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# Solubility of Solar Dried Jameed

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**Abstract:** Jameed is a fermented dried dairy product in the form of stone hard balls or other shapes produced by straining the heated buttermilk on cloth mesh bags, salting the formed paste by kneading, shaping and drying in the sun. This product is reconstitute after disintegration to be used in the preparation of Mansaf, the national dish in Jordan, which is basically lamb meat cooked in Jameed sauce (Sharab, Mareece) and served on cooked rice. This study aimed at improving the solubility of jameed and the colloidal stability of it is dispersion for this purpose a wettability and a syneresis test of dispersion were developed for the measurement of jameed solubility. Treating butter milk at 55°C for 3 min had the best result regarding jameed paste yield and solubility, along with enhancement of jameed paste texture compared with the other heat treatment. The addition of Carrageenan (0.15%), to the Jameed paste resulted in improvement of solar dried Jameed with significant result for Carrageenan treatment as evaluated by wettability and syneresis test. Whipping of the paste to which carrageenan was used, added an additional improvement to the solubility of Jameed and stability of its dispersion

**Key words:** Jameed, solar dried, carrageenan, solubility

## Introduction

Fermentation is one of the oldest methods for preservation, which contributes to the flavor, appearance and texture of food. Fermented foods are in general more attractive to the consumer than non fermented products. They play an important role in the diets of many people in Asia, Near East, parts of Africa and rest of the world (Van Veen and Steinkraus, 1970). The main goals for producing or manufacturing dried fermented milk are to improve storage life of the product, to reduce bulk so as to save storage space and to reduce packaging and transportation cost (Yamani, 1994; Khanfar, 1995).

Jameed is a dried fermented milk product that is wildly used in Jordan, Palestine, Syria, Egypt, Northern Saudi Arabia and the western part of Iraq ( Abu-Lehia, 1987). Jameed plays an important role in the nutritional well-being of Bedouins where it forms a major component of their diets (Sawaya *et al*., 1992).

Jameed is basically a hard cheese-like product considered a very stable and safe dried fermented milk product. It is mainly produced by Bedouins during the spring season when milk is produced in surplus amounts (El-Erian, 1979; Al-Mohizea *et al*., 1988). It is preferably made from sheep and goat milk but it can be made from cow and camel milk (Abu-Lehia, 1987; Al-Ruqaie and El-Nakhal, 1986).

The traditional method for producing Jameed in Badia is a unique system derived from available resources. A bag made of goat hide (Korga'ah) serves as a vat for milk collection and fermentation while another smaller bag called Su,on (Shira'a or Shakwah) is used for the churning of the fermented milk (Yamani, 1994; Khanfar, 1995). Production begins by filling the Korga'ah with the fresh milk which undergoes spontaneous and mixed fermentation process within few hours. This fermentation is due to the active micro flora found in the korga'ah which is used throughout the season without washing. Churning of yoghurt is done in the early morning, since the temperature of the fermented milk is most suitable for the churning process. The fermented milk is usually mixed with variable amount of relatively cold water to facilitate butter separation. The churning is done by rolling the bag back and forth on the floor or by pushing the hung Su,on in the air by tying it to Al-Markabah (which is a wooden pyramidal tripod made of three legs) and pushed by the hand back and forth in sudden and strong jerks perdolier movement.

There are two ways for Jameed production from buttermilk, the first involves straining the buttermilk through a fine mesh cloth without heat treatment and the second involves heating buttermilk before straining. Heat results in speeding separation of the whey and settling of the curd in the bottom of the heating pan. The whey is decanted and the curd is finally filled in the mesh cloth.

The next step in the production of Jameed is to separate most of the whey to obtain a thick paste which resemble Labaneh. This is accomplished by two different ways, the first by hanging the straining bag freely, the second

by tying the bag on a flat surface and squeezing it through putting aboard weighted with stones on top. When the curd become a thick paste the cloth bag is emptied and salt is added by kneading (Tawalbeh, 1992; Basson, 1981). The salted paste is shaped into balls covered with salt. The balls are first dried in the shade for 24 hour and then in direct sun for 10-15 days. The final product should contain moisture < 20% according to Jordanian standard (Anonymous Jordanian Standards, 1986). Time of drying depend on size, shape and weather conditions. The stability and safety of Jameed balls are a result of several factors: the low water activity due to low moisture content and high salt concentration, low pH < 4.0 and the specific effect of table salt and lactic acid that suppress the growth of pathogens and most spoilage microorganisms.

