

*Algerian Journal of  
Nutrition and Food Sciences  
(AJNFS)*

ISSN: 2773-4366

Journal homepage: [fac.umc.edu.dz/inataa/revue/](http://fac.umc.edu.dz/inataa/revue/)

**Bouhezza goat skin bag cheese: traditional cheesemaking and microbial quality**

Aissaoui Zitoun-Hamama O., Benyahia-Krid F.A., Saoudi Z., Senoussi A., Boullouf A., Mansouri S., Lazzouni I., Zidoune M.N.

Published online: December 16, 2022.

To cite this article: Aissaoui Zitoun-Hamama O., Benyahia-Krid F.A., Saoudi Z., Senoussi A., Boullouf A., Mansouri S., Lazzouni I., Zidoune M.N. 2022. Bouhezza goat skin bag cheese: traditional cheesemaking and microbial quality. *Algerian Journal of Nutrition and Food Sciences*, 2(3), 9– 13

To link to this article: <https://fac.umc.edu.dz/inataa/revue/files/ajnfs0203002.pdf>

## Bouhezza goat skin bag cheese: traditional cheesemaking and microbial quality

Aissaoui Zitoun-Hamama O.<sup>1\*</sup>, Benyahia-Krid F.A.<sup>1</sup>, Saoudi Z.<sup>1</sup>, Senoussi A.<sup>2</sup>, Boullouf A.<sup>2</sup>, Mansouri S.<sup>1</sup>, Lazzouni I.<sup>2</sup>, Zidoune M.N.<sup>2</sup>

<sup>1</sup>Laboratoire Génie Agro-Alimentaire (GENIAAL), INATAA, UPMC1 (Algérie)

<sup>2</sup>Laboratoire Nutrition et Technologie Alimentaire (LNTA), INATAA, UPMC1 (Algérie)

Received June 27, 2021 Accepted November 12, 2021 Available online December 16, 2021

**Abstract** *Bouhezza is the unique traditional cheese that has undergone a process of recognition of the quality sign in geographical. This cheese is manufactured and ripened inside an animal skin bag using raw goat's, cow's or ewe's milk. It has a particular traditional process which still preserved in some localities at the Chaouia area, East of Algeria. In the present paper we will describe the traditional manufacturing process, from the skin-bag preparation "chekoua or Djeld" to the final ripened cheese. Also, we highlight the last results on the Bouhezza characteristics focusing on its microbiological quality and the role of its autochthonous lactic acid flora.*

**Keywords** *Bouhezza, traditional cheesemaking, microbiological quality, autochthonous LAB*

**Résumé** *Bouhezza est l'unique fromage traditionnel algérien qui a bénéficié d'un label de reconnaissance du signe de qualité en Indication Géographique. Ce fromage est fabriqué avec du lait cru de chèvre, de vache ou de brebis et est affiné dans un sac en peau d'animaux. Il a un procédé traditionnel particulier qui est encore conservé dans certaines localités de la région des Chaouia, à l'Est de l'Algérie. Dans le présent article, nous décrirons le processus de fabrication traditionnel, de la préparation du sac en peau « chekoua ou Djeld » au fromage affiné. Aussi, nous mettons en évidence les derniers résultats sur les caractéristiques de Bouhezza en mettant l'accent sur sa qualité microbiologique et le rôle de sa flore lactique autochtone.*

**Mots clés** *Bouhezza, tradition fromagère, qualité microbiologique, bactéries lactiques autochtones*

### Introduction

Sector of dairy products is a principal vector of sustainable development of Algeria. Currently, it remains a deficit sector. The situation of traditional cheeses reflects the image of a suffering dairy segment where the weakest in this link risk disappearing. In otherwise, the traditional transformations of milk are poorly understood, neglected and, unfortunately, little valued. Also, we must remember the lack of knowledge on our traditional food history with the absence of writing, the non-transmission or ignorance of traditional heritage, the devaluation of traditions plus to the rural exodus and rapid changes of eating model of consumers in rural or urban areas. However, and despite this situation, the country's potential is enormous to promote and fully relaunch the raw milk production and also that of traditional cheeses. Our potentialities are diverse and complementary: the country area with its

Mediterranean-Saharan climate, a rich dairy and cheese tradition and also a great possibility of diversification of its dairy sources through varied and complementary breeding between the north and the south (Aissaoui Zitoun, 2014) and a large consumer market.

