EFFECT OF SOME FEED ADDITIVES ON YIELD AND SOME PROPERTIES OF GOAT'S MILK AND SOFT CHEESE MADE FROM IT

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SUMMARY

Control (G1) and three additives namely, caraway (*Carvum carvi L.*) (G2) ; fennel (*Foeniculum vulgare*) (G3) and fenugreek (*Trigonella foenum-graecum*) (G4) were added to the daily feed intake of goats at the rate of 100, 100 and 200 mg dried seeds/kg live body weight, respectively.

During the suckling period, does were milked. Milk yield and composition were recorded during lactation period from April to August. Rennet clotting time (RCT), curd tension (CT) and curd syneresis (CS) were determined as affected by the experimental rations (G1-G4). The yield, composition and sensory properties of the manufactured soft cheese were also assessed.

Results revealed that daily milk yield was the highest in G2 and was the lowest in G4, while it was greatly affected by lactation period. Milk fat, casein, TS, SNF, ash and TVFA were not affected by the applied treatments, whereas protein content was significantly higher in G4. RCT was significantly higher in G3 and lower in G4, whereas CT was significantly higher in G1 and the differences due to G2, G3 and G4 were insignificant. CS showed higher and lower significant values in G1 and in G4, respectively.

Cheese yield was significantly higher in G4. Total solids and protein contents of cheese were significantly higher in G3, whereas the organoleptic properties were not significantly affected by the applied treatments..

INTRODUCTION

Using chemical materials especially hormones and antibiotics as feed additives in animal and poultry rations to improve their productive performance may cause unfavorable side effects. These materials could be considered as pollutants for human and threaten their health on the long-run. Attempts to use the natural materials such as medicinal plants could be widely accepted as feed additives to improve the efficiency of feed utilization and animal productivity (Aboul-Fotouh *et al.*, 1999).

Simon *et al.*, (1984) observed that Fennel is a good herb for the entire digestive system as a laxative, appetite stimulant, antispasmodic and carminative, relieves abdominal pain, and is useful for gastrointestinal and colon disorders. It acts as a mild expectorant; useful for coughs or bronchitis and to resolve phlegm, promotes liver and kidney function and health. Carvi stimulates the functions of the digestive organs relaxes spasms of smooth muscles and acts as anti-spasmodic, tonic and activates the digestive system (Edinger, 1982). However, Duke (2002) and Sahalian (2004) reported that Fenugreek benefits the digestive system as a laxative, intestinal lubricant, carminative, vomiting, colitis, swell, vermifuge, digestive and tonic, helps in dissolving fat and cholesterol deposits, prevents fat accumulation and water retention, and helping lowering blood sugar levels. It is used to treat abscesses, inflammation, wounds, coughs, arthritis and bronchitis as well as to reduce mucus production and good for asthma and lung disorders.

Allam *et al.* (1999) observed that using Fenugreek seeds, Nigella sativa seeds and garlic cloves (500, 100 and 60 mg/kg live body weight, respectively) as feed additives in the rations of Zaraibi goats improved the nutritive values, feed conversion and economic return; and minimized feed cost during suckling period. Fenugreck increased feed intake by 13.64% and minimized total water needs by 26.02%. Moreover, serum cholesterol and total lipids reduced while triglycerides, protein and globulin in goats

increased as a result of adding chamomile flowers to the diet (El-Hosseiny *et al.*, 2000). Also, Khattab *et al.* (2001) observed that the addition of 200 g Fenugreek seeds, 50 g Caraway, 50 g black seeds and 100 g *Lepidium sativum* to the basal diet of lactating buffaloes led to increase (P<0.05) milk yield and 4% FCM. The nutrients digestibility increased significantly in the treated rations and Fenugreek seeds increased (P<0.05) blood glucose.

Concentrate supplementation to lactating goats is a recommended method of manipulating milk yield and composition (Sauvant and Morand-Fehr, 2000). There is few information regarding feeding systems and other factors affecting chemical composition of goat's milk and particularly the resultant cheese yield and its quality.

Therefore, the present study was conducted to evaluate effects of addition of caraway (*Carvum carvi L.*) ; fennel (*Foeniculum vulgare*) and fenugreek (*Trigonella foenum-graecum*) seeds to the rations of exotic Damascus goats on milk yield and composition as well as yield and quality of the resultant soft cheese.

