



Original Research Article

Evaluation of the good hygienic practices on the production of *kindirmou* and *lebol*

H.C.Edima^{1*}, E.T.Awono¹, D.M.Bilola¹, H.B.Tchoumkeu¹ and F-X.Etoa²

¹Department of Food Sciences and Nutrition, National Advanced School of Agro-Industrial Sciences, University of Ngaoundere, P.O. Box 455 Ngaoundere, Cameroon.

²Department of Microbiology, Faculty of Sciences, University of Yaounde I, Cameroon

*Corresponding author

A B S T R A C T

Keywords

Kindirmou,
Lebol,
Practices,
Production,
Ngaoundere

In order to evaluate the safety of *lebol* and *kindirmou* two local dairy products of Cameroon, an investigation was done in two sites of production at Ngaoundéré 3rd subdivision in the Adamaoua region of Cameroon. The investigation was based on a pre-designed questionnaire, which was filled out based on observations and discussions with the farmers. In the two sites of production; *Gada Mbidou* for the *kindirmou* (traditional fermented milk) and *Bini Dang*, for the *lebol* (traditional butter), three samples of each product were collected for microbial analysis. The main results of the questionnaire have shown the bad hygienic practices for the production of these two products, while the conditions of storage and distribution can cause microbial contamination. Although, microbiological analyzes have confirmed this assumption, in fact, it was counted 1.05×10^2 cfu/ml of total coliform on *kindirmou* and 1.40×10^2 cfu/ml of fecal *Streptococcus* in *lebol*. Yeast and mould have been found in the two samples. As *kindirmou* and *lebol* are the main dairy product produced and consumed locally, it is important to train producer on good hygienic practices to improve the safety of these product.

Introduction

Milk is the product of the total and uninterrupted milking of a dairy female, well fed, in good health, not overworked and shall not contain *colostrum* (FAO, 2008). Milk is a complete food with 80% of water, 5% of carbohydrates, 3.7% of fat and 3.5% of protein. It is therefore advisable to feed newborns and vulnerable people which are not lactose intolerant.

Related to its composition, milk is highly perishable and must be collected, stored and processed under the best hygienic conditions, because poorly preserved milk and dairy products can cause food poisoning infections such as Listeriosis, Salmonellosis and botulism (Edima *et al.*, 2012). Otherwise, in Cameroon, the milk production is mainly in the regions of the

Far North, North, Adamawa and Northwest. With a favorable environment for the development of livestock, Adamawa region is one of the main areas of production and processing of fresh milk (Edima *et al.* 2014). In this Region, the dairy products found on the market are referred to *kossam* which is generic term meaning milk in *Peul* language (Libouga *et al.*, 2005).

According to the processing type, the specific terms used are as follows: *Biraadam* for the raw, fresh, non-fermented, unskimmed milk; *Kindirmu* for thick milk, this is ordinary milk, heated and coagulated; *Penndiidam* for fermented milk made from skimmed *Biraadam*, heated and fermented; *Dakéré* for a mixture of fermented milk and *cassava semolina*; Yoghurt; there are two types of yoghurt, the manufactured yoghurt and the semi-manufactured one marketed under the label *Kossam*, the last local dairy product is *Lebol* a local butter. Thus, several studies have shown the poor microbiological quality of these products (Jiwa *et al.*, 1990; Libouga *et al.*, 2005; Edima *et al.*, 2013). However, the work done have not focused on the impact of manufacturing processes on the quality of the final product. Whereas the quality of products is highly dependent on milking hygienic conditions associated with processing. This study therefore aims, of the evaluation of processing and manufacturing conditions of *lebol* and *kindirmou* two local dairy products.

Materials and Methods

Evaluation of good hygienic practices on the production of *kindirmou* and *lebol*

The evaluation of good hygienic practices was done by the analysis of the production area of *kindirmou* (fermented milk) at *Gada Mbidou* and production area of *lebol* (traditional butter) at *Bini Dang*, two

localities of Ngaoundéré 3rd subdivision in the Adamaoua region of Cameroon. These sites were selected based on their proximity to the University of Ngaoundere where students used to supply in milk products; it will enable us to appreciate the hygienic quality of dairy products consumed by students. To achieve this, a check list was elaborated based on the requirements of good hygienic practices (FAO/IDF, 2012). Observations on the field and interviews conducted in *Fulfulde* that is a local language, help us to fill questionnaire. Visuals observations were done at all steps of production of the two products, to assess the hygienic and manufacturing practices throughout the chain, focusing on hygiene of equipment, method of work, environment, labor and milking practices.

