J. Food and Dairy Sci., Mansoura Univ., Vol. 9 (11): 365 - 369, 2018

Making Zabadi from Cow's Milk by Adding Different Concentrations of Goat's Protein

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ABSTRACT

Cow's milk sample were analysed for fat, protein, lactose and total solids were determined. Yoghurt manufacture from cow's milk which separated into three replicates treatments as well as goat's protein additive with 0, 1, 2 and 3%. Zabadi was manufactured and gross chemical composition were determined. The recorded pH values at zero time were 6.44, 6.28, 6.41 and 6.41 when MPC was added at the rate of 0, 1, 2 and 3% respectively. After 30 minutes of incubation, the corresponding pH values were 6.09, 6.12, 6.00 and 5.89 in order, but such differences were insignificant. TS values were 12.04, 12.86, 13.36 and 14.03 when MPC was added at the rate of zero, 1, 2 and 3% respectively. In the fresh Zabadi, the recorded TN values were 0.62, 0.66, 0.69 and 0.82% when MPC was added at the rate of 0, 1, 2 and 3% respectively. Fat content of the control samples had the value of 3.31%, and fat/TS of control fresh Zabadi had the values of 27.65% which significantly decreased to be 25.86, 24.52 and 23.77% in the samples treated with 1, 2 and 3% MPC respectively. Lactose content was gradually increased to 4.06, 4.45 and 4.72% when MPC was added at the rate of 1, 2 and 3 respectively. Ash content increased with increasing the amount of MPC added. Thus, in the fresh Zabadi, the values were 0.73, 0.78, 0.83 and 0.85% when the MPC was added at the rate of 0, 1, 2 and 3% respectively. The recorded CT in fresh Zabadi were 20.2, 25.3, 28.32 and 32.00 g when MPC was added at the rate of 0, 1, 2 and 3% respectively. Curd syneresis (CS) of the fresh Zabadi as affected by using different amount of MPC in making Zabadi. The amount of the exudate were 4.34, 3.95, 2.08 and 1.92 g after 10 min. The corresponding values were 6.20, 5.44, 3.57 and 3.21 g after 30 min and 7.35, 6.63, 5.08 and 4.40 g after 60 min when MPC was added at the rate of 0, 1, 2 and 3% respectively. For general appearance, the control samples had the lowest value (7.67 out of 10 points), whereas the treated samples had 8.5, 9.35 and 10.0. Points when MPC was added at the rate of 1, 2 and 3% respectively. This means that increasing the amount of MPC added significantly improved appearance of the resultant Zabadi. This was also noticed with respect to firmness of the curd. The given score was 7.01 out of 10 for the control Zabadi and 7.67, 8.35 and 9.35 for Zabadi samples treated with 1, 2 and 3% MPC respectively. In conclusion, using MPC with 3% goat's protein content greatly improved the organoleptic properties of full-fat cow's milk Zabadi.

Keywords: Zabadi, cow's milk ; Goat's protein.

INTRODUCTION

Goat's milk is an excellent matrix for developing a large variety of innovative health promoting products or functional foods. Current separation technologies allow for the isolation and purification of dairy proteins into natural food ingredients, many of which exhibit excellent functional properties, including foaming, emulsifying, thickening, texturization, and gelation. These value-added food ingredients help the food industry meet specific demands that cannot be fulfilled with milk itself. Concerning whey protein products, different food applications require different specific functional contributions in terms of solubility, foaming emulsifying, water binding and gelling characteristics (Abd El-Salam (1992, Imafidon, 1997, Harper and Huffman, 1999 and Mattile-Sandholm *et al.* 2002).

