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Indigenous fermented milks from some regions of Cameroon and Chad: production processes, utilizations and challenges.

Laits fermentés indigènes de certaines régions du Cameroun et du Tchad: procédés de production, utilisations et défis.

Mbawala Augustin[1,*], Koussou Mian-Oudanang[2], Mouafo Tene Hippolyte[1,4], Tchougang Mangaptche Hervé[1], Tchakouani Yamagueu Galvany Franck[1] and Ramona Suharoschi[3]

[1] Department Food Sciences and Nutrition, National School of Agro-Industrial Sciences, University of Ngaoundere, Cameroon.
[2] IRED of N'Djamena, Chad.
[3] Food Industry and Science Department, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania.
[4] Centre for Research on Food and Nutrition, Institute of Medical Research and Medicinal Plants Studies, P.O. Box 6163 Yaounde, Cameroon.
* Corresponding Author: mbawalaa@yahoo.fr

ABSTRACT:

Nowadays, the demand of traditional fermented foods (Bio character) including traditional fermented milks by consumers, is increased due to their numerous health benefits, important nutritional values and researched organoleptic properties. A great diversity of indigenous fermented milk products is manufactured worldwide and the ingredients involved in their production are also diversified. The aim of the present work is to establish after exploiting some published data, the technological processes of indigenous fermented milks produced in some regions of Cameroon and Chad and, to evocate their utilizations, their potential properties, their limits and some related challenges. In sudano-guinean and sudano-sahelian regions of Cameroon and Chad, the technological processes used to produce indigenous fermented milks remain nearly constant and the final products obtained are only represented by four types: *Pendidam* and *Kindirmou* in Cameroon, *Rouaba* and *Rayeb* in Chad. They are all produced by fermentation of raw fresh milk from cow origin and used mainly for feeding purposes. The fermented milks produced in these regions cannot act only as sources of nutrients but can also have health benefits like disease preventing or curing properties, as functional or probiotic foods. The challenges of these indigenous fermented milks from sudano-guinean and sudano-sahelian regions of Cameroon and Chad could be their vulgarization which should develop their technological processes, the exploitation of their properties to provide health benefits to consumers such as the fight against COVID-19 pandemic among others, the generation of incomes and employment favorable to economic growth.

Keywords: Indigenous fermented milks, Cameroon, Chad, production processes, utilizations, challenges, Covid-19.

RÉSUMÉ :

De nos jours, les aliments fermentés traditionnels (caractère Bio) y compris les laits fermentés sont très recherchés à cause de leurs valeurs nutritionnelles, leurs propriétés organoleptiques et leurs nombreux effets bénéfiques pour la santé humaine. Une grande diversité des laits fermentés traditionnels sont produits de par le monde et les ingrédients utilisés dans leur fabrication sont aussi variés. La présente étude a pour but d'établir après exploitation des données de la littérature, les procédés technologiques de fabrication des laits fermentés traditionnels dans quelques régions du Cameroun et du Tchad, et d'évoquer leurs utilisations, leurs applications prospectives et les challenges qui en découlent. Dans les régions soudano-guinéennes et soudano-sahéliennes du Cameroun et du Tchad, les procédés technologiques utilisés pour produire les laits fermentés traditionnels demeurent constants et les principaux produits finis sont représentés par quatre types : le *Pendidam* et le *Kindirmou* au Cameroun, le *Rouaba* et le *Rayeb* au Tchad. Ils sont tous produits par fermentation du lait de vache et utilisés principalement pour l'alimentation. Ces laits fermentés traditionnels au vu de leurs multiples propriétés ne peuvent pas servir uniquement comme source de nutriments mais peuvent avoir des effets bénéfiques pour la santé, et utilisés comme aliments fonctionnels ou probiotiques. Les challenges des laits fermentés traditionnels produits dans les régions soudano-guinéennes et soudano-sahéliennes du Cameroun et du Tchad seraient leur vulgarisation susceptible de développer leurs procédés technologiques de fabrication, l'exploitation de leurs propriétés pour engendrer des effets bénéfiques sur la santé à l'instar de la lutte contre la pandémie de la COVID-19 et autres, ce qui génèrerait des revenus et des emplois favorables à la croissance économique.

