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Ethnobotanical study of wild plants used in the Algerian traditional cheese-making of *Kemariya* in the M'Zab Valley (Algeria)

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Key words: Traditional cheese, *Kemariya*, Ethnobotanical survey, *Cynara cardunculus*, *Fagonia glutinosa*, Ghardaïa

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Abstract

The traditional cheese known by *Kemariya* occupies a very important socio-economic place in the M'Zab Valley. It is considered as one of the popular traditional cheese in the region that is coagulated by animal rennet as well as by some plant species. In order to determine and catalog the plant species used in the coagulation of milk, an ethnobotanical survey was carried out with the local population of Ghardaïa province (Algeria). This study was conducted using semi-structured questionnaires that were distributed to 100 people of two ethnics (57 Arab and 43 Mozabites). Among them, 10 informants were herbalists. The obtained results showed that nine plant species are well known and used for *Kemariya* preparation among them *C. cardunculus*. and *F. glutinosa* are the most cited. In addition, the harvest of *C. cardunculus* and *F. glutinosa* is done in spring during the flowering period (48% and 59% of responses, respectively). The used part for *C. cardunculus* was flowers (100% of responses), while for *F. glutinosa* were seeds (44.4%) and leaves (33.3%). *C. cardunculus* and *F. glutinosa* can be used either in the fresh or dry state. Goat milk was the most used milk by the local population for *Kemariya* production. These results highlight the importance of the use of the Algerian flora in cheese production. Further studies are required to preserve the Algerian culinary heritage and to identify the active ingredients of these plant species for the production of plant coagulants substituting the rennet in cheese fabrication.

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Introduction

Ethnobotanical studies deal with the interactions between humans and plants as well as the study of traditional knowledge. Moreover, the interaction of plants with human societies varies due to their uses, relative importance in addition to varying social, cultural and ethnic factors (Panhwar and Abro, 2007; Thakur *et al*., 2014).

High plant diversity is noted in Algeria because of its geographical situation, soil composition and climate (Mediterranean climate in the North, semi-arid climate in the steppe plains, arid climate in arid areas and desert climate in the Sahara) which is favorable for growth and development of rich flora (Azzi *et al*., 2012).

The dairy sector provides quality and nutritious milk and milk products for the human population. Milk has essential nutrients such as high biological value proteins, vitamins and minerals which is an attractive resource for the economic livelihood in countries with hot climate (Pulina *et al*., 2018).

For instance, the warm climate and poor hygienic conditions, combined with inadequate refrigeration increase biohazard of raw milk. This poses health safety concerns but also economic and ecological problems. Indeed, during periods of milk overproduction (lactation period), prices can be lower and milk collection centers can become saturated, and so a part of the production is lost. Besides, the short shelf life of dairy products is an obstacle to distribution over long distances (Dupas *et al*., 2019).

The consumption of dairy products in Algeria is an old tradition linked to livestock farming, since dairy products are made employing ancient artisanal processes, using milk or mixtures of milk from different species (Leksir *et al*., 2019).

In Algeria, traditional cheese production has always involved the use of coagulant plant extracts in their crude state, obtained from fig tree sap, artichoke and cardoon flowers or pumpkin seeds for the preparation of fresh cheese. They are used for the *Djeben* made from goat and sheep milk in the North part of Algeria and *Kemariya* which is made with cow, goat and sometimes camel milk in the South of Algeria (Nouani *et al*., 2009).

The use of coagulant plants instead of rennet in the cheese manufacture is suitable for specific diets as for vegetarianism as well as religious restrictions especially for Muslims (Halal products). The process has been preserved in several Mediterranean countries such as Spain and Portugal which are the most important producers of cheese made with coagulant plants (Shah *et al*., 2014; Dupas *et al*., 2019).

In Algeria, at least ten types of traditional cheese from different regions of the country are currently listed with the best known are *Djben*, *Klila* and *Kemariya* which is also called *Takammart* by local people. This last is a traditional cheese that is very popular in the South of Algeria, especially in the province of Ghardaïa (McSweeney *et al*., 2004; Leksir *et al*., 2019).

The objective of this work is to review the traditional uses of plants for the cheese-making of *Kemariya* through an ethnobotanical survey. In this sense, this study aims to document the traditional use of spontaneous plants by the local population of M'Zab Valley for milk coagulation and traditional cheese "*Kemariya*" production.

Materials and methods

Study area

This study was conducted in Ghardaïa province, one of the most important Wilaya of the South of Algeria that covers an area of 86 560 km^2. It is located at an altitude of 450 m above the sea level and it is approximately 600 km far from Algiers; the capital of Algeria (Fig. 1). This province is located in the northern and central part of the Sahara between 4°-7° E and 35°-36° N. The territory of the M'Zab Valley (Wilaya of Ghardaïa) has been awarded national heritage in 1971 and world heritage by UNESCO in 1982 (http://www.andi.dz/PDF/monographies /Ghardaia. pdfhttps://www.mosaicnorthafrica.com /portfolio/mzab-valley/).