Jameed is reconstituted by soaking in water after crushing and is consumed mainly as a sauce in the preparation of Mansaf, a traditional Jordanian dish composed of lamb meat cooked in Jameed sauce (Sharab, Mareece) served on top of rice.

Jameed when fully dried is a compact stony hard product, which is difficult to grind. The ground Jameed is difficult to suspend in water and the suspension is likely to settle. This results some times in loss of proteins during preparation and consumption of the sauce since the insoluble residues are discarded. Another draw back of the traditional Jameed is the contamination of the product especially during drying.

## Materials and Methods

**Processing steps for jameed production was taken in the study as follow:**

**Yoghurt production:** Thirty liters of cow milk were heated at 85-90°C for 2-5 minutes, then cooled to 45°C, mixed with 3% starter culture, (*Lactobacillus delbruekii*) at 42°C until curd was formed (pH, 4.4-4.5). The yoghurt was immediately cooled in the refrigerator (5-6°C) and was kept overnight before churning (Khanfar, 1995).

**Churning of yoghurt:** Table salt 2% (w/v) was added under stirring the yoghurt. Washing machine with single basin was used as a churner (Model 3003, Hydo washing machine, Eisa Zedan Company, Jordan), it has a round cross section with 30 liters working capacity. An amount of 30 liters of the cooled salted yoghurt was churned for three hours. The butter grains were scooped by a mesh wire strainer (Khanfar, 1995).

**Heat treatment of buttermilk:** Amounts of the obtained buttermilk were subjected to different heat treatments and then cooled in refrigerator (5-6°C) for 24h.

**Straining of buttermilk:** The cooled buttermilk was filled into cloth mesh and hung freely at room temperature for 48 h.

**Shaping:** The obtained Jameed paste which had a thick consistency was emptied from bags, mixed with 5% (w/w) table salt (Tawalbeh, 1992) and shaped manually into balls, 400- g each.

**Drying (constructed natural convection solar dryer):** A solar dryer was constructed to be used for drying Jameed balls instead of sun drying. The dryer is basically a wooden structure consisting of two parts, the collector and the drying chamber. The collector is an inclined body with a light glass plate on the top. The internal surface of the body is coated with a black matt for an optimum absorbance of radiation. The bottom of the collector has slots to allow a free entrance of air. The back of the collector is in the form of a box constituting a base for the cover of the drying chamber. The cover is a box with openings in the upper sides and on the top for the exhaustion of warm air. A framework is fixed on the base of the drying chamber to adapt the drying shelves. Each shelf is made of wooden frame fixed to galvanized wire mesh. For drying Jameed the shelves are mantled with cheesecloth as a porous layer, which protect the product from metal contamination. The flowchart of the processing of jameed is shown in Fig. 1.

Enable to improve the solubility and dispersion stability of jameed, this investigation studied two different factors namely; heat treatment process of the buttermilk and the type of texture-enhancer added. Cow milk from Jordan University farm was used along the investigation.

**Heat treatment of Buttermilk:** The effect of heat treatment on jameed solubility was investigated using different temperature/time combinations (Quasem, 1996), as followings:

1. Standard sample (no heat treatment applied)
2. 62°C for 30 minutes
3. 75°C for 2 minutes
4. 85°C for 1 minute
5. 95°C for 30 seconds
6. 55°C for 3 minutes (Heating until the curd formation begins).

A batch of 15 L of buttermilk was used to form jameed and each treatment was done in triplicate.

Temperature was measured using Alchole thermometer (Woodco, M5836,-20°C ~ 150°C, japan) by immersing the thermometer pulb in buttermilk during heating and stirring waiting for 30 sec. and read the temperature.

**Additives (Texture-Enhancer) Used:** Four different texture-enhancer materials were used as a direct addition as well as another one application with different addition technique, as followings:

**Addition of Arabic gum:** Arabic gum was added in concentration of 0.5% (w/w) as follows:

3 g of ground Arabic gum were dissolved in 10 ml tap water, heated until gel was formed, the gel was thoroughly mixed with 600 g jameed paste.