Mots clés : Laits fermentés indigènes, Cameroun, Tchad, Procédé de production, Utilisations, Challenges, COVID-19.

1. INTRODUCTION

Fermentation is a biotechnological process used all over the world since ancient times to produce indigenous fermented foods and alcoholic beverages. The demand of traditional fermented foods by consumers is increased due to their numerous health benefits and important nutritional value (Sharma et al., 2014). Fermented milks are one of the most popular fermented foods produced and highly appreciated by consumers worldwide. Lactic acid bacteria (LABs) have been reported as the main actors of the fermentation process of indigenous fermented milks (Djoulde et al., 2013; Kaktcham et al., 2012; Shalo et al., 1973). LABs fermentation of foods improves both the nutritional value and digestibility of the end-products (Sharma et al., 2014; Chelule et al., 2010; Nout, 2009) and the bioavailability of minerals, proteins and free sugars (Sharma et al., 2014; Santos et al., 2008; Sripriya et al., 1997). During fermentation, LABs produce metabolites such as organic acids, bacteriocins (Chelule et al., 2010; Joshi et al., 2006; Abee et al., 1995), biosurfactants (Mouafo et al., 2018a, Mouafo et al., 2018b; Mbawala et al., 2017) that have antimicrobial activity, thus prolong the shelf life of foods. The "researched" properties of each fermented milk depend on the quality of raw materials, ingredients and the technological process used during its production. The skill of fermented milk making such as yogurt, as inherited from the ancestors, have been subjected to industrial standardization process comprising the main obligatory steps that follow: heat treatment (pasteurization) of milk - cooling - homogenization - inoculation - fermentation (during incubation) - packaging - storage (Puniya, 2016). Regardless of the reported benefits interest concerning most of the indigenous fermented milks, their technological processes are still unstandardized and consequently their production remain at the artisanal level. Based on these considerations: what are the technological processes used to produce indigenous fermented milks in sudano-guinean and sudano-sahelian regions of Cameroon and Chad? What could be the health benefits provided to human being after their consumption? And what are some related challenges favoring the vulgarization of their production?

The aim of the present study is to establish the technological processes, the utilizations, the potential properties, the limits and some related challenges of indigenous fermented milks produced in some regions of Cameroon and Chad after exploiting some published data.

2. PRODUCTION PROCESSES AND DESCRIPTION OF INDIGENOUS FERMENTED MILKS

There are only four types of indigenous fermented milks produced in sudano-guinean and sudano-sahelian regions of Cameroon represented by *Pendidam* and *Kindirmou* produced mostly by Fulani people while those of Chad are represented by *Rouaba* and *Rayeb* produced by Arab and Peul. They are all produced by fermentation of raw fresh milk from cow origin. Considering the production processes (Figure 1 to Figure 4), *Pendidam* is a raw fresh milk, heated, skimmed and fermented (Jiwoua et Millière, 1990) while *Kindirmou* is a raw fresh full-cream milk, heated and fermented (Essomba et al., 2002); *Rouaba* is a raw fresh milk, churned and fermented while *Rayeb* is a full fresh milk, fermented (Koussou and Duteurtre, 2004). Finally, *Pendidam* is a light curdled milk, very acidic while *Kindirmou* is a heavy fermented milk, less acidic than *Pendidam*; *Rouaba* has a hard acidic taste while *Rayeb* has a taste nearest to natural yogurt.