MATERIALS AND METHODS

A number of 28 Damascus goats belonging to herd of Sakha Experimental Station, Animal Production Research Institute, Ministry of Agriculture was used in the present study. All does were given the NRC feeding requirements (NRC, 1996) for production of 1-2 kg milk/head/day. The daily feed intake per doe composed of 1.250 kg concentrate mixture + 4 kg berseem or 1.2 kg berseem hay. Does were classified into four groups: G1 represented the control (no additives) whereas in G2, G3 and G4 treated groups additives Carvi (*Carvum carvi*) ; Fennel (*Foeniculum vulgare*) and fenugreek (*Trigonella foenum-graecum*) were added to concentrate mixture at the rates of 100, 100 and 200 mg dried seeds/kg live body weight/head/day, respectively.

During the suckling period, all does groups were milked twice/day by hand every two weeks. Milk yield was individually measured, recorded and samples were taken for chemical analysis. The total milk yield for a doe at the day of milking was considered to represent her average daily milk yield during the previous two weeks. During the day of milking, kids were removed from their dams and allowed to suckle other goats. After the end of suckling period, machine milking was applied twice daily up to the end of lactation. Milk yield was individually measured at each milking time using Tru-Test milk meter fixed on the milk line. Breed group milk samples, 100 ml each, were taken monthly for chemical analysis. Each doe was dried up when her daily milk yield declined to 200 g for three successive days. The daily milk yield and duration of lactation were individually recorded and lactation curve was established for goats of each group.

During suckling period, at the day of hand-milking, the morning milk from goats of each breed group was pooled, cooled at 5°C, added to the evening milk, mixed well and representative samples were taken. During machine milking period, morning cooled milk samples - taken biweekly by means of the milk meter- were added to the evening ones, pooled and the representative breed group samples were taken. Milk samples were kept at -5°C till the time of chemical analysis.

Following are the milk chemical composites, which were analyzed in milk samples of each breed group of goats studied, and method used for the determination of each composite and some rheological properties as follows: Fat and total solids (TS) were measured according to Ling (1963) whereas ash as described in AOAC (1984). Total volatile fatty acids (TFVA) content was measured as given by Kosikowiski (1978). Total Nitrogen (T.N) was determined using micro-Kjeldahl as recommended by Rowland (1938). Non-casein nitrogen (NCN) and non-protein nitrogen (NPN) were determined in the collected filtrate after precipitation of casein and protein, respectively. Casein nitrogen (CN) and whey protein nitrogen (WPN) were quantified by the

difference as given by Rowland (1938) as follows: CN = TN-NCN ; casein = CN x 6.38 and whey protein = (NCN-NPN) x 6.38

Rennet coagulation time (RCT) was determined according to Berridge (1952). Curd tension (CT) was measured at room temperature (25-30°C) as given by Chandrasekhara *et al.* (1957), whereas whey syneresis (CS) was followed according to Mehanna and Mehanna (1989).

Soft cheese was manufactured mainly as given by Fahmi and Sharara (1950). Yield of fresh cheese (kg/100 kg) was calculated. All cheese samples were analyzed for total solids (TS), fat and TN as described by Ling (1963). The organoleptic properties were assessed as recommended by Naguib *et al.* (1974).

Analysis of variance and Duncan's test as well as average and standard error were carried out using a SPSS computer program (SPSS, 1999).

RESULTS AND DISCUSSION

Milk yield and composition:

Table (1) shows the differences in average daily milk yield (ADMY) among the experimental groups. The values were the highest in G2 and the lowest in G4, whereas G1 and G3 had nearly the same figures. In general, the differences among the different groups were insignificant (P>0.05). The changes in ADMY at the different lactation periods in all experimental groups (Fig. 1) showed that the highest values were in the control group after 3 months, and then decreased to the lowest values at 5th month. In G2 and G3 the highest values were recorded after 1 month, followed by decrease to the lowest degree at 5th month.