Microbiological analysis

In the two sites of production, three samples of each product (*kindirmou* and *lebol*) were collected at the distribution place. These samples were preserved at 4°C and immediately taken to the laboratory for microbiological analysis, to search: total flora, total coliforms, fecal coliforms, yeast and mould, *Staphylococcus aureus*, fecal *Streptococcus*, reducing-sulfite *Clostridium* and *Salmonella sp.*

Results and Discussion

Evaluation of hygienic practices for the production of *kindirmou* and *lebol*

As previously stated, investigation was done in the entire chain of production of *kindirmou* and *lebol*, to assess the hygienic and manufacturing practices throughout the chain, focusing on hygiene of equipment, method of work, environment, labor and milking practices, Figure 1 illustrates the results obtained.

Figure.1 Evaluation of the application of good hygienic practices in %

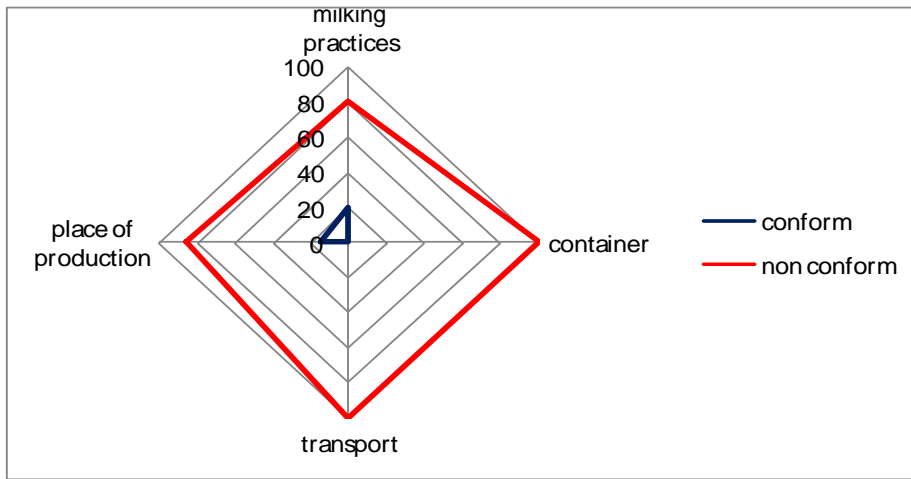


Figure.2 Evaluation of the application of good manufacturing practices in %

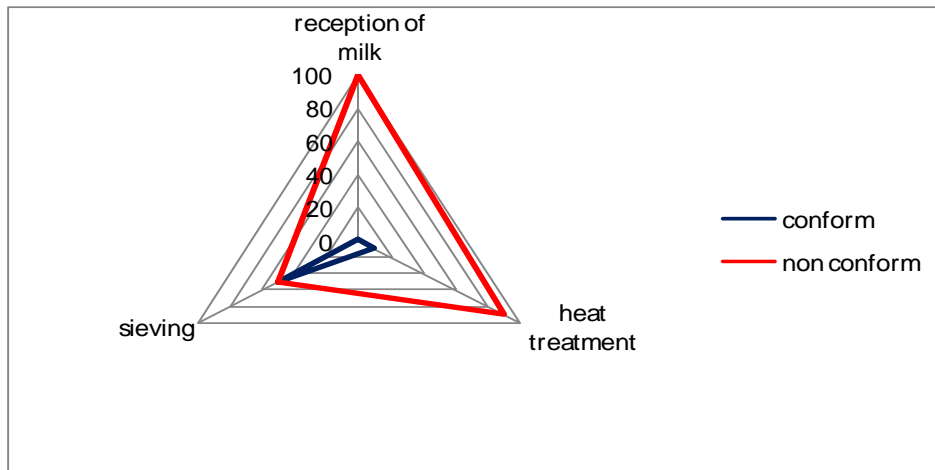


Figure.3 The level of contamination of *lebol*:

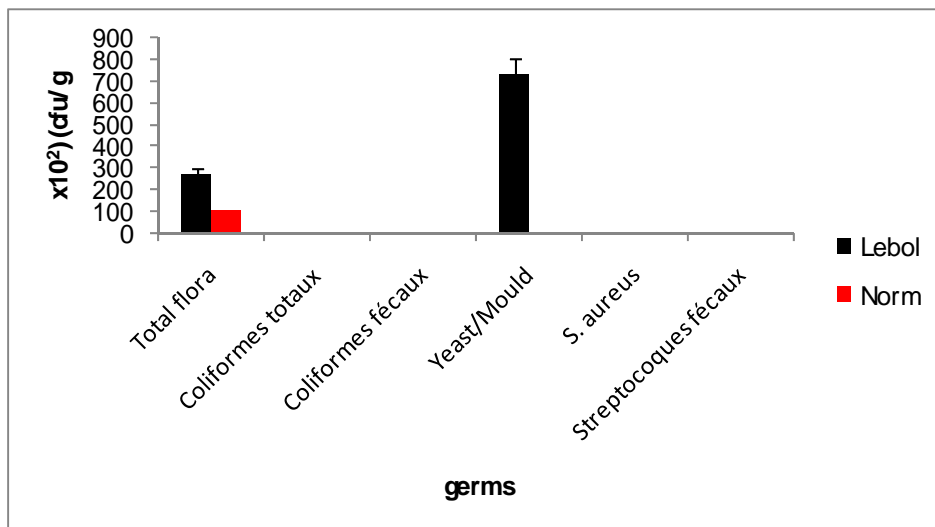
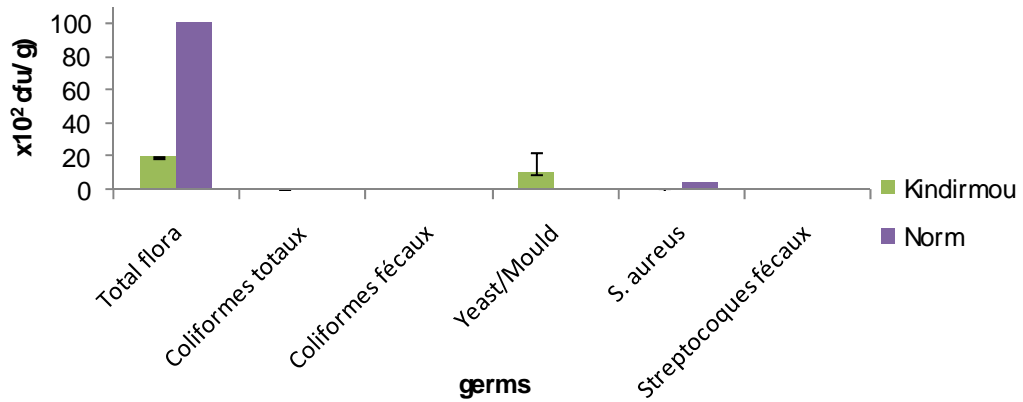


Figure.4 The level of contamination of *kindirmou*.



Picture.1 Container and transport of fresh milk



Picture.2 Reception and sieving of the milk



Picture.3 Conditions of storage of *kindirmou* and *lebol*



Milking practices: results show that none of the five requirements are satisfied. In fact, 80% of requirements according to the existence of milking area, the link of the leg and the tail of the cow; cleaning of the udder and the observation of first three gush of milk are not respected. While 20% are partially satisfied.

Indeed, there is not milking area meaning that milking is done in the open air beside other animals, feces, dust and flies with greater risk of contamination of milk. This contamination could also be due to the milkers who do not wash their hands before milking, they do not also observe the first three gush of milk to highlight a possible presence of mastitis; neither throws them away to clean galactophore channels. These difficulties particularly stem from the inability of the actors to apply the simple hygiene rules, Edima *et al.*, (2013) study have also shown that, these actors fail to apply the hygiene rules because they consider it as waste of time. These authors attributed it to the ignorance and illiteracy of the actor.

Container and transport of milk: None of the three requirements evaluated was satisfied. In fact, milk collected into plastic or calabash spend 4 hours at ambient (34–45 °C) temperature to reach the transformation unit (picture1). Transportation conditions are favorable to the degradation of quality of the milk. In fact, plastic cans are scratched and could hinder satisfactory cleaning, thus lead to appropriate conditions for the development of microorganisms (Edima *et al.*, 2014). Gran *et al.*, (2002) show that milk coming from plastic containers had higher levels of coliforms than the one coming from metallic containers. Moreover, the transportation time which is too long at the ambient temperature can also lead to the degradation of milk due to the development of microorganisms.