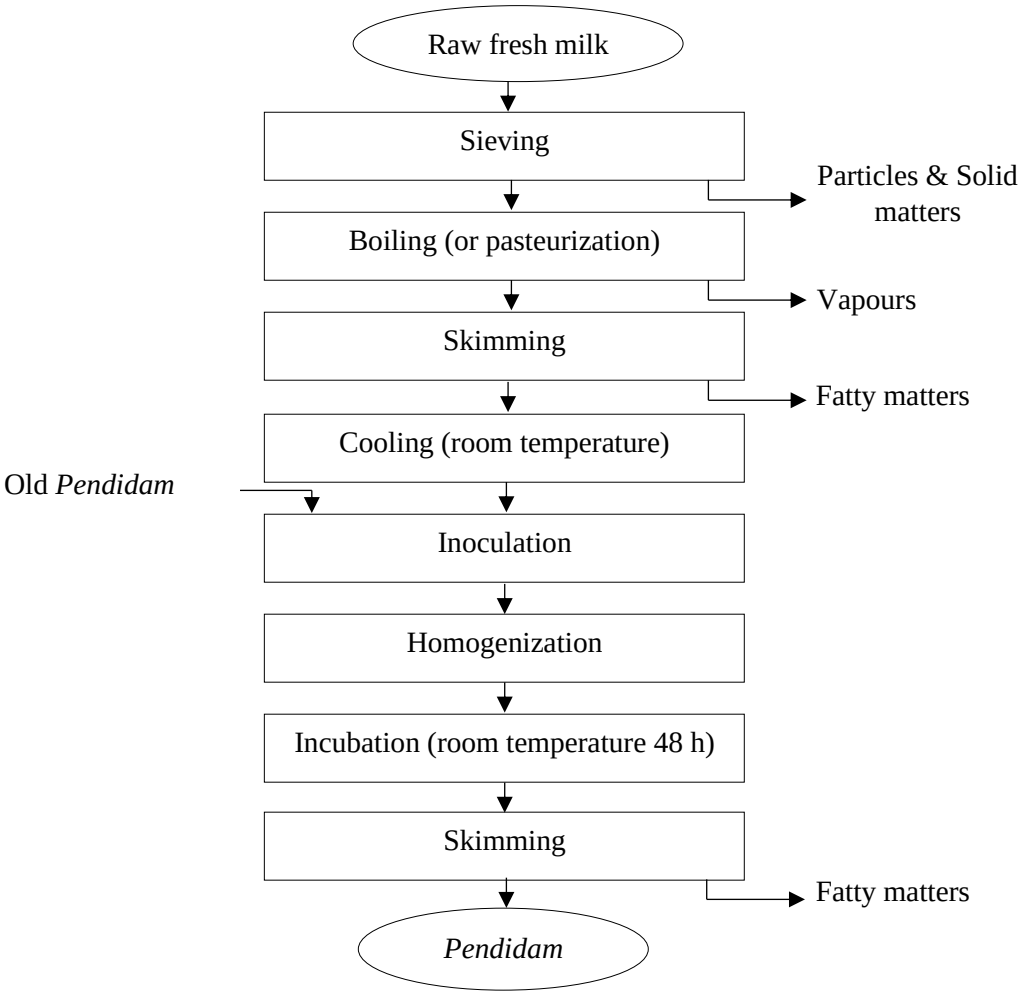

Figure 1: Flow diagram of *Pendidam* production process (Cameroon).