Casein and why proteins represented about 79.5 and 19.5% of total milk protein (30-35 g/l of milk), respectively. Their main fractions αs1, CN, β-CN, κ-CN, β –Lg and α-LA. In addition to serving a biological and nutritional role, caseins are important because of their structure, charge, and physical properties (Swaisgood, 1996 and Chandan, 1997). Caseins are able to undergo posttranslational phosphorylation due to unique primary and tertiary structures. Chemical modification of caseins results in the formation of anionic clusters in the calcium-sensitive caseins (αs and β- casein). The ionic alterations, along with the amphiphilic structure of caseins, allow the molecules to interact with one another to form large spherical micelles ranging in diameter from approximately 30 to 300 nm. The spherical casein micelles are stabilized by calcium insensitive κ-caseins (Brunner, 1981, Swaisgood, 1996 Fox and McSweeney, 1998).

The aim of the present study is the application of different preparations of goat's milk protein in making Zabadi, as affected by the addition of 1, 2 and 3% concentrates, and evaluate their impact on the composition and properties of the resultant product.

MATERIALS AND METHODS

Fresh cow's milk was obtained from Sakha Animal Production Research Station, belonging Animal Production Research Institute, Agriculture Research Center. The milk was standardized to contain 3% fat content before its using in making yoghurt. Cow's milk was applied into three replicates treatments, as well as protein goat's additive with 0, 1, 2 and 3% milk protein concentrate (MPC). The traditional method of making yoghurt was applied according to Tamime and Robinson, 1985). The resultant yoghurt was chemically and physically analyzed, and organoleptically evaluated when fresh and after 7 days of storage in the refrigerator.

Analytical methods:

Titratable acidity and total solids content were determined as given by Ling (1963). The pH values was determined directly in yoghurt using HANNA H18519 pH-meter. Fat content: was determined as described by Gerber's method as described by BSI (1952). Total nitrogen and ash contents were determined as described in AOAC (1984). Lactose content was assessed as mentioned by Barnett and Abd El-Tawab (1957).

Rheological analysis of Zabadi:

Curd tension was estimated according to Chandrasekhara *et al.* (1957) as described by Abd El-Salam *et al.* (1991). The rate of curd syneresis at 42±0.5°C was evaluated as described by Mehanna and Mehanna (1989). Organoleptic properties of Zabadi were assessed according to El-Shibiny *et al.* (1979).

Statistical analysis:

Statistical analysis was performed by using the SPSS version (10) computer program (SPSS 1999) and Duncan's Test (1955) to determined significant differences among means at the Statistical significance level of 0.05.

RESULTS AND DISCUSSION

Chemical composition of cow's milk used in making fresh Zabadi :

Table (1) shows the average of the acidity value of cow's milk used in making fresh Zabadi. The detected acidity was 0.16%, whereas the pH was 6.67. The average composition of cow's milk revealed that the TS, fat, protein and lactose contents were 10.44, 3.30, 3.53 and 3.61%, in the same order.

Table 1. Acidity, pH and gross chemical composition of cow's milk used in making Zabadi.

Constituent	Cow's milk
Acidity, %	0.16±0.01
pH value	6.67±0.02
Total solids, %	10.44±0.02
Fat, %	3.30±0.06
Protein, %	3.53±0.02
Lactose, %	3.61±0.01

Effect of using MPC on the activity of yoghurt culture in full-fat fresh Zabadi :