Among traditional dairy products can be distinguished the category of "fermented milks" and the category of "cheeses". Except fermented milks, *Lben* and *Rayeb*, and limited fresh cheeses, *Klila*, *Djben* and *L'baa*, which are the best known and geographically the most widespread, all the other products are little known. They remained confined to their original geographic niches. Our investigations led us to identify a dozen traditional cheeses in different regions of the country. Among the less well-known, we cite *Bouhezza* cheese, *Mechouna* and *Madeghissa* in eastern Algeria (Aissaoui Zitoun, 2014; Derouich *et al.*, 2016), *Takammèrit*, *Tikammarin* and *Aoules* in the south and *Igounanes* in the north center (Aissaoui Zitoun, 2014).

*Bouhezza* is the unique ripened cheese in the above cheeses list. Its first studies and characterization was initiated Laboratory of Nutrition and Agro-food Technologies (LNTA – TEPA team) (Zaidi *et al.*, 2000; Aissaoui Zitoun, 2011; Aissaoui Zitoun 2012; Marino *et*

\* Corresponding author:

Aissaoui Zitoun-Hamama O.

Email address: [azouarda@yahoo.fr](mailto:azouarda@yahoo.fr)

INATAA, UPMC1

7° Km Route de Sétif, RN 5, 25000 Constantine (Algeria)

*al.* 2012; Medjoudj *et al.* 2017<sub>a,b</sub>; Aissaoui Zitoun *et al.*, 2016; Senoussi *et al.*, 2020) and flowed by other research laboratories (Leksir *et al.*, 2019; Bellali *et al.*, 2020).

*Bouhezza* is a raw milk cheese using active container “*Djeld*”, with no use of starter or thermic treatment. The purpose of this article is to give a bibliographic review on its particular traditional cheese making preparation highlighting the microbial quality and specially the lactic flora.

### Traditional cheesemaking

Exceptional manufacturing process requiring the use of animal skin “*Chekoua* or *Djeld*” and traditional fermented milk “*Lben*”. This cheese is made from goat, cow or ewe’s raw milk, without any starter or rennet use.

### Goatskin bag preparation

The container “*Chekoua* or *Djeld*” serves to the spontaneous coagulation, draining and ripening operations and to conserve the cheese at the same time. Before using it, the fresh treated animal skin bag must interact with *Lben* for a night and then rinsed (fig. 1). Before it is used in cheese-making process, the goatskin is firstly depilated, washed, treated with salt and juniper berry, turned inside out, tied and rinsed. Secondly, the inside of the obtained container (wool side) is placed interacted with *Lben* overnight and then rinsed once more. *Lben* is a traditional beverage, obtained by a spontaneous coagulation of raw milk, which is, subsequently, churned and partially skimmed. The microbial study of traditional *Chekoua* allowed to confirm its role in the manufacturing not only as a safety packaging of the cheese maker but also as active microbiological agent which can influence the ripening.