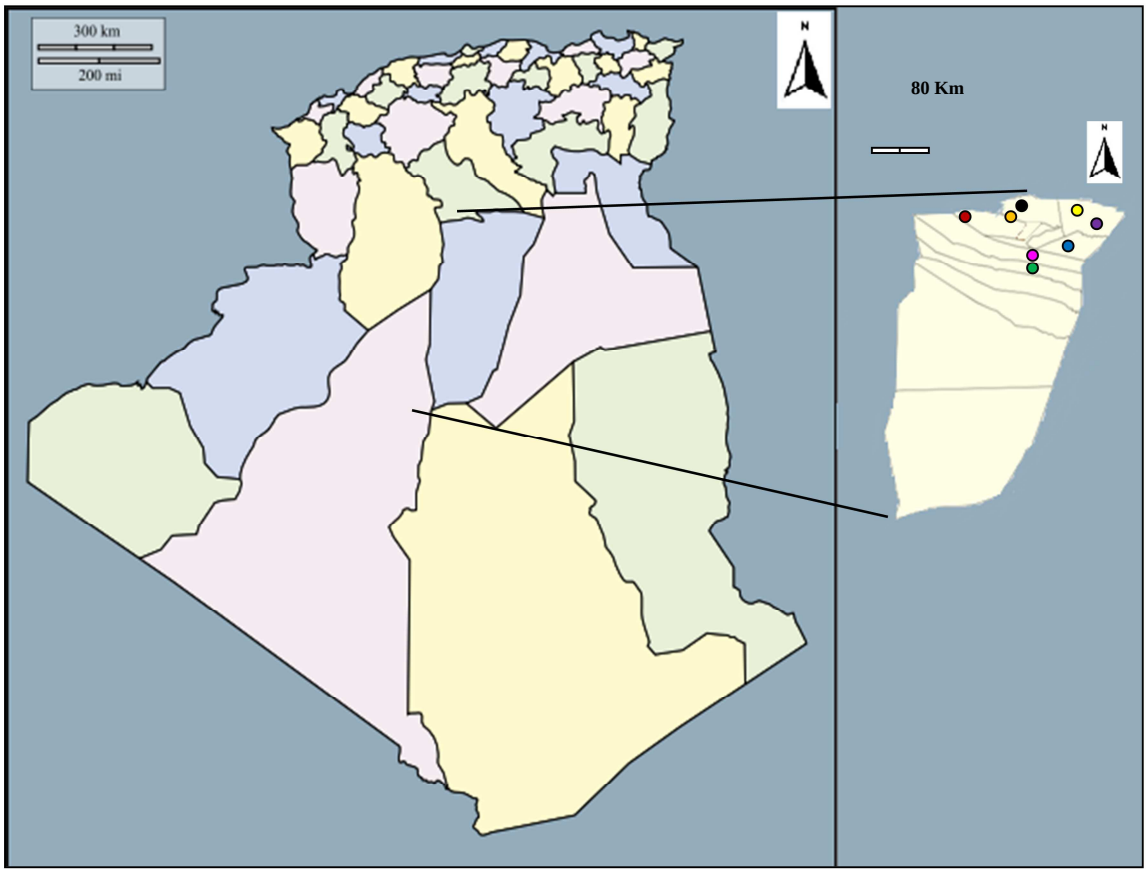

Fig. 1. Map of Algeria showing Ghardaïa province and the locations of the studied areas. Zelfana in bleu, El Guerrara in yellow, El Atteuf in purple, Sebseb in green, Berriane in black, Ghardaïa (village center) in orange, Metlili in pink and Dahayet Bendhahoua in red.

This region is characterized by very low precipitations (160mm per year). Its climate is hot and dry in the summer with temperatures that vary between a maximum of around 45°C and a minimum of 20°C, thus giving a large diurnal temperature swing; whereas, winter temperatures vary between a maximum of 24°C and a minimum of 0°C. The average annual range is about 12.2°C amplitudes of monthly average temperatures and is moderate in winter than in summer (averages are 11°C in winter and 13.5°C in summer) (Bekkouche *et al.*, 2013).

Data collection

The method used during this study consisted of semi-structured questionnaires intended for the inhabitants of the eight studied municipalities between the 1st of October, 2019 and 1st of March, 2020. The interviews were conducted with local people who were born and lived their entire lives in the studied areas. The informants of each studied municipality were selected for the interviews on a random basis. The interviews focused on the informant's sex and age. During the interviews, the informants were asked also about: local names of the plants used in the cheese-making of *Kemariya*, the period of plants harvest, parts used, preparation conditions, methods of preparation, type of the used milk, doses, duration of conversation of *Kemariya* as well as toxicity of the used plants. Means, percentages, tabulations and graph drawings were used to analyze the collected data with Excel software (Microsoft Corporation, 2016).

Results

Characteristics of survey participants

In this survey, the mean age of interviewers was 60 years (minimum 19 and maximum 102). Of the 100 informants, more than 50% were over the age of 40 years, while the interviewers with an age under 40 years represented only 36% (Fig. 2).

It appears that the use of plants as coagulants for *Kemariya* production is more important by women (56%) than by men (44%) (Fig. 3). However, women and men are equally responsible for collecting the plants used in milk coagulation, with the participation of men, especially in areas known to be dangerous. Women mainly take care of the drying, storage and artisanal preparation of *Kemariya*, they are the most knowledgeable in the traditional manufacture of cheese because of their responsibility as mothers, who give meals that are rich in nutrients for their families.

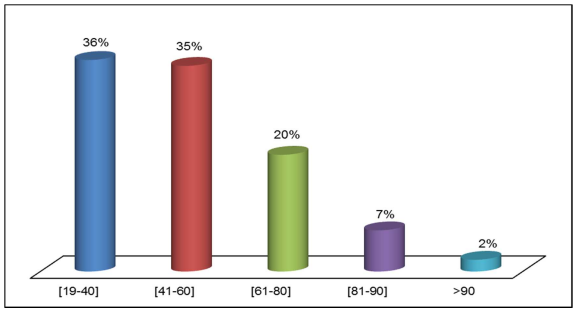

Fig. 2. Informant's distribution in age-classes.