Results presented in Table (2) revealed that the activity of yoghurt culture was affected by the concentration of added milk protein concentrate (MPC). Adding MPC at the rate of 1% was of no effect on the pH of the milk at zero time, but by increasing the concentration of the addition to 2 or 3% significantly decreased the pH. The differences in pH between 1% addition and the control were not significant, but were significant, compared with added MPC at 2 or 3% MPC. Therefore, the recorded pH values at zero time were 6.44, 6.28, 6.41 and 6.41 when MPC was added at the rate of 0, 1, 2 and 3%, respectively. The corresponding pH values were 6.09, 6.12, 6.00 and 5.89 after 30 minutes of incubation, in the same order, however such differences were insignificant. Similar trend was also observed after 60 and 90 min of incubation. The corresponding pH values were 5.34, 5.31, 5.81 and 5.39 after 60 min., and 5.05, 5.01, 5.33 and 4.99 after 90 min., respectively. This suggests that in spite of such differences in pH were insignificant, the pH of milk treated with 3% MPC was much lower, when compared with that of 2% MPC. Higher pH values were recorded in the treatment being made by the addition of 1% MPC. The foregoing results revealed that the addition of MPC was of no retarding effect on the activity of yoghurt culture, but in contrary such treatment slightly improved this activity. The higher the concentration of MPC added, the lower was the value of pH. In this respect, Rasic and Kurmann (1978) mentioned that during acidification of yoghurt milk by bacterial growth, there is a gradual removal calcium and phosphate from the caseinate particles and transfer to soluble state. At pH 5.2-5.3 the caseinate particles are destabilized, initiating precipitation. Complete precipitation occurs at pH 4.6 - 4.7.

Table 2. Effect of using milk protein concentrate (MPC) on the activity of yoghurt culture in full-fat fresh Zabadi milk during the fermentation period. (Average ± SE of 3 replicates)

Time (min)	Amount of MPC added, %			
	0	1	2	3
Zero	6.44±0.06^{a}	6.28±0.05^{a}	6.41±0.01^{b}	6.41±0.01^{b}
10	6.26±0.06^{a}	6.22±0.05^{a}	6.25±0.04^{a}	6.22±0.04^{a}
30	6.09±0.09^{a}	6.12±0.06^{a}	6.00±0.03^{a}	5.89±0.03^{a}
60	5.34±0.04^{a}	5.31±0.07^{a}	5.81±0.02^{a}	5.39±0.01^{b}
90	5.05±0.03^{a}	5.01±0.09^{ab}	5.33±0.02^{a}	4.88±0.03^{b}

- Averages (a, b… etc.) within the same row with different superscripts differed significantly (P<0.05).

Activity of yoghurt culture is an important factor, since low acidity of yoghurt unfavourably influences the consistency due to insufficient protein hydration. Acidification at pH of 4.6 and below tends to increase the hydration of protein. The rate of acidification may also affect the structure and consistency of yoghurt and serum separation. The presence of more protein in Zabadi milk, generally improves the activity of yoghurt culture. This might be due to presence of certain growth stimulators in the new medium, rather than the presence of more lactose from such treatment. It is well known that only about 20-30% of lactose consumed in the fermentation process (Mehanna and Hefnawy, 1990).

Effect of using MPC on gross content of full-fat fresh Zabadi:

Data indicated in Table (3) show the total nitrogen (TN) and total protein (TP) contents of the fresh Zabadi, as effected by the applied concentrations of MPC. The recorded TN contents were 0.62, 0.66, 0.69 and 0.82% in the fresh Zabadi treated with MPC at the rate of 0, 1, 2 and 3%, respectively. Significant variation was recorded in the fresh Zabadi treated with 3% MPC, which characterized with significantly higher TN value, compared with the other treatments. The corresponding protein values were 3.88, 4.25, 4.37 and 5.16%. This means that the higher the protein contents, the higher the concentration of MPC added, the higher was the TN content also, and subsequently the protein content. This trend of results was expected, since the addition of N source like MPC must increase TN and, subsequently, TP content of the final product being made of different concentration of reconstituted milk (El-Shibiny *et al.* 1977).

Table (3) illustrates that adding MPC had no effect on the fat content of the resultant fresh Zabadi. Thus, the treated samples and the control the same fat content of 3.31%, however, when fat was calculated in dry matter basis (fat/TS), the values gradually decreased by increasing the amount of MPC added. Thus, the fat in the control fresh Zabadi (27.65%) significantly decreased to 25.86, 24.52 and 23.77% in the samples treated with 1, 2 and 3% MPC, respectively. The foregoing results suggest that fat content was not affected by adding MPC. This might be

due to the added product is of low fat content, which is not enough to increase it in the resultant Zabadi. Lactose content was significantly affected by adding MPC, since the control fresh Zabadi is of the lowest lactose content (3.44). It is then ,gradually, increased to 4.06, 4.45 and 4.72% by adding 1, 2, and 3 MPC, respectively (Table 3).