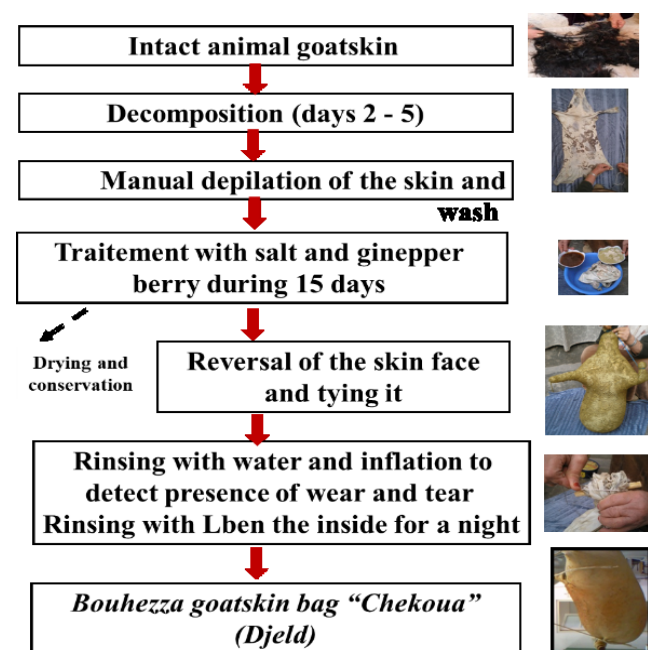


Figure 1. Diagram of Chekou or Djeld preparation

### Cheese manufacturing

Cheesemaking of *Bouhezza* cheese takes place over several months from the start of spring. However, the manufacturing and ripening time is from 1 to six months. *Bouhezza* differs from other ‘ripened-in-animal-skins’ cheeses. Spontaneous acidification, draining and ripening operations occur concurrently inside the permeable animal (goat or lamb) container.

The *Bouhezza* manufacturing is started with salted *Lben* filling at least half the volume of the *Chekoua*. Then, completed for several weeks with *Lben* and salt additions, and is finished with raw milk addition (fig. 2). The *Lben* used is preferably skimmed and low in acidity. The adjustment of the successive *Lben* additions is made according to the availability of milk/*Lben* and the draining speed.

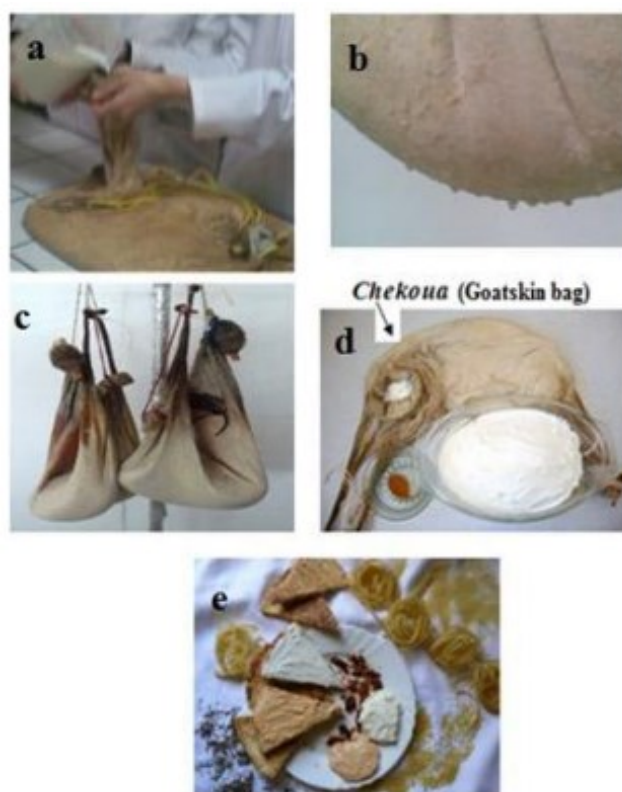


Figure 2. Traditional *Bouhezza* cheesemaking in permeable goat skin

### Microbial ecosystem of *Bouhezza* cheese

Researches on *Bouhezza* cheese, made with raw cow’s or goat’s milk, mentioned that it is characterized by a weak acidity and a salty taste. *Bouhezza* is softy and semi-fat cheese, ripened in the mass by the indigenous lactic acid bacteria. This specific environment promotes growth and development of many flora. *Bouhezza* create rich microbial ecosystem at different manufacturing and ripening time (Aissaoui Zitoun *et al.*, 2011; Aissaoui Zitoun *et al.*, 2012; Medjoudj *et al.*, 2017<sub>a,b</sub>). The cheese is mad from the first day with *Lben* which is a real source of different microorganisms. Total flora in cow’s or goat’s *Lben* ranged to  $9 \log \text{ufc.ml}^{-1}$ , where predominated

lactic acid bacteria and moulds. The predominance of mesophilic lactococci has also been reported in both Moroccan *Lben* (Benkerroum and Tamine, 2004) and in Tunisian leben (Samet-Bali *et al.*, 2011).