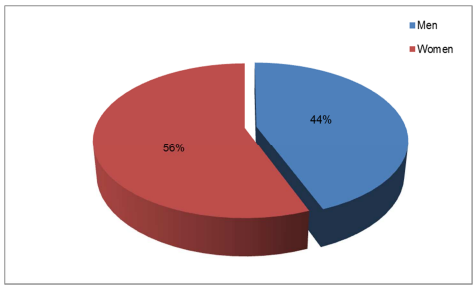

Fig. 3. Percentage of information provided by gender.

The use of plants for the preparation of *Kemariya* in the M'Zab Valley was widespread in all age groups with predominance among people of [41 to 60] years old (35%) (Fig. 4).

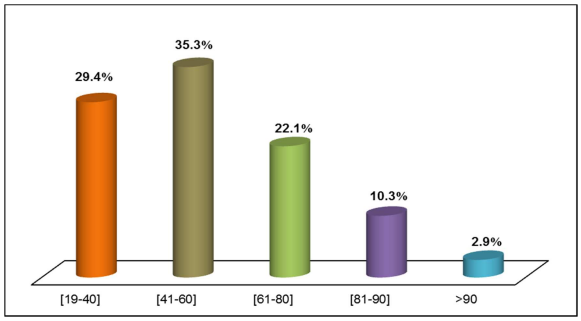

Fig. 4. Distribution of the population using plants in milk coagulation according to age-classes.

Plants used in the production of traditional cheese "Kemariya"

The obtained results showed that more than 68% of questioned people know and use plants as coagulants in the preparation of traditional cheese *Kemariya*, while 32% did not know about plant species used in the coagulation procedure (Fig. 5). These results prove that the local population of Ghardaïa knows and uses plants in their daily life for the preparation of traditional cheese.

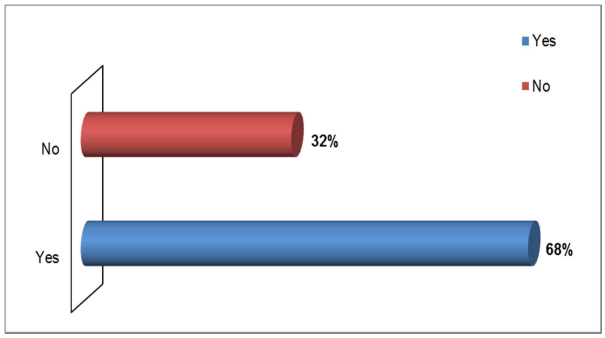

Fig. 5. Knowledge about the use of substitute vegetable rennet.

Concerning the type of cheese preferred by the local population, we found that the majority of the questioned population preferred the traditional cheese *Kemariya* (82%) and only 18% of people preferred modern cheese (Fig. 6). The preference of traditional cheese by the local population of Ghardaïa can be linked to the isolation of rural areas, the inexistence or scarcity of commercial infrastructures, the high cost of modern cheese, the modest income of the studied population as well as the habit of eating *Kemariya* as a dessert during the festive seasons (Leksir *et al.*, 2019).

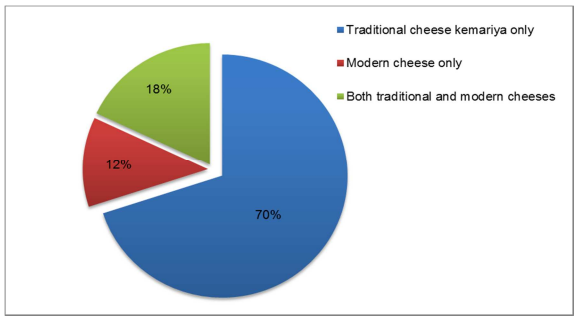

Fig. 6. Preferred type of cheese for consumption in Ghardaïa province.

The plant species used in milk coagulation and traditional cheese "*kemariya*" preparation are summarized in Table 1. The botanical name, vernacular name, plant part used and frequency of citation of each species were provided. Nine plant species are traditionally used in Ghardaïa province for milk coagulation and cheese production. The most cited species are *Fagonia glutinosa* Delil. (Zygophyllaceae) which is the most used plant with a proportion of 39.7%, followed by *Cynara cardunculus* L. (*Asteraceae*) with a rate of 33.8% (Fig. 7). The other species were less used in comparison with the two first (Table 1). Two species are also used to flavor the cheese produced which are *Artemisia campestris* L. (Asteraceae) and *Rhantherium adpressum* Coss. & Dur. (Asteraceae).

Table 1. Coagulant plants used by local population of Ghardaïa province.

Scientific name	Family	Local name	French name	English name	Used part	Citation frequency (%)
Artemisia campestris L.	Asteraceae	Alala Dgfouft	Aurone Armoise des champs Armoise champêtre	Field Sagewort Field-Southernwood Field-Wormwood	Leaves	2.9
Cynara cardunculus L.	Asteraceae	El'Khorchof Thaga	Carde Cardon Cardonette	Cardoon Cardoon artichoke	Flowers	33.8
Emex spinosa L. Campd	Polygonaeae	Homayde	Emex épineux	Spiny Emex Spiny-threecovnerjack	Fruits	1.5
Fagonia glutinosa Delil	Zygophyllaceae	El'Chraika Komida	/	/	Seeds Leaves Flowers Fruits	39.7
Ficus carica L.	Moraceae	Karma	Figuier Figuier de carie	Fig Fig-tree Edible Fig	Latex	10.3
Pituranthos chloranthus Coss. & Dur.	Apiaceae	Guezah Tattayt	Pituranthose à balait	/	Aerial parts	4.4
Rhantherium adpressum Coss. & Dur.	Asteraceae	Arfadja	/	/	Aerial parts	1.5
Silybum marianum L.	Asteraceae	Chawk l'djamal	Chardon-Marie Artichaut- sauvage Chardon marbré Silybe de marie	Thistle Variegated Milk thistle Blessed milk thistle	Flowers	4.4
Teucrium polium L.	Lamiaceae	Jaada Gattaba Khayatit lajrah	Herbe de marie Germandrée blanc-grisâtre Polio de montagnes	Poley Ezovion	Aerial parts	1.5