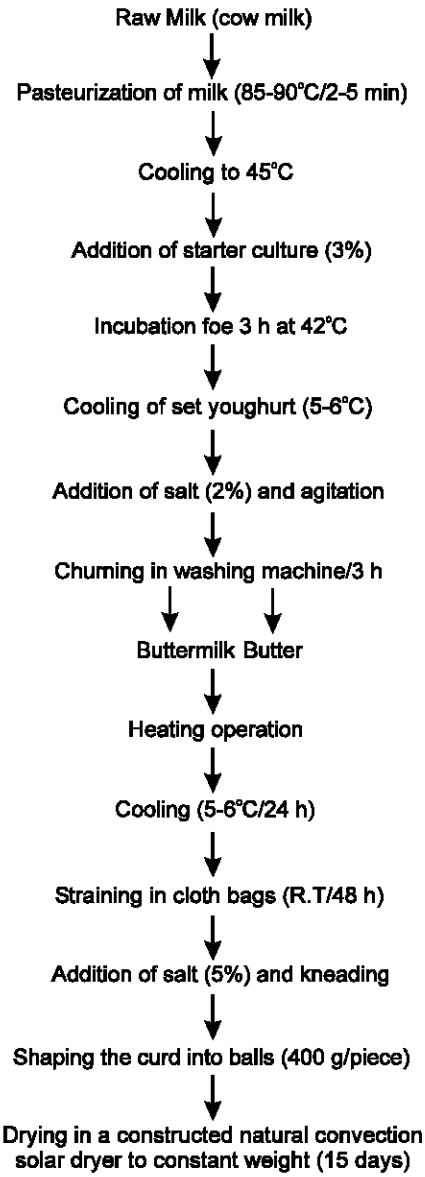


Fig. 1: The processing steps for the production of experimental Jameed.

**Addition of carrageenan mix:** Carrageenan mix (Genugel type MB-716, Copenhagen Pectin Company, Denmark) is a mixture of carrageenan and locust bean gum standardized with sugar and potassium chloride, was added in concentration of 0.15% (w/w) as follows: (Norman, 1990) 0.9 g was dissolved in 10ml tap water, heated to 42-45°C, the formed gel was added to 600g jameed paste and mixed well.

**Addition of starch:** Maize starch (packed by blue mill, Adnan Khudari and Sons, Jordan) was used in the concentration of 1% (w/w), as follow:
6 g starch were suspended in 10 ml water, heated (62-74°C) until gel formation, cooled then mixed thoroughly with 600 g jameed paste.

**Addition of baking powder:** Baking powder (Tasty, El-Ayed factory) was added at 2% level as follows:
12 g of baking powder was thoroughly mixed using electrical mixer (Hinari type, FM2, China) with 600 g jameed paste.

**Whipping of jameed paste:** 600 g jameed paste was mixed with 150 ml water (25%), 4 g carrageenan mix was added as explained before, the amount was whipped for six minutes using electrical hand mixer (Hinari type, Model FM2, China) with whipping accessories. The whipped mix was placed in flat plastic yoghurt cups mantled with cheese cloth for drying.
The shaped salted Jameed paste balls were placed on the surface of perforated trays and dried in the shade for 24 h then direct sun for 15 days (until moisture content was < 20%) ( Anonymous Jordanian Standards, 1986). Control sample was prepared from jameed without additives for the purpose of comparison.

**Analytical Tests:**
**Reconstitution (solubility) tests of jameed:** Two major test were developed to study the effect of the investigated treatments on the reconstitution of jameed after drying, those tests are:

**Wettability (Diffusability) Test:** A cube weighing ca. 45 g of jameed was cut using a hand saw from a whole jameed ball; 315 ml water were added to the piece placed in 500 ml cup and soaked for 24 h (Quasem, 1996). The excess free water was carefully decanting weighed to calculate the soaked amount as follows:

$$\% \text{ absorbed water} = \frac{315 \text{ ml water-x}}{\text{Weight if cubs (g)}} * 100$$

Where; X: the weight of excess water (g).

**syneresis (whey separation) test:** The soaked cube (45 g) was mixed with (315 ml water) for two minutes using electrical hand mixer (Hinari, model FM2, China) with the whipping accessory. The dispersed jameed was transferred to a 100 ml graduated cylinder and the clear zone was measured after 1 h and 24 h (Quasem, 1996). Syneresis (whey separation) was calculated, as follow:

$$\% \text{ syneresis} = \frac{X}{Y} * 100$$

Where; X: The height of the clear zone.
Y: Total height of jameed dispersion.