Table 3. Gross content of full-fat Zabadi (FFZ) made from cow's milk fortified with different concentrations of goat's milk protein (MPC). (Average ± SE of 3 replicates).

	Amount of MPC added, %			
	0	**1**	**2**	**3**
TN, %	0.62±0.02^{b}	0.66±0.01^{b}	0.69±0.01^{b}	0.82±0.04^{a}
TP, %*	3.88±0.10^{b}	4.25±0.06^{b}	4.37±0.11^{b}	5.16±0.21^{a}
Fat , %	3.31±0.04^{a}	3.32±0.05^{a}	3.32±0.02^{a}	3.32±0.05^{a}
Fat/TS, %	27.65±0.50^{a}	25.86±0.41^{b}	24.52±0.31^{bc}	23.77±0.33^{c}
Lactose, %	3.44±0.03^{c}	4.06±0.03^{b}	4.45±0.11^{b}	4.72±0.31^{a}
Ash, %	0.73±0.02^{b}	0.78±0.02^{b}	0.83±0.02^{ab}	0.85±0.03^{a}
Total solids, %	12.04±0.11^{d}	12.86±0.05^{c}	13.36±0.04^{b}	14.03±0.11^{a}
Acetaldehyde*	130.1±16.2^{a}	106.32±8.50^{a}	137.2±15.2^{a}	149.2±11.3^{a}

- Averages (a, b… etc.) within the same row with different superscripts differed significantly (P<0.05).

The decrease in lactose during storage of Zabadi agrees with the traditional trend given in the literature. Rasic and Kurmann (1978) reported that lactose might be subjected to other initial actions before it is finally metabolized, and *S. lactis* might utilize lactose in two ways: a) by hydrolytic breakdown into glucose and galactose by enzyme lactose or betagalactosidase: b) by oxidation via enzyme lactose dehydrogenase to lactobionate, followed by enzymatic degradation to gluconate and galactose. The present results came in agreement with those found by Mehanna *et al.* (1988) and Mehanna and Hefnawy (1990).

Data presented in Table (3) show that the lowest content of ash was detected in the fresh control Zabadi ash content of fresh Zabadi, followed by increase by increasing the added concentration of MPC. The ash contents of fresh Zabady were 0.73, 0.78, 0.83 and 0.85%, and were 0.80, 0.84, 0.86 and 0.91% in the stored Zabadi when the MPC was added at the rate of 0, 1, 2 and 3%, respectively. The increase in ash content of treated Zabadi milk was responsible for the corresponding increase in the resultant Zabadi, since the used milk protein concentrate contains about 7% ash. So, the higher was the amount of MPC added, the higher was the ash content in the final product. The present results agree with the finding of Salama (2002).

Regarding the total solids content (TS) of the prepared fresh Zabadi, it could be obvious that it was significantly increased by increasing the added concentration of MPC. It could also be seen that the TS content of Zabady was 12.04, 12.86, 13.36 and 14.03 when MPC was added at the rate of zero, 1, 2 and 3%, respectively, which are significant differences. Increasing the TS content as affected by adding MPC was expected since this product contains about 95% TS. So, the higher the amount of MPC added, the higher was the TS content. These findings came in harmony with those reported by El-Shibiny *et al.*, 1979, Mehanna *et al.*, 1988 and Mehanna and Mehanna, 1989.