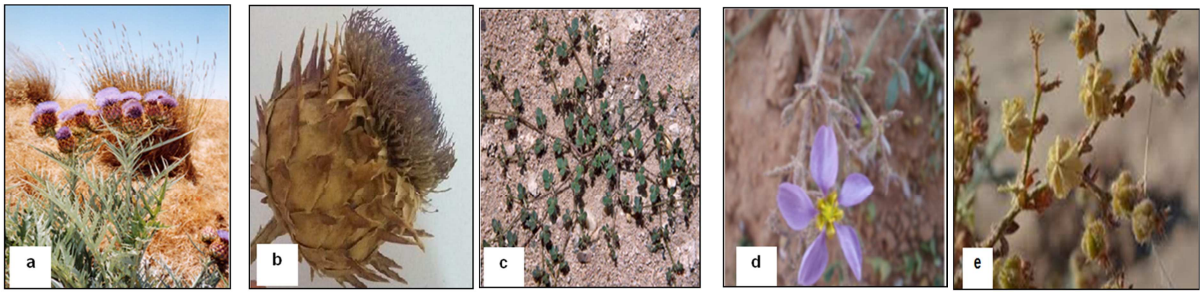

Fig. 7. Morphological aspect of *C. cardunculus* and *F. glutinosa*. Aerial parts of *C. cardunculus* (a), dried flower of *C. cardunculus* (b), *F. glutinosa* in its natural environment (c), its flower (d) and its fruits (e).

The harvest period of plants depends on the parts that will be used to prepare the cheese. The information concerning the appropriate period of harvest of *C. cardunculus* and *F. glutinosa* by the local population of Ghardaïa is shown in Fig. 8. *C. cardunculus* is usually harvested in spring (48%), autumn (35%) or summer (17%). For the harvest of *F. glutinosa*, it is generally done in spring and autumn with the proportions of 59% and 37%, respectively, but its harvest can take place throughout the whole year (4%).

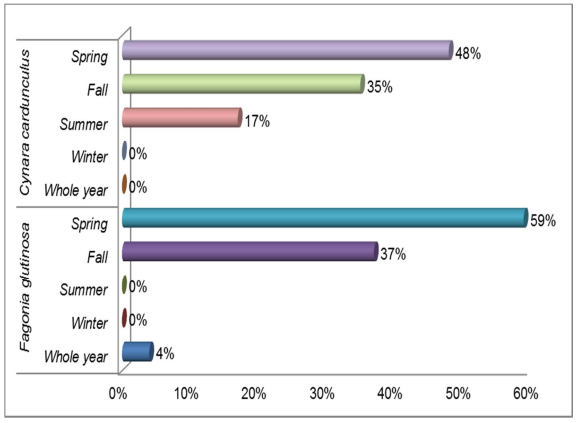

Fig. 8. Different periods of harvest of *C. cardunculus* and *F. glutinosa* for *Kemariya* production.

The most used parts of the cited plants are flowers and aerial parts (3 species for each), followed by leaves and fruits (2 species) and one specie for seed and latex (Table 1). Concerning *C. cardunculus*, we found that all respondents said that the flowers were usually the part used in milk coagulation (100%), while they were seed and leaves for *F. glutinosa* (with 44.4% and 33.3% of respondents, respectively) (Fig. 9).

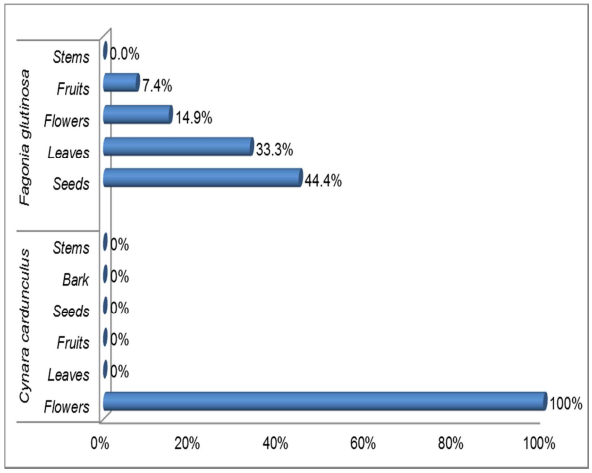

Fig. 9. Used parts of *C. cardunculus* and *F. glutinosa* in the *Kemariya* production.

The use of *C. cardunculus* and *F. glutinosa* in the coagulation of milk according to the state of the part used is shown in Fig. 10. The obtained results show that the two plants can be used either in the fresh or dry states. *C. cardunculus* is employed by 39% of the population in the fabrication of traditional cheese, both in fresh and dry states. Some of the questioned people preferred using this species at fresh state (30%). Of the total of respondents, 52% of the population said that *F. glutinosa* was used in the fresh or dry state depending on availability (Fig. 10). Natural drying is an effective method of conservation for avoiding contamination of the target plants; it increases its lifespan and decreases its weight to facilitate its transport (Conceição *et al.*, 2018).