During *Bouhezza* manufacturing, Aissaoui Zitoun *et al.* (2012) mentioned that the most representative groups include indigenous LAB (Lacti Acid Bacteria) *Lactococcus* (8.45 log cfu.ml<sup>-1</sup>), *Lactobacillus* (7.73 log cfu.ml<sup>-1</sup>) and yeast-moulds (5-6 log cfu.ml<sup>-1</sup>). The yeast and moulds counts were lower and stable. The authors noted that the counts of faecal coliforms fluctuated between 1 and 3 log cfu.g<sup>-1</sup>; the low pH (5 to 4) and the salt content throughout ripening could be responsible for the low count levels of this group. The similar charges were noted in goat's cheese (Medjoudj *et al.* 2017<sub>b</sub>, Medjoudj, 2018).

The first observation on faecal coliforms is that the number decreases until it disappears in ripened cheese, after several weeks of manufacture (Aissaoui Zitoun *et al.*, 2012). Also, the pathogenic flora looked for were *Salmonella*, *Staphylococcus aureus*, *Listeria* and *E. coli* O157H7, using the BAX® System (DuPont Qualicon, UK) after enrichment. Those bacteria were not detected in both raw cow's or goat's milk cheese (Aissaoui Zitoun *et al.*, 2012; Madjoudj *et al.*, 2017<sub>b</sub>) and also in prepared goat skin bag before use in manufacturing cheese (Aissaoui Zitoun, 2014; Medjoudj, 2018).

### Lactic acid bacteria in *Bouhezza* cheese

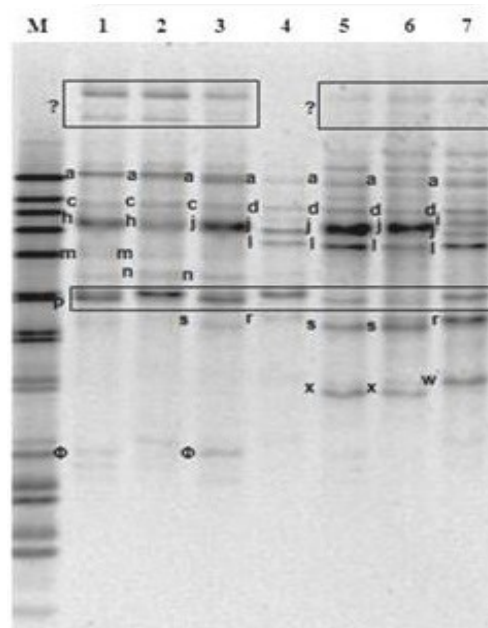
LAB are regarded as the most important bacteria concerning food fermentation, pharmaceutical and special dietary applications (Zhang and Cai, 2014). The discovery that LAB -natural contaminants of raw milk-were at the heart of dairy fermentations paved the way for their isolation, characterization and exploitation (Stanley, 1998). They can be added as a starter culture in milk coagulation step because of their ability to release proteases, lipases, or β-galactosidases to form a unique taste, aroma, and texture (Juan *et al.*, 2016).

*Bouhezza* is a no starter cheese. LAB were the major components of microflora and ranged until 8 log cfu.g<sup>-1</sup> (Aissaoui Zitoun, 2014). In *Bouhezza* raw cow's milk cheese, the counts of indigenous LAB, *Lactobacillus* and *Lactococcus*, throughout ripening remained stable (6 to 7 log cfu.g<sup>-1</sup>). At 21 days of manufacturing-ripening, these groups stabilised at 7 log cfu.g<sup>-1</sup>. The stable count of LAB induced a few changes in the low pH and acidity of the curd (Aissaoui Zitoun *et al.*, 2012). Cheeses made with raw milk have important and complex flora that affect their sensory characteristics during ripening. No Starter Acid Lactic Bacteria (NSLAB), as reported in different studies, are a major bacterial group that have a crucial impact on the characteristics of different traditional cheeses (Licitra *et al.*, 2007 ; Mucchetti *et al.* 2009). In *Bouhezza* cheese, a mixture of NSLAB was compound with *Lactococcus lactis*, *Lactobacillus plantarum* and *Leuconostoc cremoris*/*Ln. mesenteroides* species (fig. 3).