Table (1): Milk production and milk composition of goat's milk as affected by experimental rations

Property	*Treatment groups*			
	G1	G2	G3	G4
Milkyield (kg/d)	0.937±0.08[a]	0.989±0.06[a]	0.938±0.05[a]	0.816±0.06[b]
Milk composition:				
Fat %	2.58±0.17	2.75±0.16	2.53±0.30	2.83±0.11
Fat yield (kg)	74.01±2.91	82.03±3.75	67.55±6.60	73.77±9.00
Protein %	2.884±0.24b	3.005±0.19[ab]	2.903±0.19[b]	3.394±0.08[a]
Proteinyield (kg)	90.41±3.82	89.64±4.74	81.35±1.31	80.62±8.21
Casein%	2.90±0.32	2.396±0.16	2.36±0.12	2.710±0.07
Casein/TN%	77.26±0.53[a]	78.075±0.73[a]	77.97±0.78[a]	74.14±0.33[b]
Whey protein %	0.491±0.03[a]	0.364±0.04[b]	0.410±0.02[ab]	0.425±0.02[ab]
TS%	10.31±0.341	10.53±0.25	10.32±0.46	10.64±0.31
SNF%	7.73±0.52	7.78±0.12	7.79±0.11	7.246±0.33
Ash%	0.77±0.01	0.77±0.02	0.74±0.01	0.75±0.01
TVFA*	0.209±0.01	0.182±0.01	0.199±0.01	0.210±0.01

* ml 0.1 N-NaOH/10 g miik.

Means a, b and c...etc in the same row with different superscripts differ significantly ($P<0.05$).

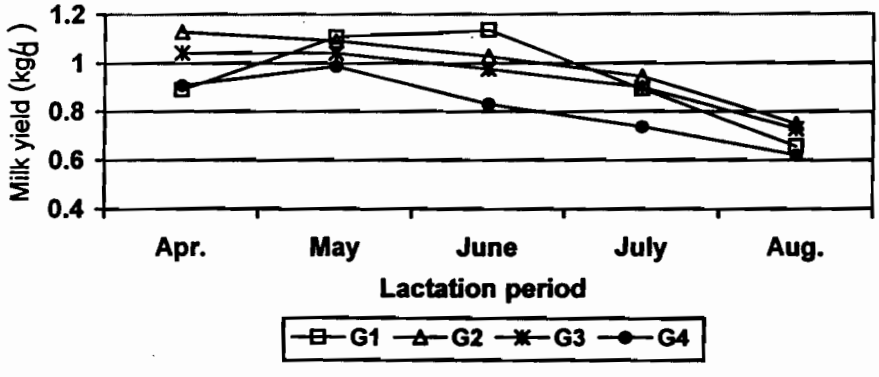

Fig. (1): Milk yield (kg) of goat's milk during lactation period as affected by experimental rations.

Percentage of milk fat did not differ significantly among the experimental group (Table 1). The values ranged between 2.53 and 2.83% for the control group (G1), and showed the same trend during lactation, while in all treatment groups the maximum value

was recorded in the 3rd month, but the minimum one was at the first and end days of lactation, respectively (Fig. 1), G2 showed almost the highest values.

Percentage of protein was significantly (P<0.05) different among the experimental groups, being higher in G4, followed by G2, but the differences were not significant between G1 and G3 (Table 1). At lactation time, protein content was the highest in G2 at the first period. It is of interest to note that protein content of groups G2, G3 and G4 showed similar trend of changes during the lactation period (Fig. 2).

Results presented in Table (1), revealed that percentage of casein was not significantly affected by the applied feeding treatments. In spite of the insignificant differences among casein/TN values, the ratio was the lowest in G4. The whey protein value was significantly (P<0.05) different among the experimental groups being higher in G1, followed by G4 and G3, respectively, while the lowest values were in case of G2 (Fig. 2).

Total solids (TS) contents did not differ significantly among the experimental groups ranging between 10.31 and 10.64% (Table 1). According to the changes in fat and TS contents in all groups, solids not fat (SNF) content did not differ significantly among the experimental groups. SNF showed nearly similar trend to that occurred in fat and TS contents (Fig. 2).

Ash content was not significantly affected by the applied treatments and the values ranged between 0.74 and 0.77% (Table 1 and Fig. 2). Total volatile fatty acids (TVFA) content was also not affected significantly by feeding treatments (Table 1 and Fig. 2) since all the experimental groups showed nearly similar figures. Generally, it is well known that the gross composition of goat's milk is affected by many factors such as diet, breed, parity, stage of lactation and environmental conditions (Guo *et al.*, 2001).