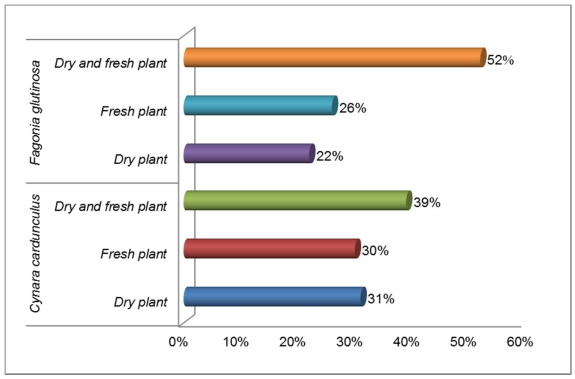

Fig. 10. Used forms of *C. cardunculus* and *F. glutinosa* used for the *Kemariya* production.

As regards to the toxicity, all the questioned population of Ghardaïa province mentioned that the plant species used in coagulation milk and cheese fabrication were not toxic. The results of the ethnobotanical study show the richness and diversity of knowledge on the use of plants in the coagulation of milk in Ghardaïa province. Some species were characterized by a strong consensus of use in the artisanal preparation of the traditional cheese called *Kemariya*.

The used milk and produced Kemariya

The totality of the interviewed population used *C. cardunculus* or *F. glutinosa* directly in milk without a combination with other ingredients. From Fig. 11 that show the proportions of the used type of milk for the preparation of *Kemariya* by the local population of the Ghardaïa province, we noticed that goat milk represented the most used milk for the preparation of

Kemariya when using substitute vegetable rennet of *C. cardunculus* and *F. glutinosa* with proportions of 89% and 61%, respectively. The local population used also cow milk with a proportion of 7% and 17% for the two plants, respectively. Finally, people used both goat and cow milk with a proportion of 22% for *F. glutinosa* and 4% for *C. cardunculus*.

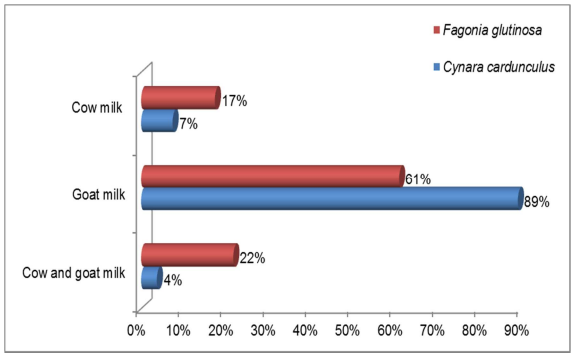

Fig. 11. Types of milk used for *Kemariya* production.

The use of *C. cardunculus* and *F. glutinosa* in the coagulation of milk and cheese production according to the dose is shown in Fig. 12. We noticed that more than 50% of the studied population used *C. cardunculus* (65%) and *F. glutinosa*, (52%) with non-precise doses; whereas a small number of people mentioned the use of these two species with precise doses (Fig. 12). In addition, the entire 100% of the population that used *F. glutinosa* for the manufacture of *Kemariya* said that the duration of conservation of this type of cheese is less than a day, while the duration of conservation of *Kemariya* prepared from *C. cardunculus* is less than a day with a proportion of 74%, followed by a duration of one week at most and more than a day with the proportions of 22% and 4%, respectively (Fig. 13).

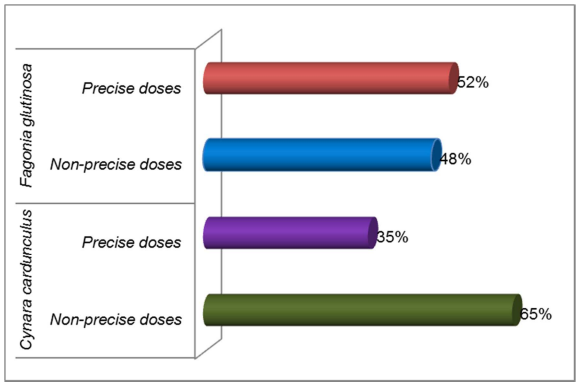

Fig. 12. Dose type of *C. cardunculus* and *F. glutinosa* used for *Kemariya* preparation.

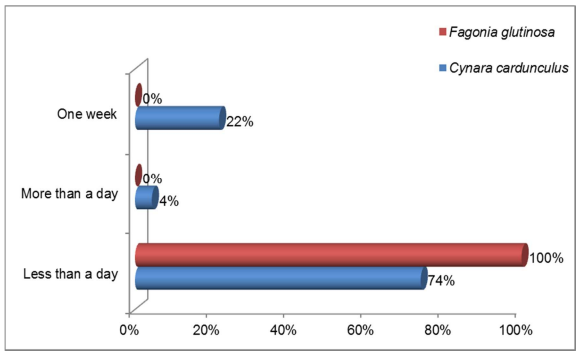

Fig. 13. Conservation period of *Kemariya*.

Presentation of the two most used plants in Kemariya production

The two plants with the highest usage in the coagulation of milk in Ghardaïa province are named *C. cardunculus* and *F. glutinosa* were in-depth analyzed in this study.

Cynara cardunculus

This plant is commonly known as cardoon or artichoke. It is an herbaceous plant that develops into a rosette, and then emits a thick and branching main stem that can reach 1.50 to 2m high, carrying at its ends terminal flower heads. Very large and long leaves, with toothed and thorny edges, deeply divided into acute lobes, silver-green or gray-green, its flowers are purple, solitary and often exceeding 6 cm in diameter (Fig. 7). The cardoon has a very deep pivoting root system, which gives it good resistance to drought and non-severe cold (Quézel and Santa, 1962; Djerroumi and Nacef, 2004). Cardoon flowers are rich in proteases such as cardosins A and B, aqueous extracts of flowers have long been used to make cheese (Silva and Malcata, 2005; Fernández *et al.*, 2006), dry flowers are macerated in a small amount of salted water and then the filtrate is added to the milk (Macedo *et al.*, 1993).

