

## Promoting more efficient sheep milk processing for Jameed production in Jordan

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## Introduction

In Jordan, there is a strong demand for products made from processed sheep milk. About 13.4% of the country's milk is produced from sheep. The demand for small ruminant dairy products is high and small scale milk processing is an important part of the livelihoods of sheep and goat keepers and contributes up to 20% of the households' income.

The International Center for Agricultural Research in the Dry Areas (ICARDA), here in collaboration with the project for "Enhancing dairy processing skills and market access of rural women in Jordan" funded by OPEC Fund for International Development (OFID) and the IFAD-funded project "Improving the Food Security and Climate Change Adaptability of Livestock Producers using the Rainfed Barley-based System in Iraq and Jordan" in a joint initiative with the National Center for Agricultural Research and Extension (NCARE), in Jordan, developed activities oriented to improve the productivity and income of households and small processing Jameed processing units in El-Karak. The region holds 15%<sup>1</sup> of the country's sheep population that produce about 8500 tons of milk in a 4-months season.

Women are at the core of Jordan's dairy processing sector. Forming the majority of the sector's workforce, they are a key contributor to household incomes and rural economies. On-going efforts to improve the productivity, hygiene and profitability of dairy production provide an opportunity to fundamentally improve the livelihoods of producers' families. The collected information was studied and reviewed with the aim to improve the processing method of Jameed. The developed method was tested first at ICARDA headquarter station in Aleppo, Syria, then at two willing cooperatives in El-Karak region. This was followed by an interactive training where producer to producer knowledge exchange took place.

## Dairy products and processing constraints

Jameed is hard dry skimmed yogurt mainly made from sheep milk, in the form of balls that is used in making Mansaf, the national dish of Jordan. Butter milk is concentrated using cheese cloth, to make a very thick product. Salt is added in many ways and concentrations and in different steps. The concentrated product is formed and shaped into round balls. It is then set to dry for few days. It is also often referred to as "rock cheese". Generally, processing units are often poorly equipped and human capacity is low, reflected in the generally inferior nature of many products – despite the area's reputation. There are also issues related to hygiene – production occurs in sub-optimal conditions where mould, yeast and harmful bacteria can grow, spread, and ultimately, undermine quality. There are also serious health implications for the mostly female workforce who routinely come into contact with raw milk.

## Milk

### On-farm milk handling

Processors are facing the problem of milk elevated acidity and various other fraudulent practices. One of these is the late milk delivery to processing units on irregular timing. Developed acidity in milk is a problem especially in hot weather. The elevated acidity in milk is normally associated with undesirable smell (Hilali et al, 2006). Processing milk with initial elevated acidity will lead to unfavorable taste in the end product. It is well known that sheep milk is rich in total solids compared to goat milk and mixing with other species milk or water affects yogurt firmness and marketability value of yogurt. A field sampling protocol of sheep milk between 2013, 2014 and 2015 (Table 1) revealed major changes in composition (low fat and low solids non-fat contents, large variation in electric conductivity is correlated with udder health and a high value is an indication of mastitis).

Table 1  
The quality of milk delivered to the cooperatives in EL-Karak region

	Fat	SNF	Density	Lactose	Protein	Freezing Point	pH	EC	SCC
<b>Average</b>	6.44	10.26	1.035	5.68	3.76	-0.680	7.10	4.73	1196.55
<b>Min</b>	1.15	6.55	1.000	3.44	2.48	-0.813	6.59	2.48	186
<b>Max</b>	19.26	17.12	1.057	9.44	8.8	0	7.56	10.4	4691
<b>n</b>	210	218	218	217	218	201	96	216	40
<b>Stand. Dev.</b>	2.05	0.96	0.0047	0.60	0.49	0.165	0.30	1.08	1176.71

<sup>1</sup> Ministry of Agriculture, Annual report of the Directorate of Animal Production 2012

### Hygiene

A good milk filtration after milking at the farm level will reduce the microbial load which is essential to reduce associated problems like crumbling and off-flavor. Mixing milk from ewes bearing mastitis with bulk milk affects negatively the quality of milk and the quality of end-products (Homosh et al, 2010).