Curd tension:

The data of curd tension (CT) given in Table (4) clearly indicate that using different concentrations of MPC were of significant effect on the obtained increase of the CT of the fresh Zabadi. The recorded CT in fresh Zabadi were 20.2, 25.3, 28.32 and 32.00 g when MPC was added at the rate of 0, 1, 2 and 3%, respectively. In the light of the illustrated results, an obvious improvement was

The foregoing results suggest a great improvement of Ct was observed by increasing the MPC in the the resultant Zabadi. This is due to not only to the increase in TS content, but also to the functional properties of the protein of in the added CT(El-Shibiny *et al.* 1977 and Mansour *et al.* (1994).

Curd syneresis:

Data illustrated in Table (4) reveal the curd syneresis (CS) of the fresh Zabadi as affected by using different concentrations of MPC in making Zabadi. In case of the fresh Zabadi, the amount of the exudate were 4.34, 3.95, 2.08 and 1.92 g after 10 min of holding the samples of the different treatments at 42±0.5^{o}C. The corresponding values were 6.20, 5.44, 3.57 and 3.21 g after 30 min and 7.35, 6.63, 5.08 and 4.40 g after 60 min when MPC was added at the rate of 0, 1, 2 and 3%, respectively.

Table 4. Curd tension (CT) and curd syneresis (CS) of full -fat Zabadi made from cow's milk fortified with different amounts of goat's milk protein concentrate (MPC) (Average ± SE of 3 replicates).

	Amount of MPC added, %			
	0	**1**	**2**	**3**
CT, g	20.02±1.14^{c}	25.03±1.60^{b}	28.32±1.30^{ab}	32.00±1.30^{a}
CS, * after:				
10 minutes	4.34±0.60^{a}	3.95±0.21^{a}	2.08±0.30^{b}	1.92±0.21^{b}
30 minutes	6.20±0.51^{a}	5.44±0.25^{a}	3.57±0.22^{b}	3.21±0.21^{b}
60 minutes	7.35±0.11^{a}	6.63±0.06^{b}	5.08±0.01^{c}	4.40±0.03^{d}

*** (g / 15 g curd)**

Averages (a, b… etc.) within the same row with different superscripts differed significantly (P<0.05).

Statistical analysis showed that at any syneresis time, the applied treatments were significantly affected with the amount of whey excudated from Zabadi curd. The foregoing results show that CS of Zabadi greatly decreased

with increasing the added concentration of MPC. This is not only due to the increase of TS, but also to the functional properties of MPC. This product was mainly used to prevent or minimize the occurrence of the wheying-off of the treated produc. which agrees with the results given by Mehanna and Mehanna (1989); Mehanna *et al.* (2000). It might be of interest to note the correlation between curd tension and curd syneresis. The higher were the values of CT, the lower were the amounts of whey exuded from the curd. This agrees with the finding of El-Asfory (1999). However, factors affecting CT of Zabadi are greatly affected also CS (Rasic and Kurmann, 1978).

The Organoleptic Properties of Fresh Zabady:

Table (5) illustrates the scoring points given to the different organoleptic properties of the fresh Zabadi made from the applied treatments. For general appearance, the control samples had the lowest value (7.67 out of 10 points), whereas the treated samples gained 8.5, 9.35 and 10.0 points when PMC was added at the rate of 1, 2 and 3%, respectively. This means that by increasing the concentration of added MPC significant improvement in the appearance of the resultant Zabadi was observed. This was also noticed with respect to firmness of the curd. The given score was 7.01 out of 10 for the control Zabadi and 7.67, 8.35 and 9.35 for Zabadi samples treated with 1, 2 and 3% MPC, respectively. Concerning smoothness of the samples, the achieved values of 8.68, 9.50, 9.50 and 9.53 out of 10 points. Such small differences were insignificant. The flavour of Zabadi was evaluated according to some properties like acidity, bitterness, flat, foreign, cooked and unclean. However, no acidic taste, bitterness foreign, cooked or unclean flavour were detected in the control and the treated samples which gained 10 out of 10 points. Only, the control samples which gained the lowest points for their flat taste (8.17), whereas, the values given for the treated samples were 8.38, 9.30 and 9.41 points out of 10 when MPC was added at the rate of 1, 2 and 3% respectively. However, the lowest total score was given for the flavour properties of the control Zabadi (58.17 out of 60 points) whereas the treated samples had the points of 58.38, 59.30 and 59.41 out of 60 points for Zabadi made using 1, 2 and 3% MPC respectively.

