



Determination of the Effect of Three Libyan Herbal Plants on the Quality and Taste of Milk in Aljfarah District, Libya

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Authors' contributions

This work was carried out in collaboration among all authors. Author MS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MOA and MB managed the analyses of the study. Author WMA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The current study investigated the effect of selected local herbal plants on the quality and physical organoleptic taste of cow milk. In total, three medicinal plants namely *Solanum schimperianum* hochst (Zitoun), *Olea europaea* L (Hadeq) and *Acacia etbaica* schweinf (Kasha) were chosen. Five different farms in Aljfarah district were selected in the study. Approximately, 5gm of leaves from each plant were collected, cleaned and dried then crushed into powder. A 1800 ml milk sample was collected from the whole-milk container of each farm. 200 ml was used for each treated and control group. A standard fumigation process using charcoal fire was performed on each treated

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group using the prepared plant powder. The quality of treated milk against each tested plant was estimated by physical testings' using gustatory and olfactory rank using 45 participants. In total, 40.9% of participants ranked *Solanum schimperianum* hochst as their first best choice followed by 34.8% for *Olea europaea* L and 23% chose *Acacia etbaica* schweinf. Fifty percent of participants have reported better quality of taste and odour of treated milk comparing to control groups. Also, 82% of participants expressed their confidence regarding the effectiveness of herbal plants in improving the quality of milk. In conclusion, herbal plants improved the quality of milk and limited the spoilage process, showing the potential application of herbal plants in milk industry.

Keywords: Herbal Plants; milk; fumigation; dairy; Libya.

1. INTRODUCTION

Milk is essential food resource for human health and diets, but potentially associated with food borne and infectious pathogens and residues of antimicrobial drugs [1]. Preservation of quality and nutritious value of milk is important for human wellbeing and economic purposes, however many factors (e.g. microbial and environmental contaminants, species of animal, nutrition, climate and temperature and hygiene) may affect such quality including odour, taste and contents [2]. In addition, flavour and odour may be affected by feed and weed flavours, strong odour plants, poor quality silage, cow manure odour, poor ventilation and unhygienic milking equipment [3]. Therefore, keeping high milk quality for long time is extremely important for the public consumers as well as the commercial sectors [4].

Microbial contamination is a major factor in determining the quality and hygiene of milk [5]. Microbial contamination can result from different sources, including manual milking process equipment's, feed, soil, faces, transportation milking environment [6,7]. For instance, lactic acid bacteria (e.g. *Lactobacillus streptococcus* are able to degrade lactose into lactic acid. Other organism such as (*Salmonella spp*, *Listeria monocytogenes*, *Escherichia coli* O157: H7, *Campylobacter jejuni*, *Staphylococcus aureus*, *Yersinia enterocolitica*, *Mycobacterium tuberculosis*, *Coxiella burnettii*) could be found [8], degrade and use proteins and milk fats deteriorating the quality of milk [3].

Herbal and bioactive plants are considered important source for medical and antimicrobial properties. Such plants may inhibit and reduce bacterial counts significantly playing an important role in maintaining human health and prevention against various diseases such as TB [8]. For example, FAO estimated that over 50,000 medicinal plants are used across the

world for medicinal and healing purposes of which more than 750 plant species have been identified to have therapeutic effects for humans [9]. These plants are increasingly used in livestock to promote growth, prevention and combat disease and increase productivity [10].

In the underdeveloped regions, various reports showed the significant role of medicinal plants in maintaining health status in human and livestock [11]. In North Africa, native and exotic medicinal plants have known to contain high bioactive ingredients such as active poly phenols that can be used to improve milk quality [12]. These are also widely used in traditional medicine for therapeutic purposes. The aim of this study was to evaluate and determine the effect of herbal plant fumigation using selected local plants on milk quality. For the purpose of this study, three well-known local plants were chosen for this study.

2. MATERIALS AND METHODS

2.1 Collection and Processing of Plant Samples

Herbal plants that are locally used for traditional medicine were collected from Aljfarah district in the north west region, Libya Table1. Three plants rich in bioactive components were chosen based on local popularity of use and identified and classified according to their scientific and locally 'traditional name' *Solanum schimperianum* hochst "Hadeq" [13], *Olea europaea* L "Zitoun"[14] and *Acacia etbaica* schweinf "Kasha"[15] were selected following preservation environmental guidelines. Plants were collected in clean plastic bag, labelled and kept in cool container then determined by botanists at the School of Biotechnology, the University of Aljfarah. Leaves were collected from each plant, washed and sun dried then milled to powder and stored in glass jar for fumigation process.

Table 1. Type of herbal plants used for fumigation and their mode of preparation

S/N	local name	Scientific name	Part of plant used
	Zitoun	<i>Olea europaea L.</i>	Leaves
	Hadeq	<i>Solanum schimperianum hochst</i>	Leaves
	Kasha	<i>Acacia etbaica schweinf</i>	Leaves

2.2 Collection of Milk Samples

Milk samples from bovine were obtained from five local farms. The main milk container of each farm was adopted as the source of our samples and included in the study based on no clinical case on the farm (particularly mastitis), and non-being treated by any process including fumigation. Approximately, 1800 ml was collected from each farm under hygienic condition and transferred in cool container to the faculty. 200 ml was used for each fumigated and control milk sample.