Fagonia glutinosa

Fagonia genus is well distributed in arid areas of all continents except Australia. It is found in different localities such as Algeria, Tunisia, Palestine, Syria, Saudi Arabia, Mesopotamia and Persia (Batanouny and Batanouny, 1970; Beier *et al.*, 2004).

F. glutinosa is a perennial, prostrate, pubescent, pale green plant with long internodes, trifoliate leaves, short spines, as long as petioles, small purplish-pink flowers, opening in a star and subsequently giving

small capsules. Their main habitat is on sandy and rocky sandy soils (Ozenda and Quézel, 1956) (Fig. 7).

Artisanal manufacturing of traditional Kemariya cheese

In rural areas, milk is abundant during periods of high lactation. For lack of means of preservation, it is difficult to keep the excess of this quickly perishable food; the main part of the production is therefore transformed into cheese. *Kemariya* obtained from cow's milk or goat's milk, is made by women according to traditional methods in the regions of "M'zab", using vegetable rennet of the 9 plant species cited in Table 1. For example, *C. cardunculus* flowers and *F. glutinosa* (seeds, flowers, leaves or fruits) in dried form are used by addition 2 to 4 g per 1 L of milk for 30 min until coagulation. After 1 h to 24 h, the mixture will undergo the separation of the remaining liquid. The last step is to place the coagulum in molds (Fig. 14).

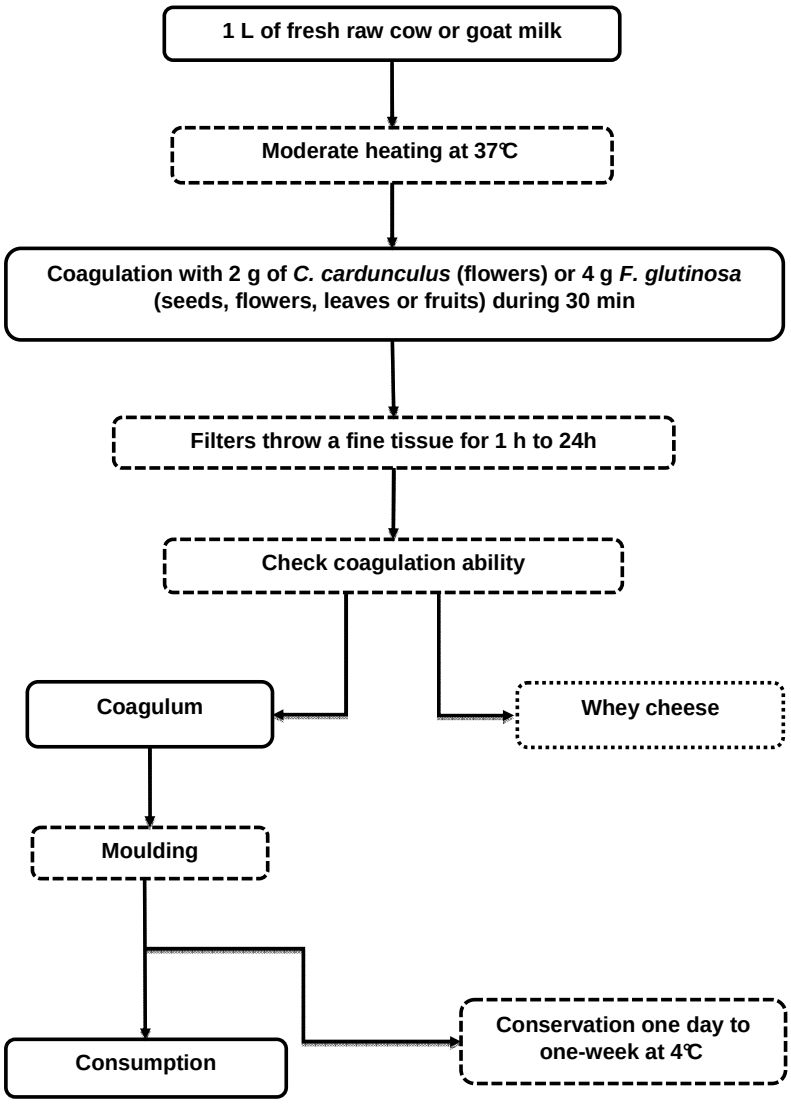

Fig. 14. Schematic diagram of traditional manufacture for *Kemariya* production in Ghardaïa province.

Kemariya cheese-making experiment

For the experimental part of the manufacturing of *Kemariya*, it was done according to the traditional method of the inhabitants of the province of Ghardaïa. The milk used to make the cheese is raw goat milk. The used milk is distributed in two containers of 1000ml at a temperature of 37°C. *C. cardunculus* (2g of flowers in a fine tissue) were added in the first container and 4g of seeds of *F. glutinosa* (in a fine tissue) were added in the other

container. Both containers were incubated for 30 min and as soon as the two phases of the milk (whey and curd) were separated, the mixture is poured onto a filter cloth to facilitate drainage. Then the containers are placed to rest for 1h to 24h and drip whey is collected in full. Finally, the curds were placed in molds and *Kemariya* can be conserved from one day to one week at 4°C (Fig. 15).

