيوانى**

الغرض من هذه الدراسة كان تحديد تأثير إستبدال بذور السمسم الغير صالحة للتصنيع لـ 10% ,20% من العلف المركز على الأداء التناسلى والإنتاجى وأيض الدم والكفاءة الإقتصادية للماعز الزرايبى الحلابة. استخدمت 15 عنزة حلابة عمرها 36 إلى 38 شهر ومتوسط وزنها35.71 كجم، قسمت إلى ثلاثة مجاميع (5 عنزة /مجموعة). العليقة الكنترول ع1 تكونت من سيلاج الذرة، و العلف مركز. العليقة ع2، ع3 احتوت نفس العليقة السابقة مع استبدال 10%،20% من العلف المركز ببذور السمسم الغير صالحة على التوالى. وتم ضبط ع2، ع3 للبروتين والطاقة مثل ع1. استمرت التجربة من قبل موسم التلقيح حتى 8 اسابيع من الحليب. أوضحت النتائج أن ع2، ع 3 أفضل فى معدل الخصوبة حيث حجم البطن 2.60، 2.80 مقارنة مع ع1 الكونترول 2.20 على التوالى. وزن الجسم للماعز خلال الحمل، والرضاعة ، الحليب ، معدل نمو الجداء أظهر مع ع2،ع3 فروق معنوية (0.05) مقارنة مع ع1. كان محصول اللبن عالى معنويا (0.05) مع ع2 (189.58 كجم)، ع3 (183.14 كجم) مقارنة مع ع1 (141.32 كجم) خلال 8 اسابيع حليب. مكونات سيرم الدم الضارة مثل الجلسريدات الثلاثية (74.20، 72.60، 71.40 مليجرام)، LDL (137.93، 125.70، 123.57 مليجرام) والكولسترول (180.33، 173.67، 170.33 مليجرام) كانت اعلى معنوية مع ع1 بالمقارنة مع ع2، ع3 على التوالى. ومستوى سيرم الدم من المكونات المفيدة HDL كان عالى المعنوية مع ع2(38.17 مليجرام) ،ع3 (38.57 مليجرام) مقارنة مع ع1(28.80 مليجرام). كان الربح 34.15 % ، 28.89 % مع ع2، ع3 على التوالى مقارنة مع ع1 .وكانت اعلى كفاءة اقتصادية مع ع3 (143.55%) يليها ع2 (139.85 %) مقارنة مع ع1 (100 %). وبناء عليه لتحسين أداء االماعز الحلابة يمكن تشجيع المربين على تطبيق إحلال بذور السمسم الغير صالحة للتصنيع بنسبة 10% أو 20% من العلف المركز الكلى مما يساعد جزئيا على تخفيف الزيادة في تكاليف التغذية وتحقيق أداء انتاجى افضل للماعز الحلاب.