Area of production: Area of production of *kindirmou* and *lebol* are not in accordance with FAO requirements. These production sites are located in shanty town. Production is often done in presence of dust, dung and grass. Animals such as cats, dogs and chickens always move around the production area. Sometimes, production is done not far from toilets. When the production does not take place outside, it is done inside room with partial ceiling under where old objects are suspended. Then the risk that fragments coming from those objects contaminate product is higher. Observations show also that production rooms have only one door and one window compromising by this the putting in place of the “*forward march*” principle.

Evaluation of manufacturing practices

Reception of milk: According to the FAO requirements, reception of milk is not well done in the production sites (fig.2). It was observed that milk is receipt in dirty environment and receptionists do not wash their hands before handle. At the arrival, milk is not tested. Utensil used for cooking is the same used for the production of *kindirmou* and *lebol*. Producer of *lebol*, contrary to those of *kindirmou* riddle milk after reception. This is important as it permit to eliminate solid contaminant (picture 2).

Pasteurization of milk: Pasteurization of milk is done in margin of norm (85°C/20 minutes). For *kindirmou*, producer used to boil milk for 1 hour at about 65 or 70°C. Pasteurization is done in saucepan and cooling is done inside the same saucepan at ambient uncontrolled temperature. The only parameter of pasteurization taken into consideration by *kindirmou* producer is time. When they put milk to boil, they just control time. After one hour on fire, they just remove milk from fire. Concerning *lebol*,

producer used to boil milk for 25 minutes at about 100°C. Pasteurization is done in saucepan and cooling is done inside pail also at ambient uncontrolled temperature.

Sowing, fermentation, churning and storage: Apart of material, other factors are not satisfied. Fermentation is done under uncontrolled temperature. Material of fermentation is cleaned but not disinfect. For *kindirmou*, ferment used is a portion of the last production. The use of ferment coming from last production is a source of contamination because *kindirmou* is produce in unhygienic condition. Moreover, conditions of conservation are not to guaranty integrity of ferment. Churning is done using plastic bottle. It has been also observed that neither packaging, nor storage condition respect the requirements. *Kindirmou* is conserve in refrigerator while *lebol* is just put rusty inside plate and left at ambient temperature. After showed environmental conditions and practices used for the production of *kindirmou* and *lebol*, it seems important to evaluate the microbial quality of these products.

Microbiological analysis

Figures 3 and 4 show the level of contamination of *kindirmou* and *lebol*, we see that microbial flora vary from one product to other; *Salmonella sp.*, *sulfite reducing Clostridium* and fecal *Streptococcus* were only present in the *lebol*, which should make this product unfit for human consumption, due to the presence of causative agent of gastroenteritis. While fecal coliforms are absent on the two products.

According to aerobic mesophile flora, is around 2.03×10^3 cfu/g and 2.68×10^4 cfu/g respectively for *kindirmou* and *lebol*. For the European reglementation, *kindirmou* is

conform concerning the rate of total flora, this is due to the fermentation of milk during the *kindirmou* process which causes the production of lactic acid and inhibits the development of non acidophilus germs. But as we observed, there is no fermentation step on the *lebol* process, so this product is not preserved by the low pH like the *kindirmou*.

Moreover, *lebol* is not contaminated by total coliform while 1.05×10^2 cfu/g was found on *kindirmou* samples; although the health risks directly related to the presence of total coliforms is low, their presence reflects negligence in the implementation of hygiene while handling the product (Libouga *et al.*, 2005).

Fecal *Streptococcus* are absent in *kindirmou* but present in *lebol*. Yeast and mould have been found in the two samples. Their presence due to the poor condition of conservation of the products, are higher compare to the European reglementation and can lead to the production of mycotoxins which are dangerous for the human health. *Kindirmou* and *lebol* are conform according to the European reglementation concerning the rate of *Staphylococcus aureus*.

Globally, contamination of *kindirmou* and *lebol* is due to bad hygienic practice during milking, the transportation and the transformation of milk. In fact, Edima *et al.*, (2012, 2013, 2014) reveal bad practices of milking, and transport condition that may lead to the contamination of milk. The presence of total coliforms and *Salmonella* testify a fecal contamination and unhealthy environment. Fecal *Streptococcus* and *Staphylococcus* could have mammary origin. But, it seems like pasteurization done at the production is important as it eliminate of pathogenic and altering microorganism.

Finally, it appears that good hygienic

practices are not applied at all the steps of production of manufacturing of both *kindirmou* and *lebol*. The consumption of those products can affect human health. Training of all the actors became therefore crucial as well as human health is concern.

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