In general, stage of lactation seems to have the same impact given in the literature on the gross chemical composition of goat's milk (Guo *et al.*, 2001 and Soryal *et al.*, 2004).

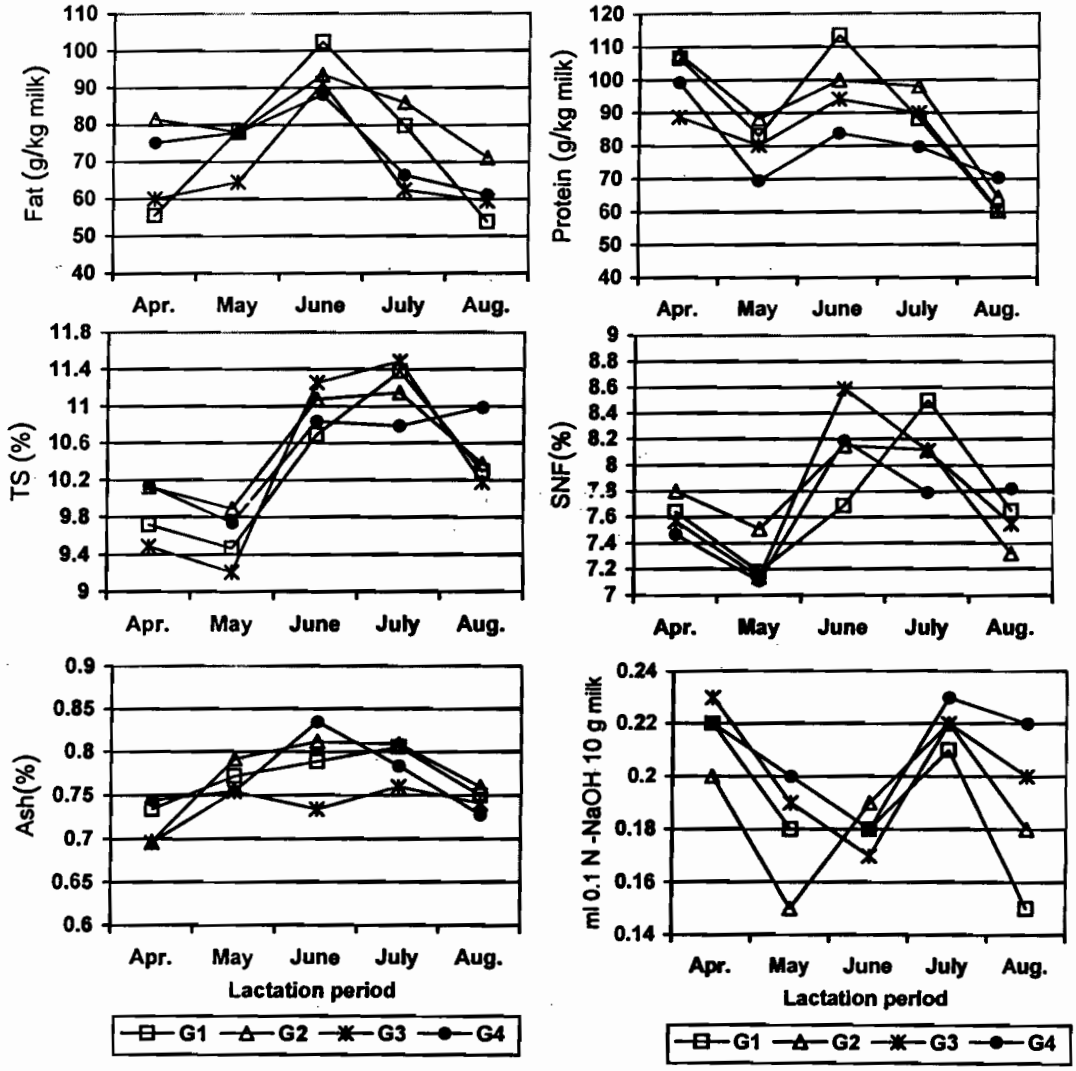

Fig. (2). Milk yield and composition during the lactation period from April to August as affected by the feeding treatments (G1-G4).