**Chemical Tests:**
**pH:** A well homogenized 10 grams of the Jameed sample were diluted with 70 ml distilled water, to determine the pH of Jameed by immersing the pH meter electrode of (Hana Instruments, Limena, Italy Model HI 8416) in the homogenized mix.

Table 1: Effect of different heat treatments of buttermilk from cow milk on the yield and solubility of the solar dried jameed

| No. | Heat treatment | Jameed paste Yield(%) | jameed Yield(%) | wettability (%) | Syneresis (whey separation)* 1 h | Syneresis (whey separation)* 24 h |
|---|---|---|---|---|---|---|
| 1 | Control (No heat) | 14.6$^{c}$ | 3.8d | 217.8$^{a}$ | 41$^{a}$ | 60.5$^{a}$ |
| 2 | 62°C/30 minutes | 17.2$^{a,b}$ | 5.4$^{c}$ | 167.0$^{b}$ | 43.2$^{a}$ | 48.8$^{b}$ |
| 3 | 75°C/2 minutes | 16.9$^{b}$ | 5.3$^{c}$ | 199.0$^{a,b}$ | 52.7$^{a}$ | 56$^{a}$ |
| 4 | 85°C/1 minutes | 17.7$^{a,b}$ | 5.8$^{b}$ | 201.8$^{a,b}$ | 51.6$^{a}$ | 53.7$^{a,b}$ |
| 5 | 95°C/30 sec. | 17.3$^{a,b}$ | 7.0$^{a}$ | 188$^{a,b}$ | 50.2$^{a}$ | 59$^{a}$ |
| 6 | 55°C/3 min.** | 18.6$^{a}$ | 6.1$^{b}$ | 185$^{a,b}$ | 42.4$^{a}$ | 53$^{a,b}$ |

*Volume of clear phase (layer). **Minimum heat treatment for buttermilk for the formation of coagulation (syneresis).
$^{a,b,c}$Means with no common letters within column differ significantly.

Table 2: Effect of whipping and incorporation of different additives in jameed paste from milk on the solubility of solar dried jameed*

| No. | Type of additives | addition (%) | Wettability (%) | Syneresis (whey separation)** 1 h | Syneresis (whey separation)** 24 h |
|---|---|---|---|---|---|
| 1 | Arabic gum | 0.5 | 201.3$^{c}$ | 25.3$^{a,b}$ | 43.8$^{b}$ |
| 2 | carrageenan mix | 0.15 | 219.9$^{b}$ | 16.6$^{a,b}$ | 31$^{c}$ |
| 3 | starch | 1 | 185.9$^{c,d}$ | 31.5$^{a}$ | 45.7$^{b}$ |
| 4 | Baking powder | 2 | 119.4$^{e}$ | 37.6$^{a}$ | 55.5$^{a}$ |
| 5 | Carrageenan mix and whipping | 0.15 | 304.8$^{a}$ | 4.3$^{b}$ | 10.4$^{d}$ |
| 6 | Control | without addition | 174.2$^{d}$ | 41.5$^{a}$ | 53$^{a}$ |

*Heat treatment at (55°C/3 min.). **High of the clear phase. $^{a,b,c,d}$Means with no common letters within column differ significantly.

**Titratable acidity:** Acidity of Jameed was determined, according to the standard methods for examination of dairy products (Messer *et al.*, 1985).

**Moisture and total solids:** A sample was ground using a mortar and the atmospheric oven method was used to determine moisture and total solids in Jameed (Messer *et al.*, 1985).

**Sodium chloride (salt):** Sodium chloride was determined according to the standard methods for the examination of dairy products (Messer *et al.*, 1985).

## Results and Discussion

**Evaluation tests for the solubility of solar dried jameed:** Preexpirmental trials showed that no dingle method was suitable to evaluate the solubility of jameed. The use of the known solubility methods for milk powder (Quasem, 1996) were not indicative, since the depend on the presence of soluble whey proteins, i.e: α-lactalbumin and β-lactoglobulin which were not denatured by heat. In jameed, the whey proteins are denatured due to the relatively severe heat treatment of the milk. The test of choice for the solubility of jameed should measure the ease of reconstitution of the product along with the stability of the dispersion.