The lactic acid bacteria identification using PCR-TTGE analysis, revealed the regular presence in *Bouhezza* of *Lactococcus lactis* and *Lactobacillus plantarum* species. A remarkable change in the profiles was noted after addition of raw milk by the appearance of new bands. Similarly, phenotypic identification confirmed the predominance of *Lactobacillus* and *Leuconostoc*.

Also, LAB in *Bouhezza* goat's milk cheese were ranged about 7 to 9 log cfu/g and showed some fluctuations during ripening. Principal strains founded were *Lc. lactis* subsp. *cremoris* and *S. gallolyticus* subsp. *macedonicus*. *Lactobacilli* are present with a low load of 6 to 8 log cfu/g containing *Lb. plantarum*, *Lb. johnsonni*, *Lb. gasseri*, *Lb. fermentum*, *Lb. helveticus*, *Lb. acidophilus* and *Lb. crispatus* (Medjoudj *et al.*, 2017<sub>b</sub>).

Belong the NSLAB, Boullouf *et al.* (2018) reveals the possibility of combination between strains to select mixed starter having good technological aptitudes for use fermented milk manufacturing. Three thermophilic selected strains of *Lactobacillus* ssp., *Pediococcus pentosacius* ssp. *intermedius* and *Leuconostoc kimchi* in mixed cultures were tested in manufacturing fermented milk. Also, other mesophilic strains from *Lactobacillus paracasei* and *Pediococcus* were tested in *Lben* and in



**Figure 3.** PCR-TTGE (Polymerase Chain Reaction Temporal Temperature Gel Electrophoresis) profiles of *Bouhezza* cheese from cow milk at different ripening times: 1, 7 d; 2, 15 d; 3, 21 d; 4, 42 d; 5, 56 d; 6, 70 d and 7, the final spiced *Bouhezza* cheese (Aissaoui Zitoun *et al.*, 2012)

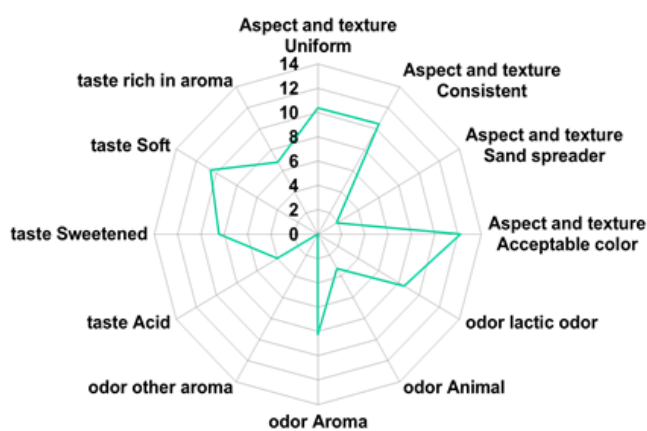
Line M: genomic DNA markers (*Lactobacillus plantarum*, *Lactobacillus fermentum*, *Enterococcus faecium*, *Lactobacillus helveticus*, *Lactococcus lactis*, *Streptococcus thermophilus*, *Corynebacterium moorparkense*, *Lactobacillus paracasei*, *Arthrobacterium nicotianae*, and *Brevibacterium casei*).