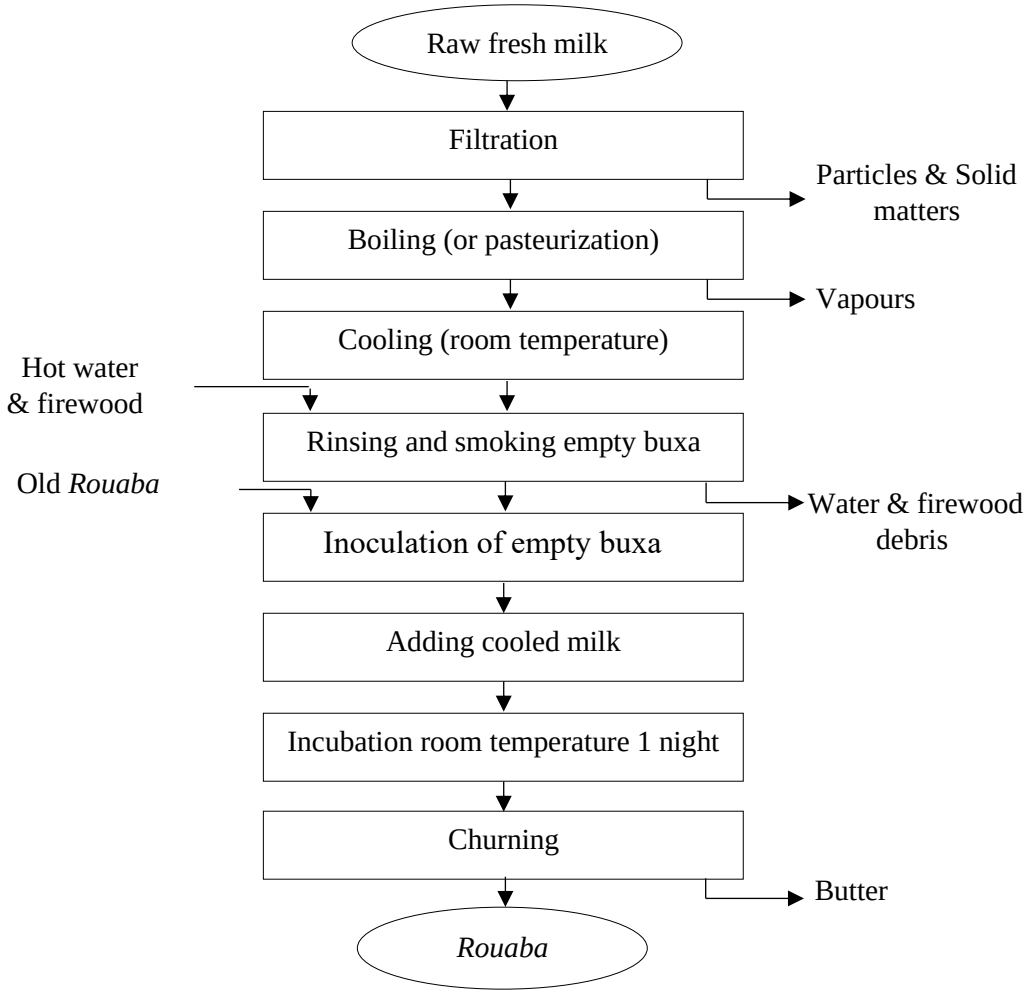

Figure 2: Flow diagram of Arab production process of *Rouaba* (Chad).