2.3 Fumigation Methods

Fumigation process was started by burned charcoal in lidded steal container with small hole in lid centre, until its smoke completely finished. After proven the fire doesn't have a smoke out, then the dried herbal plant powder was inserted to the fire, then the fire container was covered by its lid, smoke raising outside of the small hole. The dried milk containers glass/plastic were hold/suspend upside down to the smoke for 3-5 minutes. After the burnt plant smoke filled the container and starting come out from the container, immediately filled with 200 ml milk sample and tightly with clean clothes.

These steps were repeated for each medical plant and milk samples that selected for fumigation process. 30 treated milk samples in total were tasted for its effectiveness in maintaining the quality of milk according to the traditional use. Organoleptic tests (odour and taste) were carried out within 24 hours difference between the first- and second-day examinations. The organoleptic test was done by each participant for each batch. The persons involving in the organoleptic test have a good experience of milk parameters and milk industry. The scoring method was done as; Excellent, Very good, Good, Normal milk odour or Bad odour.

2.4 Evaluation and Determination of Milk Quality

Participants were involved in a semi-open structured questionnaire prepared in advance,

tasted in advance while ingested. 23 of them have experience in dairy products and expertise in milk tastes including dairy farmers and 22 were normal milk customers. A systematic sampling method was used to select dairy farm owners for the interview. The questionnaire survey focused on evaluating the type of plants used for fumigation milk, the rank of plants based on the perception of the interviewed person, and why they were classified first, while others were the main focus of the liquid.

3. RESULTS

A Total of 45 participants were involved in the study of which 83% encountered milk spoilage. Also, 62% and 38% of participants respectively indicated a weekly and daily milk spoilage.

In the study area smallholder dairy farm owners use the above three mentioned herbal plants unselectively. However, the participants ranked the selected medicinal plants according to their effectiveness as a solution to prevent milk spoilage for two days as follows: 40.9% ranked *Solanum schimperianum hochst* as their first best choice followed by 34.8% for *Olea europaea L* then 23% for *Acacia etbaica schweinf*. Also, 50% of participants revealed that the use of herbal plants improved odour and taste, and 81.8% express positive impacts on the quality of milk.

4. DISCUSSION AND CONCLUSION

Raw milk under strict hygienic conditions and measurements should contain bacterial count of approximately 1,000 per ml, whereas milking process using traditional methods may contain up to 50,000 bacteria per ml [11]. During the first 2-3 hours, natural inhibitory substances of milk may significantly prevent rise in bacterial count. This may maintain the quality of milk particularly if combined with cooling process at 4°C [16,17]. The previous hygienic methods maintain bacterial count of fresh raw milk below 50,000 per ml preventing bacterial multiplication and keeping milk at high standards [18,19].

The three bioactive herbal plants (*Olea europaea L*, *Solanum schimperianum hochst* and *Acacia*

etbaica schweinf) used in the current experiment are commonly used for fumigation of milk and aromatic flavouring by local farms in Aljfarah district. Similarly, fumigation practice is frequently used in dairy farms of many African countries as well for preservation of milk [20,21].

Among the 45 participants, 83% reported spoilage in milk; 62% and 38% indicated respectively a weekly and daily milk spoilage.

Only 12.5% of the farms fermenting the remaining spoilage (after raw milk consumption/sale) to avoid spoiled and 22.5% given spoiled milk to pet animals. 65% the milk was not used immediately could be dumped. These figures indicate a significant economic loss on dairy industry. In 55.6% of the farms were used herbal plants for milk fumigation to prevent milk spoilage and increase its shelf life.

Table 2. Participants idea on milk spoilage

Variables	Number	Percentage
Method of spoilage control (45)		
Putting in cooler	20	44.4%
Fumigation	25	55.6%
Problem of milk spoilage (45)		
Yes	36	80.0%
No	9	20.0%
Frequency of milk spoilage (45)		
Daily	17	38.0%
Weekly	28	62.0%
Fate of spoiled milk (45)		
Dumped	29	65.0%
Given to pet	10	22.5%
Fermented	6	12.5%

Table 3. Use of herbal plants and the level of importance by the interviewee

Variables	Number	Percentage
Herbal plant type as first choice (45)		
Solanum schimperianum hochst	19	41.9%
Olea europaea L	16	34.9%
Acacia etbaica schweinf	10	23.0%
Why the plants are best (45)		
Good in odour	11	25.0%
Good in taste	11	25.0%
Good in odour and taste	23	51.5%
Fumigation prevent spoilage (45)		
One day	13	29.9%
Two day	27	58.9%
Three days	5	11.2%
Fumigation has positive impact (45)		
Yes	38	84.4%
No	7	16.0%

Table 4. Organoleptic taste result

Container type	Days		Organoleptic
	Day one	Day two	
Control	N	N	Odour
Control	N	N	Taste
Glass	E	V	Odour
Glass	E	V	Taste
Plastic	V	G	Odour
Plastic	V	G	Taste

N.B. E- excellent, V- very good, G-good, N-normal milk odour and taste

In addition, 40.9% of participants chose *Solanum schimperianum* hochst as their best choice as a solution to prevent milk spoilage for two days followed by, 34.8% for *Olea europaea* L and 23% for *Acacia etbaica* schweinf. Further analysis showed that 50.0% of participants favour the use of herbal plants for improvement of both odour and taste. For quality, 81.8% of interviewee participants express positive impact of the use of herbal plants for milk quality. The previous results correspond with other several studies which reported that smoking of milk containers using bioactive herbal plants may significantly improve taste and odour of milk as well as reduce microbial contamination of containers thus extending shelf life of milk [22,23]

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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