Characteristics of milk coagulum:

Table (2) reveals that the trend of rennet clotting time (RCT) was different as affected by the applied treatments. The values of RCT were insignificantly different between G1 and G2, and were between those of G3 and G4. G3 samples had the highest significant values, whereas G4 had the lowest significant figures. This trend of results reflected on curd tension (CT) and curd syneresis (CS). Thus, the control samples had the highest CT value, which differed significantly from those of the other treatments. However, the different in CT values due to G2, G3 and G4 treatments were insignificant. Such trend of results was accompanied by similar trend for the CS. Thus, G1 had the highest CS values, which significantly differed than those of the other treatments, especially, at the late syneresis time. Curd from G4 gave the lowest values in this respect followed by those of G3 and G2, respectively.

Table (2): Rennet clotting time (min), curd tension (g) and curd syneresis (g/15 g) of goat's milk as affected by experimental rations (G1-G4)

Treatments	Item	Clotting time	Curd tension	Curd syneresis after*			
				10 min	30 min	60 min	120 min
G1	Min.	12.58	14.0	5.33	6.47	7.63	7.94
	Max.	12.95	19.0	5.64	6.75	7.27	8.53
	Mean	12.72^{b}	16.0^{b}	5.54^{a}	6.66^{a}	7.45^{a}	8.26^{a}
	SE	0.115	0.730	0.103	0.080	0.180	0.290
G2	Min.	11.18	10.0	5.34	6.01	7.05	7.44
	Max.	13.00	18.0	5.85	6.46	7.36	7.56
	Mean	12.10^{b}	13.83^{a}	5.59^{a}	6.33^{a}	7.26^{b}	7.53^{b}
	SE	0.525	0.325	0.256	0.126	0.100	0.020
G3	Min.	16.78	10.0	5.01	5.86	6.77	7.09
	Max.	18.00	16.0	5.25	6.00	6.82	7.23
	Mean	17.20^{a}	13.67^{a}	5.13^{a}	5.94^{ab}	6.79^{b}	7.12^{b}
	SE	0.398	0.918	0.118	0.060	0.020	0.010
G4	Min.	10.26	11.0	4.04	4.93	5.96	6.39
	Max.	10.41	15.0	4.57	5.73	6.36	6.55
	Mean	10.31^{c}	13.50^{a}	4.31^{b}	5.33^{b}	6.16^{c}	6.52^{c}
	SE	0.050	0.710	0.264	0.390	0.201	0.030

Means a, b and c... etc in the same column with different superscripts differ significantly ($P<0.05$).

Soft cheese:

Data in Table (3) show that yield of the cheese was significantly higher in G4 than the values from the other treatments. In spite of cheese yield from treatment G3 was the lowest, the differences in this respect between G3, G2 and G1 were insignificant. However, cheese yield in the present study was higher than those given by Mehanna and Hefnawy (1991) who obtained 15.17% for yield of Domiati cheese made from goat's milk. Soryal *et al.* (2004) gave values of 12 to 18% and attributed such range of results to variations in moisture content. On the other hand, soft cheese yield was reported in the literature to be affected by fat and protein content of goat's milk (Zeng and Escobar, 1995). Sanz Sampelayo *et al.* (1998) fed diets that different in protein sources to goats and reported a higher cheese yield ranging from 20.1 to 26.2%.

Table (3): Effect of experimental rations on cheese yield, chemical composition and organoleptic properties of fresh soft cheese

Property	Treatment groups			
	G1	G2	G3	G4
Yield, %	19.84±0.84^{b}	19.17±0.84^{b}	17.77±0.57^{b}	23.08±0.08a
Total solids, %	31.73±0.20^{ab}	31.85±0.38^{ab}	36.67±0.16^{a}	28.83±0.57^{b}
Fat, %	14.50±0.85	12.00±0.20	13.25±0.25	12.75±0.75
Protein, %	8.62±0.53^{b}	10.15±0.18^{a}	11.01±0.86^{a}	8.79±0.07^{b}
Sensory scores*				
Flavour (60)	49.62±2.32^{a}	49.75±2.22^{a}	42.38±1.19^{b}	48.00±1.20^{a}
Body & texture (30)	25.13±1.60	26.38±1.12	25.88±1.15	26.50±1.23
Saltiness (5)	3.13±0.30	4.25±0.25	4.25±0.25	4.00±0.33
Appearance (5)	4.25±0.25	4.38±0.33	3.87±0.29	4.00±0.33
Total (100)	82.13±1.52^{a}	84.76±2.05^{a}	76.38±1.85^{b}	82.50±1.63^{a}

* Average±SE of 15 evaluations from 3 replicates.
Means a, b and c... etc in the same row with different superscripts differ significantly (P<0.05).