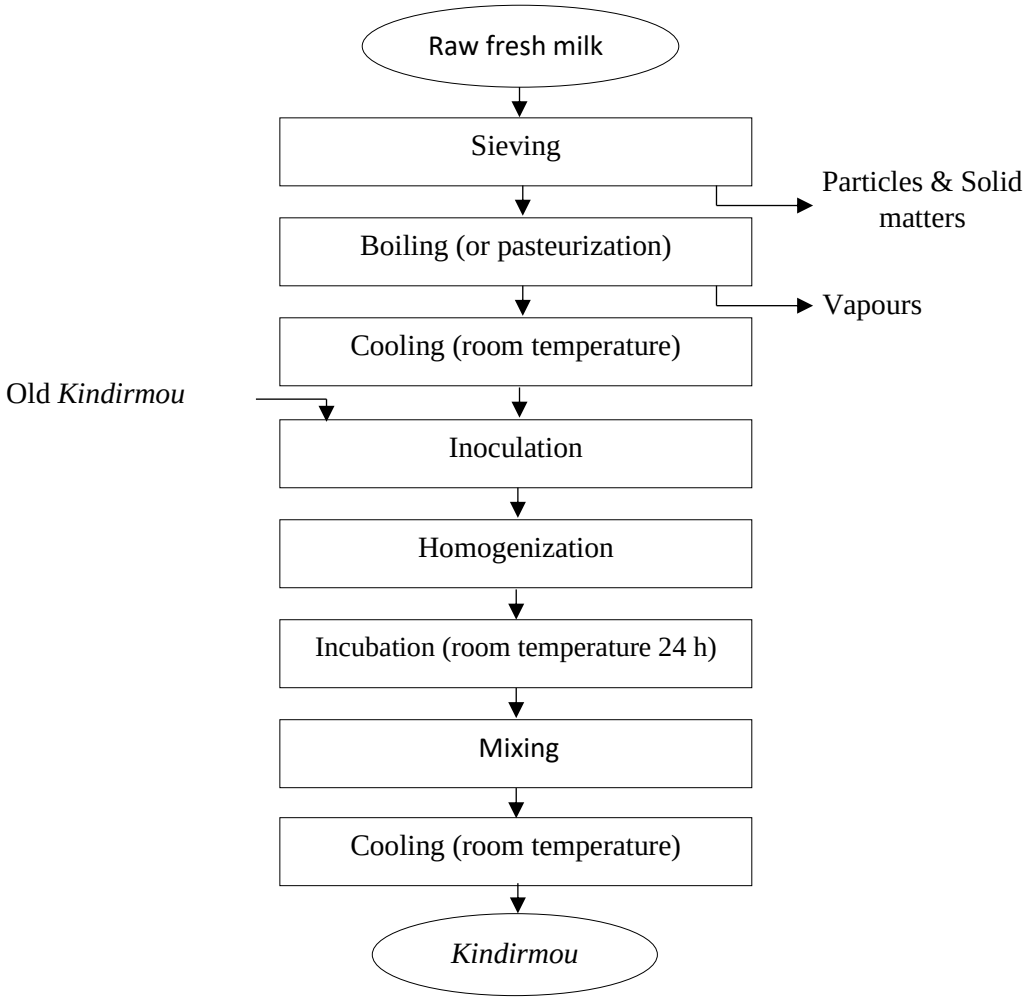

Figure 3: Flow diagram of *Kindirmou* production process (Cameroon).