### Influence of feeding

Balanced feeding for lactating ewes will increase milk yield. Composition of agro and agro industrial by products in North Asia and West Asia region has been documented (Abbeddou et al, 2011). Diets including these by products could influence the milk content of fat, protein and total solids which in turn affect the textural and organoleptic properties of dairy products (Hilali et al, 2011). Additionally, feed ingredients can enhance the quality by increasing some functional components in milk and dairy products such as CLA and n-3 fatty acids.

### Jameed

Generally, the produced milk is collected and transported as raw milk and processed mainly into Jameed, a traditional Jordanian dairy product which is an integral part of the culinary habits in Jordan (Figure 1). The local knowledge of jameed processing was documented and validated using participatory tools in three provinces; El-Karak, Tafilah and Maan.

Figure 1  
**Jameed balls**



Milk is filtered and may be heated up to 52-55°C. Milk is cultured by adding 1-3% yogurt from a day before in big pots or plastic barrels 50-100 L. The inoculated milk is then incubated for 2-4 hours depending on the processor and region, by covering the pots/barrels with a blanket to maintain temperature. Processors use approximations in all measurements i.e. they do not use thermometer. To cool down the cultured milk the blankets are removed and may cool by refrigeration till next day if cooling facility is available. On the next day, yogurt is prepared for churning by adding 25-34% of ice and cold water. Some processors add 0.5% of salt. The yogurt is churned by centrifugation till the butter grains are formed.

After butter collection, the butter milk is heated up to approximately 50°C with no stirring till a whey separation is observed. The heated butter milk is transferred to cotton bags for concentration and 1-3% of salt is added to help syneresis. The cotton bags are let to rest for 2-4 hours before it will be pressed for 2-3 days to reach the desired consistency, where salt is added on the second day of pressing. The concentrated butter milk is mixed again with 2-5% of salt and formed in shape of slightly elongated 8-10 cm balls, and let to dry for 4-10 days in a well-ventilated place, the final weight of jammed ball varies 150-600 g approximately. Figure 2 describes the main steps of traditional Jameed processing. The main identified constraints during this processing scheme are:

- The use of milk with elevated acidity;
- Inadequate thermal treatment of milk which could be a direct cause for transmission of infectious diseases, particularly zoonotic diseases;
- Low hygiene and inadequate processing knowledge like management of dairy cultures and proper temperatures during processing (incubation, churning, etc.), is affecting the texture and organoleptic properties of the end product.

According to consumers and traders, white color, and complete shape are the most important indicators for Jameed quality. Jameed should fracture by hitting and should be free of moulds. The price could be reduced up to 50% for broken Jameed.

Jameed samples were collected for laboratory analysis. Based on the results (Table 2), drying procedure is affected by heterogeneous local processing methods which result in high differences for the different analyzed components and therefore a lack of standardized type of Jameed. This is very similar to other products in the Middle East. The low churning efficiency induces rancidity under the common storage conditions.