Principales species : a, *Lb. plantarum*/*Lb. johnsonni* or *Lb. gasseri*; c, *Leuconostoc cremoris* or *Ln. mesenteroides*; d, *Staphylococcus equorum* subsp. *linens*; h, *S. xylosum*; i, *Lb. brevis* or *S. xylosum*; j, *Lb. helveticus*/*Lb. acidophilus* or *Lb. Crispatus*; l, *Lb. delbrueckii* subsp. *Lactis*; m, *E. faecalis* or *S. succinus*; n, *S. gallolyticus* subsp. *macedonicus*; p, *Lc. lactis* subsp. *cremoris*; r, *Lb. buchneri*; s, *B. cereus*/*B. licheniformis*; w, *C. variabilis*; x, *C. flavescens*; A, *Lb. paracasei*/*Lb. casei*/*Lb. rhamnosus*/*Lb. zae* or *B. infantis*; ?, Unknown band.



Klila cheese manufacturing (Aissaoui Zitoun *et al.*, 2018). Figure 4 show sensorial quality of fermented milk made with *Bouhezza* starter.

Other work shows the possibility of use of mixed starter *Lactobacillus paracasei* and *Pediococcus* strains to manufacture.



**Figure 4.** Sensorial properties of fermented milk prepared with mixed thermophilic starter (Boullouf *et al.* 2018)

## Conclusion

*Bouhezza* is a very unique, traditional cheese that is prepared, salted and ripened in a goatskin.

The *Bouhezza* cheesemaking involves coagulation, draining, salting and ripening operations continuously and not successively in the animal skin-bag “*Djeld*” via the regular addition of fermented or raw milk over a period of months. It is only after, at least a month of manufacture, that the curd form in the skin-bag to matures and gives it specific sensory characteristics. A global view of its process and microbial quality were given. As shown, *Bouhezza* is a soft and mid-fat cheese mainly ripened in the cheese pasta where growth many flora. Lactic acid bacteria (LAB) are the major components of the cheese microflora and are considered as the major ripening agent. They are followed by yeasts and moulds. The presence of lactobacilli in this cheese could be explained by their tolerance of low pH and high salt content. Hygienic conditions during manufacture and ripening are needed to obtain a reliable product. Notably, no pathogenic bacteria were detected in different farm cheeses made with cow’s or goat’s milk. Among NSLAB, regular presence in *Bouhezza* of *Lactococcus lactis*, *Lactobacillus plantarum* and *Leuconostoc* species were found which involve their use as starter for traditional or industrial dairy product in Algeria.

## References

Aissaoui Zitoun, O., Benatallah, L., El Ghennam, H. and Zidoune, M.N., 2011. Manufacture and characteristics of the traditional Algerian ripened *Bouhezza* cheese. *J. Food Agric. Environ.* 9, 96–100.

Aissaoui Zitoun, O., Pediliggieri, C., Benatallah, L., Lortal, Carpino, S., Licitra, G. and Zidoune, M.N., 2012. *Bouhezza*, a traditional Algerian raw milk cheese, made and ripened in goatskin bags. *J. Food Agric. Environ.* 10(2), 289–295.

Aissaoui Zitoun, O., 2014. Fabrication et caractérisation d’un fromage traditionnel Algérien “*Bouhezza*”. Thèse de Doctorat en Science, INATAA, Université Frères Mentouri Constantine 1, 196 p.

Aissaoui Zitoun, O., Carpino, S., Rapisarda, T., Licitra, G. and Zidoune, M.N., 2016. Use of Smart Nose and GC/MS/O analysis to define volatile fingerprint of a goatskin bag cheese “*Bouhezza*”. *Emir. J. Food Agric.* 28(11), 746–754.

Aissaoui Zitoun, O., Hamama, H., Bencheikh El Hocine, A.K., Boullouf, A., Senoussi, A., Benyahia, F.A., Adoui, F., Boughellout, H. and Zidoune, M.N., 2018. Selection and use of autochthon starter in manufacturing Lben and Klila. First International Colloque: Food Security and Sustainable Development in semi-arid zone (SADDMSA). December 08-10, Sétif, Algeria.

Benkerroum, N. and Tamine, A.Y., 2004. Technology transfer of Moroccan traditional dairy products (Lben, Jben and Smen) to small industrial scale. *Food Microbiol.*, 21, 399–413.