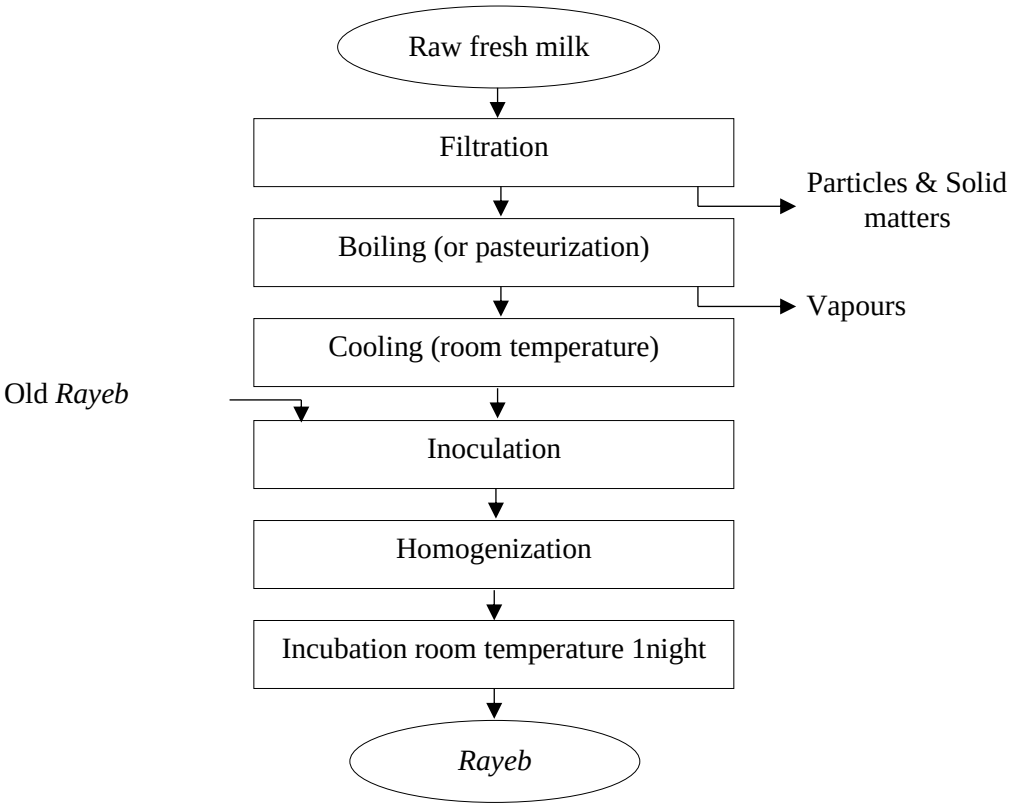

Figure 4: Flow diagram of *Rayeb* production process (Chad).

3. LOCAL UTILIZATIONS OF FERMENTED MILKS PRODUCED

According to Essomba et al. (2002), in Cameroon milk and fermented milks play an important role in the Fulani tribe of northern regions since they contribute to income and employment generation to generally female sex producers, transformers and traders. For Fulani people, fermented milks are considered as veritable foods whereas other people with nonbreeding traditions consume it as « dessert ». Fulani people recognize health benefits attributed to fermented milks: its acidity permit children to combat intestinal worms and to consumers they bring power, bravery and toughness. For Fulani people, *Pendidam* is appointed in priority to children who must consume it regularly while *Kindirmou* is mostly destined to adults particularly men to whom it gives virility.

Koussou and Duteurtre (2004) reported that in Chad, *Rouaba* and *Rayeb* are highly consumed by inherent sahelian people as a source of proteinaceous foods. *Rouaba* is a researched curdled milk because of its acidic taste and also is highly appreciated for its organoleptic properties. *Rouaba* and *Rayeb* correspond to a new demand by urban populations concerning refreshing beverages. Their success is also due to "farmer" character of the product since some sellers write in the frontage signboard of their selling points "pure cow milk" to attract customers.

4. POTENTIAL PROPERTIES, LIMITS AND CHALLENGES OF INDIGENOUS FERMENTED MILKS

In addition to investigated traditional utilizations, each indigenous fermented milk produced in sudano-guinean and sudano-sahelian regions of Cameroon and Chad could:

- possess probiotics properties depending probably on the varieties of LABs it contains;
- be a source of specific and interesting flavors, aromas and textures due to the nature of end-products resulting to microbial phenomena occurring during fermentation processes;
- be a source of biomolecules probably produced by LABs, responsible of anti-constipation effect, anti-hypertensive properties, lipids metabolisms improvement, anti-obesity effect, and cholesterol-lowering activity, etc.

Below are represented unexhaustive citations of some technological and commercial limits of indigenous milk and fermented milks beverages:

- insufficiency of quantity and poor quality of the main raw material (milk) produced which is highly linked to the season;
- unstandardized starter culture formulation;
- low productivity considering increasing consumers demand;
- absence of regulation on raw materials supplying and quality, on production processes, packaging and storage;
- non-respect of the chilling chain during transportation, distribution and/or commercialization steps;
- poor source of incomes and employment to milk and fermented milks producers, transformers and traders.

A general constat can be remarked: absence or insufficiency of microbiological and biochemical investigations on indigenous fermented milks produced in sudano-guinean and sudano-sahelian regions of Cameroon and Chad until now. Thus, a potential field for future research is opened to researchers in cooperation with industrials in how to vulgarize such authentic products with specific flavors, aromas and textures. Results of such studies could demonstrate that most of the fermented milks produced in these regions cannot act only as sources of nutrients but also can:

- have health benefits like disease preventing or curing properties (nutraceutics);
- possess properties of probiotic and/or functional foods.

For these reasons, the increase of their consumption by population must be recommended by administrative authorities throughout the concerned countries.