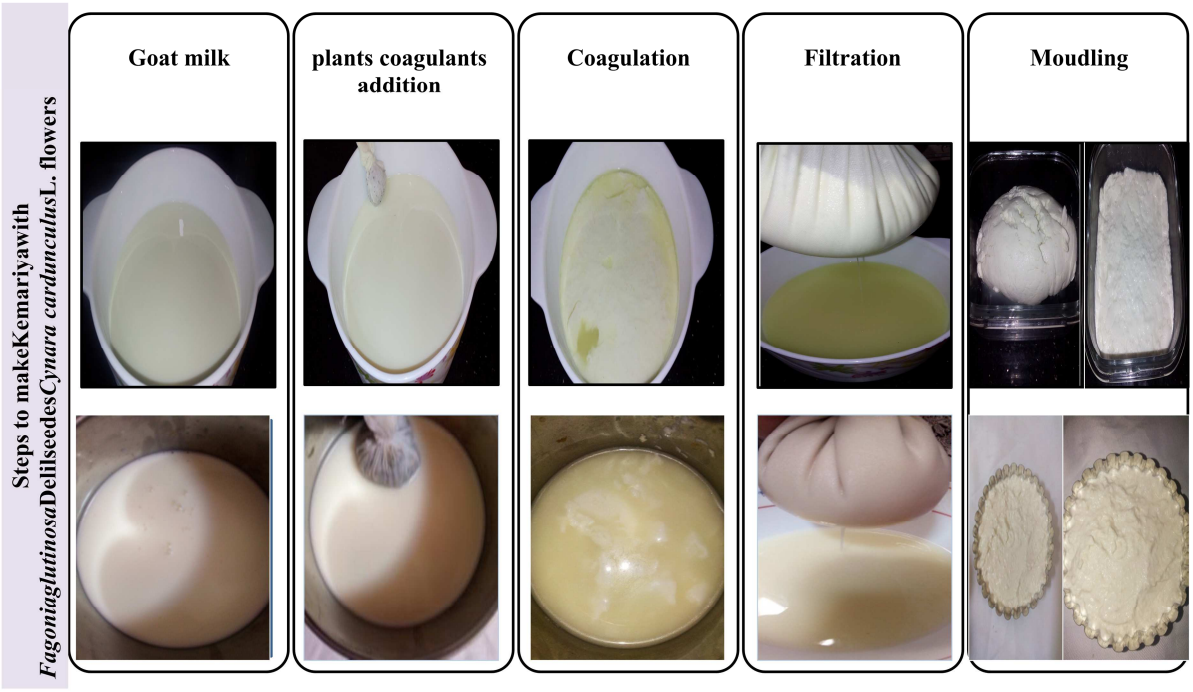

Fig. 15. Workflow used in cheese-making of *Kemariya* using vegetable rennet and goat milk. The top photos show the use of *C. cardunculus* flowers in making *Kemariya* while the bottom photos show the making of *Kemariya* with *F. glutinosa* seeds.

Discussion

Plants have been traditionally used for centuries in cheese manufacturing, either for their aromatic properties or as technological auxiliaries (e.g. milk-clotting enzyme preparations and cheese wrappers) (Dupas *et al.*, 2019). Our results showed that a 68% of the questioned residents in the studied areas preferred using plants as a milk coagulant for the preparation of the artisanal cheese *Kemariya*. This is often because they are readily accessible, trusted and they are directly derived from local plants or other substances found within the community (Guedje *et al.*, 2011; Worley, 2011). On the other hand, the use of spontaneous plants can economically beneficial, bearing in mind that most of the rennet used by Algerian cheese-making factories is imported (Zikiou et Zidoune, 2018). Traditional cheeses have a special place among various food preparations (Leksir *et al.*, 2019). Our results showed the majority of local populations of Ghardaïa province prefer the traditional cheese *Kemariya*. On one hand, *Kemariya* cheese may represent an alternative to modern cheese which is often felt to be expensive. On the other hand, the isolation of rural areas, the inexistence or scarcity of commercial infrastructures, the modest income of the studied population and the high demand for this cheese during the festive season as the main dessert eaten with honey, peanuts, and served with mint tea are the causes of its preferred use (Leksir *et al.*, 2019). Demographic factors such as age, gender and occupation are important determinants of knowledge (Lara Reimers *et al.*, 2018). Our results showed that both males and females practiced the traditional preparation of *Kemariya* but there was slightly higher knowledge among women than men. Women are usually in charge of drying, storing and preparing recipes for the care of family members (Mehdioui and Kahouadji, 2007). According to Leksir *et al.* (2019), traditional dairy products, with strong cultural, medicinal and economic values, are the historical

product of the social and economic dynamism of the rural communities. In fact, women are the most holders of traditional knowledge; they share their responsibility as mothers and give first aid especially for their children (Bakiri *et al.*, 2016). In addition, our study showed that the elderly people (aged 41 to 60) have expectedly greater knowledge upon the utilization of coagulant plants including *C. cardunculus* and *F. glutinosa* due to their long-lasting direct and regular contact with nature resources. In contrast, the younger generation showed less interest in these traditional practices mostly because of changing dietary habits (Leksir *et al.*, 2019). Hence, elder people must provide and transmit their knowledge to the new generation (Lakouéténé *et al.*, 2009; Chekole *et al.*, 2015). Traditional cheeses are cultural goods that deserve to be studied, characterized and protected (El Rhazi *et al.*, 2015; McSweeney *et al.*, 2004). Some types of cheese are known, made, and eaten to the present day, while others are unfortunately endangered for various reasons, namely the unavailability of fodder (food availability), the rural exodus and the change in food habits (Benkerroum and Tamime, 2004; Benkerroum, 2013; Leksir *et al.*, 2019).

According to Dupas *et al.* (2019) and Shah *et al.* (2014), plants since ancient times have been used in the preparation of many types of cheese with the most commonly encountered one is fresh cheese. This last is the product of plants addition to milk to facilitate its coagulation. In the present study, we found nine plant species that are traditionally used in the manufacturing of traditional *Kemariya* cheese in the study area including *C. cardunculus* and *F. glutinosa*. According to Shah *et al.* (2014), *Cynara* spp. in particular *C. cardunculus*, also known as "wild cardoon" is the most used vegetal coagulant. This plant is widely used in the making of various Spanish and Portuguese cheeses in some Mediterranean countries (Fernández-Salguero and Sanjuán, l999).