Table 5. Organoleptic scoring of the fresh full-fat Zabadi made from cow's milk fortified with different amounts of goat's milk protein concentrate (MPC)* (Average of 10 panelists).

Property**		Amount of MPC added, %			
		0	1	2	3
General appearance	(10)	7.67±0.3^{b}	8.50±0.2^{b}	9.35±0.2^{a}	10.00±0.0^{a}
Firmness	(10)	7.01±0.5^{b}	7.67±0.2^{b}	8.35±0.4^{ab}	9.35±0.2^{a}
Smoothness	(10)	8.68±0.3^{a}	9.50±0.0^{a}	9.50±0.0^{a}	9.53±0.3^{a}
Wheying-off	(10)	7.35±0.3^{b}	7.67±0.2^{b}	8.63±0.5^{b}	9.60±0.4^{a}
Flavour	(60)	58.17±0.0^{b}	58.38±0.2^{b}	59.30±0.3^{a}	59.41±0.3^{a}
Acid	(10)	10.00±0.0^{a}	10.00±0.0^{a}	10.00±0.0^{a}	10.00±0.0^{a}
Bitterness	(10)	10.00±0.0^{a}	10.00±0.0^{a}	10.00±0.0^{a}	10.00±0.0^{a}
Flat	(10)	8.17±0.0^{b}	8.38±0.2^{b}	9.30±0.2^{a}	9.41±0.4^{a}
Foreign	(10)	10.00±0.0^{a}	10.00±0.0^{a}	10.00±0.0^{a}	10.00±0.0^{a}
Cooked	(10)	10.00±0.0^{a}	10.00±0.0^{a}	10.00±0.0^{a}	10.00±0.0^{a}
Unclean	(10)	10.00±0.0^{a}	10.00±0.0^{a}	10.00±0.0^{a}	10.00±0.0^{a}
Total	(100)	88.68±0.2^{d}	90.65±0.2^{c}	94.00±0.2^{b}	97.90±0.3^{a}

*** Average ± SE of 15 evaluations from 3 replicates.**

**** Values in parenthesis represent the maximum attainable score.**

- Averages (a, b… etc.) within the same row with different superscripts differed significantly (P<0.05).

Generally, the applied treatments resulted in significant effects on the total score points of the resultant Zabadi. The recorded values were 88.68, 90.65, 94.00 and 97.90 out of 100 points for Zabadi made using 0, 1, 2 and 3% MPC respectively.

The foregoing results of organoleptic evaluation suggest that using MPC greatly improved general appearance of the final product. Firmness was significantly improved by the applied treatments. Smoothness ranked the highest scoring points when MPC was added at the highest rate. In the specification sheet supplied by the manufacturer, goat's protein offers very good water retention and texturing properties. It improves rheological properties of Zabadi (viscosity, firmness) while reducing syneresis. This was true in the present study, since the treated samples had the lowest amount of exudate and subsequently the goat's protein ranked higher scoring points for wheying-off property when compared with the control samples. Testing rate of syneresis expressed as the amount of exudate in g per 15 g of Zabadi curd agrees with the organoleptic evaluation. So, the higher was the amount of MPC added, the greater was the improving of such property and subsequently the lower was the amount of exudate and the higher was the scoring points given.

In conclusion, using MPC with 3% goat's protein content greatly improved the organoleptic properties of full-fat cow's milk Zabadi.