To satisfy the increase in demand, breeders have to ameliorate the quantity and the quality of milk produced independently to the season. Controlled fermentation during production can improve the quality and consequently the shelf life of the indigenous fermented milks produced.

Training of fermented milks producers on Good Hygiene Practices (GHP) and Good Manufacturing Practices (GMP) must be done to solve the potential problems due to their lack of education in food safety, particularly in areas where facilities for the safe preparation of foods are absent.

5. CHALLENGES ABOUT SOME APPLICATIONS OF LABs METABOLITES: BIOSURFACTANTS/BIOEMULSIFIERS (BS/BE)

A recent data published on Biosurfactants (Smith et al., 2020) hypothesizing that theses bioactives molecules are a Covid-19 perspective, could be verified when considering the fact that Biosurfactants (BS) are:

- amphiphilic molecules with both hydrophobic and hydrophilic moieties;

- Bioemulsifiers (BE) since they possess emulsifying properties with additional tensioactive characteristics;

- mostly produced by bacteria, yeasts, etc. and those produced by *Lactobacillus* spp. are GRAS (Generally Recognized As Safe);

- can be produced by Lactobacilli isolated from a cameroonian hard acidic fermented milk (*Pendidam*) very consumed (Mbawala et al., 2013a);

- cell wall-linked and/or extracellular metabolites;

- commonly extracted and/or precipitated from the cell wall or the cell-free supernatant (CFS) of a culture of Lactobacilli by chemical solvents (acids, ethyl acetate, acetone, methanol, ethanol, etc.).

Independently to the consideration that bioethanol is a bio-solvent that can be used to precipitate the Biosurfactants/Bioemulsifiers (BS/BE) from the CFS of cultured Lactobacilli, some applications and challenges of the BS/BE produced by Lactobacilli isolated from « *Pendidam* », a cameroonian hard acidic fermented milk were demonstrated such as:

- Antimicrobial activities against *Pseudomonas* spp. (Fresh Beef), against bacteria and yeasts (Yellow *Achu* Soup) (Mbawala et al., 2017; Mbawala et al., 2013a);

- Improvement of the shelf life of *Pendidam* (Mbawala et al., 2015; Mbawala et al., 2014);

- Emulsifying properties that increase shelf life (Yellow *Achu* Soup), improve sensory properties (Milk Bread, Sausage), improve texture (Beef Dough) (Mbawala et al., 2015);

- Biopreservatives properties (Ground Beef) through antimicrobial, antioxidant and antiadhesive activities, prevention of lipid oxidation and proteolysis and color stabilization, etc. (Mouafo et al., 2018a; Mouafo et al., 2018b).

In fact, some advantages of the BS/BE present in *Pendidam* were enumerated: they are produced mainly by Lactobacilli and can be extracted with bio-solvent (bioethanol) => GRAS status; they form stable emulsions (48 hours) at extreme pH and temperature, and at varied salinity (NaCl) (Mbawala et al., 2017); they possess tensioactive, antimicrobial, antioxidant and antiadhesive properties and they stabilize the color (Mouafo et al., 2018a; Mouafo et al., 2018b), etc.

Thus, great challenges about health care can be hypothesized concerning these GRAS bioactives compounds: the utilizations of BS/BE extracted from *Pendidam* to fight against the Covid-19 pandemic, the HIV pandemic, the *Influenza* viruses pandemic and the cardio-vascular diseases (CVD) by emulsifying HDL-cholesterol depots in blood vessels, etc.

6. CONCLUSIONS

Fermented milks are the most fermented foods consumed by people of some regions of Cameroon and Chad regardless to religious, ethnical and social considerations.

Suitable and available studies on traditional processes of milk fermentation may provide to people basic information on good manufacturing practices and good hygiene practices which are helpful to realize safe productions.

The future of indigenous fermented milks in these countries must be their popularization, which could develop their technological processes, provide health benefits to more consumers, generate income and employment, and permit economic growth.

7. ACKNOWLEDGEMENTS

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8. CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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