Despite an important variation of methods used by the cheese-makers, our results show that the traditional method of *Kemariya* making was similar to those obtained by Macedo *et al.* (1993) and Dupas *et al.* (2019).

According to Tavhare and Nishteswar (2014), the climate, temperature, rainfall, duration of daylight, methods of collection, processing and storage have an impact on the secondary metabolites of the plant. However, it is well known that the concentration of biologically active constituents varies with the stage of plant growth and development (WHO, 2003). Consequently, the activity of the plant extracts is extremely variable depending on the variety, the stage of maturity, the part of plants used, the drying time and the final moisture content. Our results showed that the best time of *C. cardunculus* and *F. glutinosa* harvest is in spring. According to Fernández-Salguero *et al.* (2002), the flowers of *C. cardunculus* can also be picked at different stages of flowering and from different geographical areas (Barbosa, 1983; Cordeiro *et al.*, 1991; Martins *et al.*, 1996). For our local interviewed population, the harvest of *C. cardunculus* flowers was mostly done in spring which is the period of high lactation and milk abundance. For lack of means of preservation, it is difficult to keep the excess of this quickly perishable food, thus milk is collected in milking vases and the main part of the milk is therefore transformed into cheese (Leksir *et al.*, 2019).

Several studies have been performed on *C. cardunculus* flowers that were used as coagulants in cheese-making and many attempts were made to characterize this plant coagulant with a special focus on the proteolytic and lipolytic agents during cheese ripening (Sousa et Malcata, 1996; 1997; 1998; 2002).

As for the *F. glutinosa* plant, in addition to seeds, other different parts (leaves, flowers and fruits) are also used for cheese preparation. Preparation conditions have a significant influence on the proteolytic and milk-clotting activities of the coagulants (Amira *et al.*, 2018). Our results are similar to the findings of Sousa and Malcata (2002) describing *C. cardunculus* flowers as the most used part in cheese making. *C. cardunculus* and *F. glutinosa* plant parts can be used either fresh or in the dry state after various drying and storage operations. A high percentage of the informants indicated that the dried plant parts were used more frequently in the studied areas.

According to Sousa and Malcata (2002) after collection from the mature plants of *C. cardunculus*, the flowers are usually dried in the shade in the open air. It is now accepted that only the stylets and stigma (violet part) possess a milk-clotting capacity (Faro, 1991; Ramalho-Santos *et al.*, 1997). Furthermore, natural drying is an effective conservation method by avoiding the contamination, increasing the used plants parts lifespan and reducing their weight in order to facilitate their transport (Bourkhiss *et al.*, 2009). Our results on the mode of the preparation of *Kemariya* and the used milk type are similar to those reported by Leksir *et al.* (2019) and McSweeney *et al.* (2017). In our case, the traditional cheese was made from cow milk and more frequently with goat milk and they were coagulated by vegetable rennet only without other addition. According to Benderouich (2009), sedentary and nomadic livestock systems are important in the province of Ghardaïa, especially the family breeding of the goat species is very widespread, for satisfying the family's needs for milk and dairy products.

The collected information revealed that the doses used for *C. cardunculus* and *F. glutinosa* in the traditional making of *Kemariya* are non-precise, this is often because the dose used varies depending on the amount of milk used to make *Kemariya* cheese (Benderouich, 2009). On the other hand, the obtained data revealed that a high proportion of informants conserve *Kemariya* cheese in short durations for one day to one week; this is because the study area is considered as a desert area with a lack of means of conservation and cooling. As a result of that, *Kemariya* spoilage accelerates, especially since it is considered as a soft cheese (Benderouich, 2009; Leksir *et al.*, 2019).

Concerning toxicity of *C. cardunculus* and *F. glutinosa*, almost all informants reported their non-toxicity. According to Lakhdari *et al.* (2016), *F. glutinosa* leaves are useful against skin diseases, mouth problems for babies, body weakness, fractures, and muscle spasms. For *C. cardunculus*, in addition to its flowers usage in making *Kemariya* cheese, different parts of the plants such as leaves, fleshy leaf petioles and receptacles are used for soups, stews and salads preparations (do Amaral Franco, 1976; Fernández *et al.*, 2006). There are also some reports of usage of its petioles and roots if properly prepared (Kelly and Pepper, 1996). Cardoon is traditionally used as a diuretic, choleretic, cardiotonic and antihemorrhodial agents. Cardoon leaves are used for their cholagogue, choleretic and choliokinetic actions, for treatment of dyspepsia and as antidiabetics (Koubaa *et al.*, 1999).

Conclusion

In Algeria, several traditional kinds of cheese are endangered and deserve special attention especially as the traditional Algerian dairy products are less and less prepared by the young population. The traditional transformation of milk is partly unknown, neglected and, unfortunately, totally undervalued. The absence of written history about the food in Algeria, non-transmission of information and rural exodus; are the main causes in addition to the ignorance of our inheritance.

This work consisted of documenting the traditional use of plants as coagulant substitute rennet and especially the two endemic Algerian plants; *C. cardunculus* and *F. glutinosa* in the coagulation of milk. Information gathered from the local population of Ghardaïa has shown that these plants are used in the preparation of the traditional cheese called *Kemariya*. This study also showed that especially elderly people have a better knowledge of coagulant plants while the younger generation showed less interest in traditional practices which is mainly due to the non appreciation of traditions and change of food habits. Thus, more attention must be put on the documentation of this knowledge before it's loose or disappearance.

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