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تصنيع زبادي من اللبن البقرى باضافة تركيزات مختلفة من مركز بروتين لبن الماعز

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تم تحليل كيماوى لعينة لبن بقرى لتقدير الدهن والبروتين واللاكتوز والجوامد الصلبة الكلية. تم تصنع زبادي من لبن بقرى وقسم الى ثلاث معاملات مكررة باضافة بروتين لبن الماعز بنسبة 0 ، 1 ، 2 ، 3٪. تم تصنيع الزبادي وتم تحليل التركيب الكيمياني. كانت قيم الأس الهيدروجيني في وقت الصفر هي 6.44 ، 6.28 ، 6.41 و 6.41 عندما تمت إضافة بروتين لبن الماعز بمعدل 0 ، 1 ، 2 و 3٪ على التوالي. بعد 30 دقيقة من التحضين ، كانت قيم الأس الهيدروجيني المقابلة هي 6.09 ، 6.12 ، 6.00 و 5.89 بالترتيب ، وكانت الفروق غير معنوية. كانت قيم الجوامد الصلبة 12.04 و 12.86 و 13.36 و 14.03 عندما تمت إضافة بروتين لبن الماعز بمعدل صفر و 1 و 2 و 3٪ على التوالي. في الزبادى الطازج ، كانت قيم البروتين الكلى 0.62 ، 0.66 ، 0.69 و 0.82٪ عندما أضيفت بروتين لبن الماعز بمعدل 0 ، 1 ، 2 و 3٪ على التوالي. نسبة الدهن للعينة الكنترول كانت 3.31٪ ، والدهن / الجوامد الصلبة في الزبادي الطازج 27.65٪ والتي انخفضت بشكل كبير لتصل إلى 25.86 ، 24.52 و 23.77٪ في العينات المصاف اليها بروتين لبن ماعز 1 ، 2 و 3٪ على التوالي. زاد محتوى اللاكتوز تدريجيا إلى 4.06 و 4.45 و 4.72٪ عند إضافة بروتين لبن الماعز بمعدل 1 و 2 و 3 على التوالي. كما زاد محتوى الرماد مع زيادة كمية بروتين لبن الماعز المضاف. وكانت القيم 0.73 ، 0.78 ، 0.83 و 0.85٪ عند اضافة بروتين لبن الماعز بنسبة 0 ، 1 ، 2 و 3٪ على التوالي. كانت صلابة الخثرة فى الزبادى الطازج 20.2 ، 25.3 ، 28.32 و 32.00 جم عندما أضيف بروتين لبن الماعز بمعدل 0 ، 1 ، 2 و 3٪ على التوالي. تأثر معدل طرد الشرش فى الزبادى الطازج باستخدام كمية مختلفة من بروتين لبن الماعز. وكانت 4.34 و 3.95 و 2.08 و 1.92 جم بعد 10 دقائق. وكانت القيم المقابلة 6.20 و 5.44 و 3.57 و 3.21 جم بعد 30 دقيقة و 7.35 و 6.63 و 5.08 و 4.40 جم بعد 60 دقيقة عندما تمت إضافة بروتين لبن الماعز بمعدل 0 ، 1 ، 2 و 3٪ على التوالي. بالنسبة للمظهر العام للزبادى كانت اقل قيمة لها فى العينة الكنترول (7.67 من 10 نقاط) ، في حين كانت العينات المعاملة 8.5 و 9.35 و 10.0 عند اضافة بروتين لبن ماعز بمعدل 1 و 2 و 3٪ على التوالي. وهذا يعني أن زيادة كمية بروتين لبن الماعز حسن مظهر الزبادى الناتج وكان هذا ايضا فى ملمس خثرة الزبادى الناتج. حيث كانت 7.01 من 10 للعينة الكنترول و 7.67 و 8.35 و 9.35 لعينات الزبادى المعاملة بإضافة بروتين لبن ماعز 1و 2 و 3 ٪ على التوالي. توصى هذه الدراسة بإضافة بروتين لبن الماعز بنسبة 3٪ لتحسين الخصائص الحسية للزبادى المصنع من لبن بقرى كامل.