Figure 2  
**Flow chart of traditional Jameed processing**

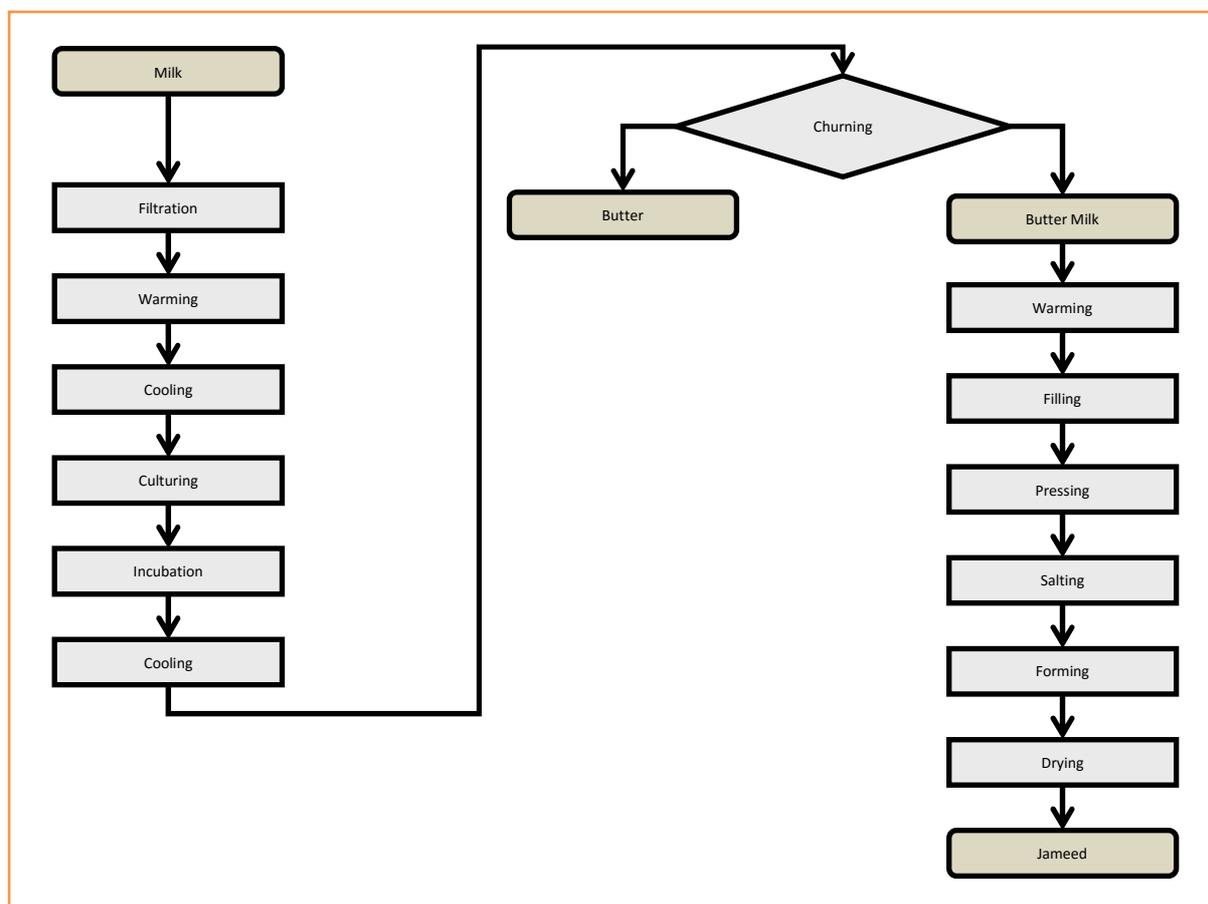


Table 2  
**Chemical properties of sampled Jameed**

	Fat (%)	TS (%)	Ash (%)	Salt (%)	Acidity (%)	pH
<b>Average</b>	11.42	61.39	12.54	7.19	6.99	3.76
<b>Min</b>	3.98	55.20	9.13	5.50	5.04	3.64
<b>Max</b>	17.35	71.39	15.18	8.47	8.61	3.97

### Promoting improved processing protocols

Based on the above listed constraints, ICARDA, in a participatory process with the processing units which are women-headed in most instances, developed an improved processing method for Jameed with the aims to increase yield, diversify the end-product, save on energy and water use under a fragile, dry environment and address the consumer health by optimizing salt content (Hilali et al, 2014). The main technical improvements emanating from scientifically-sound research work both in the lab and in the field are reported in what follows:

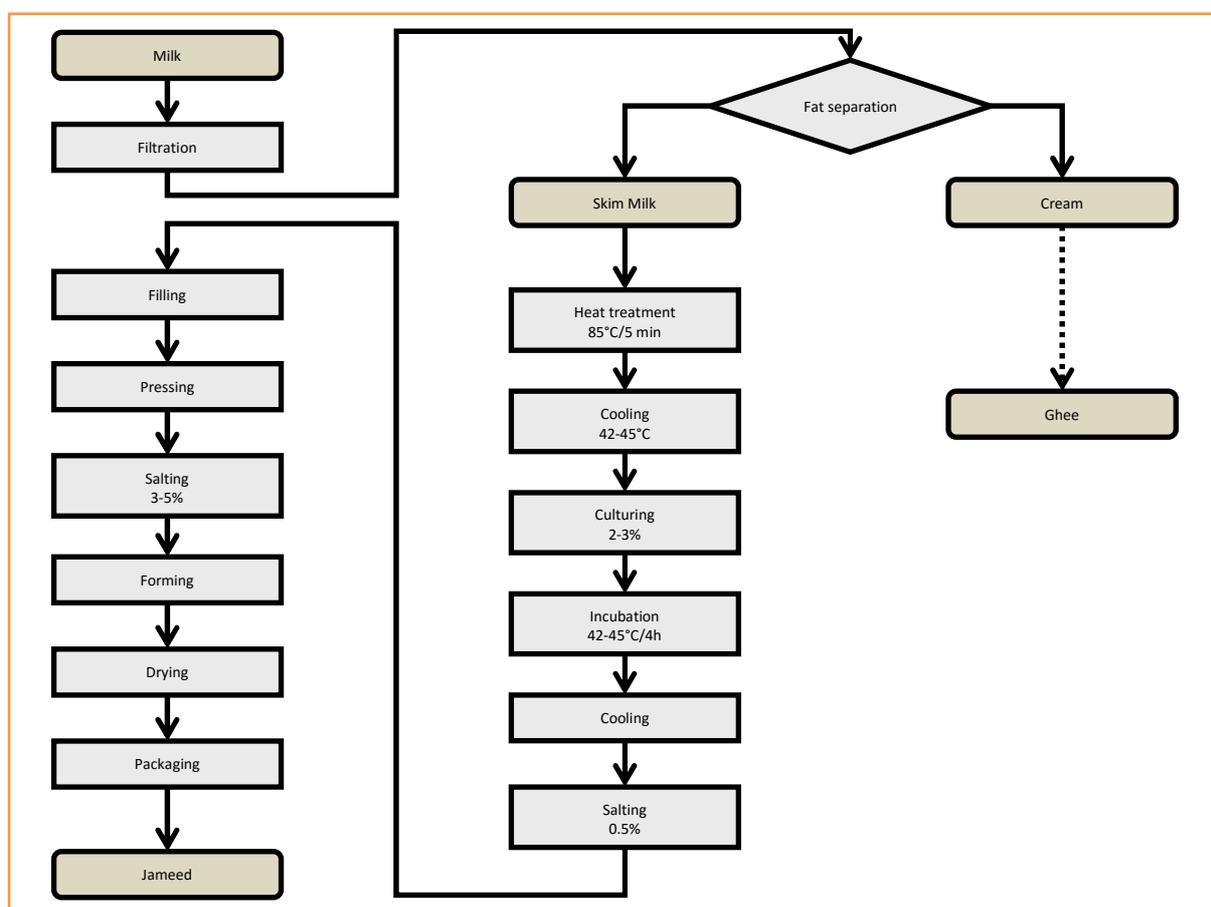
- Systematic milk thermal treatment (85°C/5min) to produce safe and enhance the textural properties of the product (Hilali et al, 2006)
- Introduction of a fat separator to produce high quality Jameed with higher economical value and to increase ghee yield (diversification of the end product)
- Optimization of salt use.

The new processing scheme (Figure 3), while improving the hygienic quality of the bulk milk, yielded more homogeneous end product in terms of chemical composition with a reduction in fat content, hence reducing rancidity problems (Table 3).

Table 3  
Jameed chemical properties affected by processing method

	Fat (%)		TS (%)		Ash (%)	
	Improved	Traditional	Improved	Traditional	Improved	Traditional
<b>Average</b>	3.27	11.42	64.29	61.39	16.73	12.54
<b>Min</b>	3.21	3.98	64.20	55.20	16.62	9.13
<b>Max</b>	3.34	17.35	64.38	71.39	16.80	15.18

Figure 3  
Flow chart of the improved processing method of Jameed



Some simple calculations were done to compare the modified method against the traditional method (Table 4) and the results demonstrated that water and energy needed including cooling can be reduced.

Table 4  
**Comparison between the traditional and the improved processing schemes**

	Traditional method			Modified method			Difference		
	Liter	%	Kw	USD	Liter	%	Kw	USD	%
<b>Milk</b>	50			70.62	50			70.62	
<b>Cream</b>					9.95		0.11		
<b>Skimmed milk</b>					40.05				
<b>Water</b>	20	40			3				<b>85</b>
<b>Volume to be cooled</b>	70				12.95				<b>81.5</b>
<b>churning</b>			2.63				0.34		
<b>Consumed energy</b>			2.63				0.44		<b>83.06</b>
<b>Butter</b>	3.5	7			4.5	9			
<b>Ghee</b>	2.5	4.9		34.60	3.15	6.3		44.49	
<b>Salt</b>	2.5	5		1.77	2.5	5		1.77	
<b>Jameed</b>	5	10		70.62	4.5	9		63.56	
<b>Income</b>				32.84				35.66	<b>8.6</b>

#### Bibliography / More Information

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