Total solids of the resultant cheese was the highest in G3, and the lowest in G4 treatments, whereas insignificant differences were recorded between TS of G1 and G2 cheese. The differences in fat content due to the applied treatments were insignificant in spite

of the control cheese had the highest fat content. Protein content was the highest in G3 cheese with insignificant differences with that of G2 cheese. G1 and G4 had the lowest protein content.

The orgaoleptic evaluation (Table 3) revealed that the falvour of the cheese was not affected by the applied treatments with exception of cheese from G3 treatment, which gained the lowest scoring points. The differences in this respect between cheese falvour of the other treatments were insignificant. The goaty flavour in all cheeses was attributed to the abundant amount of short-chain fatty acids in goat's milk as compared with cow milk. The body and texture, saltiness and appearance were not affected by the applied treatments since the scoring points given were not significantly different, However, the total score given for G3 cheese was significantly lower than those given for the other cheeses.

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الملخص العربى

تأثير بعض الاضافات الغذائية على محصول وتركيب لبن الماعز والجبن الناتج منه

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معهد بحوث الانتاج الحيوانى ، مركز البحوث الزراعية ، وزارة الزراعة ، الجيزة ، الدقي .

أهتم البحث بدراسة تأثير بعض الإضافات الغذائية الى الطيقة على محصول وتركيب وصفات لبن الماعز والجبن الناتج منه ، قسمت ٢٨ معزة من سلالة الدمشقى إلى أربع مجاميع: المجموعة الأولى مقارنة ، تم إضافة بذور الكراوية ، الشمر ، الحلبة الجافة يومياً على الغذاء للمجموعات الثانية والثالثة والرابعة بمعدل ١٠٠ ، ١٠٠ ، ٢٠٠ ملجم /كجم من وزن الماعز على الترتيب. وقدر محصول اللبن وتركيبه خلال فترة الحليب التى تبدأ من شهر أبريل إلى شهر أغسطس. تم تقدير بعض الخواص التصنيعية اللبن كسرعة التجبن بإنزيم الرنين وقيم الجذب الخثرى وكمية الشرش المنفصلة من الخثرة نتيجة تأثير المعاملات الغذائية ، وتم تقدير محصول وتركيب والخواص الحسية للجبن المصنع من لبن تلك المعاملات.

وقد أوضحت النتائج أن أعلى إنتاج اللبن كان للمجموعة الثانية بينما كانت المجموعة الرابعة أقل المجاميع خلال فترة الحليب. بينما لم تكن هناك فروقاً معنوية بالنسبة للدهن والكازين والجوامد الصلبة اللبن والجوامد الصلبة اللادهينة والرماد والمحتوى من الأحماض الدهنية نتيجة المعاملات الغذائية ، بينما كانت هناك فروق عالية المعنوية فى المحتوى من البروتين بالنسبة للمجموعة الرابعة عن باقى المجموعات الغذائية ، أيضاً بالنسبة لوقت التجبن بإنزيم الرنين كانت أعلى القيم للمجموعة الثالثة وأقلهم للمجموعة الرابعة ، أيضا بالنسبة لقيم الجذب الخثرى كانت أعلاها للمجموعة الأولى عن باقى المجموعات ، وأيضاً بالنسبة لقيمة الشرش المنفصلة من الخثرة كان أعلى القيم بالنسبة للمجموعة الأولى وأقل القيم للمجموعة الرابعة.

بالنسبة للجبن المصنع من اللبن الناتج نتيجة المعاملات الغذائية كان أعلى تصافى للجبن المصنع من المجموعة الرابعة ، وكانت أعلى نسبة للجوامد الصلبة والبروتين فى الجبن المصنع عن المعاملة الثالثة ، بينما لم تكن هناك فروق معنوية بالنسبة للخواص الحسية للجبن الناتج نتيجة تأثير المعاملات الغذائية.