Boudalia, S., Boudebbouz, A., Gueroui, Y., Bousbia, A., Benada, M., Leksir, C., Boukaabene, Z., Saihi, A., Touaimia, H., Aït-Kaddour, A. and Chemmam, M., 2020. Characterization of traditional Algerian cheese “*Bouhezza*” prepared with raw cow, goat and sheep milks. *Food Sci. Technol, Campinas* 40(2): 528–537.

Boullouf, A., Lamraoui, G., Lazzouni, I., Aissaoui Zitoun, O. and Zidoune M.N., 2018. Mixed starter cultures of lactic acid bacteria isolated from *Bouhezza* cheese. The tenth cheese symposium INRA, Teagasc, April 4-6, Rennes, France.

Juan, B., Zamora, A., Quevedo, J. M., and Trujillo, A.J. 2016. Proteolysis of cheese made from goat milk treated by ultra high pressure homogenisation. *LWT Food Sci. Technol.* 69, 17–23.

Leksir, C., Boudalia, S., Moujahed, N. and Chemmam, M., 2019. Traditional dairy products in Algeria: case of Klila cheese. *J. Ethn. Foods* 6, 7.

Licitra, G., Ogier, J.C., Parayre, S., Pediliggieri, C., Carnemolla, T.M., Falentin, H., Madec, M.N., Carpino, S. and Lortal, S., 2007. Variability of the bacterial biofilms of the “tina” wood vat used in the Ragusano cheese making process. *Appl. Environ. Microbiol.* 73: 6980–6987.

Marino, V.M., Belbeldi, A., La Terra, S., Manenti, M., Licitra, G. and Carpino, S. 2012. A survey of fat-soluble antioxidants, linolenic acid and conjugated linoleic acid content of traditional Algerian *Bouhezza* cheese. *J. Food Agric. Environ.* 10 (3&4), 186–190.

Medjoudj, H., Zidoune, M.N. and Hayaloglu, A.A., 2017a. Proteolysis and volatile profile in the Algerian traditional *Bouhezza* cheese made using raw goat’s milk. *Int. J. Food. Prop.* 20(8), 1876–1893.

Medjoudj, H., Aouar, L., Zidoune, M.N. and Hayaloglu, A.A., 2017b. Proteolysis, microbiology, volatiles and sensory evaluation of Algerian traditional cheese *Bouhezza* made using goat’s raw milk. *Int. J. Food. Prop.* 20 (sup3), S3246–S3265.

Medjoudj, H. 2018. Contribution à l’étude pour la caractérisation du fromage traditionnel *Bouhezza* au lait de chèvre. Thèse de Doctorat en Science, Université Frères Mentouri Constantine 1.

- Mucchetti, G., Ghiglietti, R., Locci, F., Francolino, S., Bonvini, B., Remagni, M. C., Zago, M., Iezzi, R. and Carminati, D., 2009. Technological, microbio-logical and chemical characteristics of pannerone, a traditional Italian raw milk cheese. *Dairy Sci. Technol.* 89,419–436.
- Samet-Bali, O., Bellila, A., Ayadi, M.A., Marzouk, B. and Attia, H., 2010. Comparison of the physic-chemical, microbiological and aromatic composition of traditional and industrial Leben in Tunisia. *Int. J. Dairy Technol.* 63,98–104.
- Stanley, G., 1998. Cheeses. In Wood B.J.B. (ed.): *Microbiology of Fermented Foods.* pp. 263–307.
- Senoussi, A., Schadt, I., Hioun, S., Chenchouni, H., Saoudi, Z., Aissaoui Zitoun–Hamama, O., Zidoune, M.N., Carpino, S. and Rapisarda, T., 2020. Botanical composition and aroma compounds of semi-arid pastures in Algeria. *Grass Forage Sci.* DOI: 10.1111/gfs.12510.
- Wilkinson, M. and La Pointe, G., 2020. Invited review: Starter lactic acid bacteria survival in cheese: New perspectives on cheese microbiology. *J. Dairy Sci.* 103,10963–10985.
- Zhang, H. and Cai, Y., 2014. *Lactic Acid Bacteria Fundamentals And Practice.* Springer Dordrecht Heidelberg. New York London. 536 p.