Two parameter were followed to evaluate the solubility of jameed, these are; wettability which could be considered as percent of water absorbed by a standard piece of jameed after 24 h soaking and syneresis which measures the percent of clear layer separated from a column of jameed dispersion.

The two methods were found to be suitable and practical to comprehensively evaluate the solubility of jameed and stability of its dispersion, whereas. The suitability of the two methods depends on the fact that these parameters are actually what the consumer expect from a soluble jameed.

**Effects of different heat treatment:** Table 1 shows that, jameed paste yield was affected by different heat treatments of buttermilk. It is obvious that the highest yield was at the critical heat treatments (55°C/3min) compared to the control and all other heat treatments.

Table 1 also shows that jameed yield increases with the intensity of heat treatment of the buttermilk, when heat was applied in the range of low temperature long time pasteurization (LTLT) (62°C/30 Minute) or above. However, the difference in yield between control (no heating) and all other heat treatments was substantial and significant, e.g. the difference in the jameed yield between control and (LTLT) treatment was 1.65% and the highest yield was when the buttermilk was heated at 95°C for 30 second.

The most interesting result was the relatively high jameed yield when buttermilk heated at 55°C for 3 min this treatment will be referred to as critical heat treatment which was the minimum heat treatment of the buttermilk at which whey separation was maximum. It seems that two factors influences the yield, the first is water holding capacity (WHC) and second flocculation (agglomeration) of the proteins. In the control sample the flocculation seems to be lowest so that apart of protein was lost in the strained whey, this was indicated by the relatively high cloudiness of the strained whey of the control treatment. The mild heat treatment resulted in high flocculation of proteins and high clarity of the whey and thus preventing proteins loss on straining.

It is worth noting that the jameed paste product at critical heat treatment was characterized by high smoothness and cohesiveness which make the paste easier to shape, than in other treatments.

The result shown in Table 1 the wettability test revealed that the control (no heat treatment) gives the most favorable result (217.8%).

The highest solubility as measured by syneresis was also was also when the buttermilk was heated at the critical heat treatment as compared to control (no heat treatment) as well as to the other heat treatment, however the least solubility was measured at the most intense heat treatment which is 95°C/30 sec.

From these results it is concluded that heating at (62°C/30 min) is more intense than heating at (75°C/2 min) and heating at (55°C/3 min) critical heat treatment would give the best result regarding yield and overall quality.

**Effect of incorporation of different additives:** The result of the effect of adding different thickening (binding) agents and leaving agents to jameed paste as well as whipping on solubility of jameed, is shown in Table 2. Regarding the use of binding agents, carrageenan mix gave the significantly highest solubility as measured by wettability, syneresis among the three agents used and compared to the control, followed by Arabic gum and starch.

Treatment No. 5, which combined the addition of carrageenan in the same amount as in Treatment No.2 with subsequent whipping to introduce air in the mix, resulted in a further significant improvement of the wettability and decrease of the syneresis which made this treatment the best among all treatment in this investigation.

The reason for this improvement is not related to the intended incorporation of air in the paste, but rather to higher homogeneity due to the agitation for six minutes, since no measurable increase in the volume after whipping was observed. It seems that the carrageenan molecules which is considered as protective colloid; constituted an evenly distributed hydration shields around casein molecules and possibly around the fat globules so that the absorption of water molecules by the dried structure was facilitated. It is also remained that, in case of whipping, water was added in an amount of (25%) to make the mixture fluid enough for the whipping process whereas in treatment no.2 carrageenan mix was mixed using the mixing (kneading) accessory without addition of water. During solar drying of the thickened paste, water molecules released their position in the gel structure without being collapsed, so that more porous product was obtained. Therefore, the product was exceptionally fragile.

**Conclusion and Recommendations:**

1 Substantial improvement of the solubility of jameed could be achieved through the addition of minute amount of carrageenan (0.15%), Arabic gum (0.5%) or starch (1%) to the jameed paste before drying.
2 Heating of the churned yoghurt at 55°C/3min just to effect flocculation of the casein was the best among heat treatments and resulted in a better whey separation, higher yield, smoother and more cohesive curd (jameed paste) and substantial improvement of jameed solubility (wettability of jameed and stability of its dispersion).
3 The result of the study can not be extended on Jameed when made from goat milk or goat milk mixture a further study is needed to evaluate.

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