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REVIEW: 'THE MIRCOBIOLOGY OF WEST AFRICA FERMENTED DAIRY PRODUCTS'

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Abstract: Fermented dairy products have been preserved and used by humans, since pre-historic times. They were mostly made and used in: Asia, Africa, the Middle East, Northern and Eastern Europe (Sawadogo *et al*., 2004). Cutting across cultures, fermented dairy products in West Africa are mostly yoghurt-like in nature. And their mode of processing varies from one region to the other. However, the raw material is mostly, un-pasteurized, unskimmed milk (Eka and Ohaba, 1997).

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Introduction

Fermented dairy products have been preserved and used by humans, since pre-historic times.

They were mostly made and used in: Asia, Africa, the Middle East, Northern and Eastern Europe (Sawadogo *et al*., 2004). Cutting across cultures, fermented dairy products in West Africa are mostly yoghurt-like in nature. And their mode of processing varies from one region to the other. However, the raw material is mostly, un-pasteurized, unskimmed milk (Eka and Ohaba, 1997).

The microbiota in the products varies from one region to the other. This may be due to differences in climate (Savadogo *et al.*, 2004).

Therefore it is incumbent that, in cold regions the microorganisms found in the products are mesophilic for instance: *Lactococcus* and *Leuconostoc. Spp*, whilst thermophilic bacteria may include: *Lactobacillus* and *Streptococcus. Spp* prevailing in hot tropical and sub-tropical climates (Thomas, 1985; Tamine and Robinson,1988; Kurmann, 1984).

The said products are deemed to confer health benefits to the consumers. However, research has also shown that, they are associated with pathogenic bacteria. For example; Staphylococcus *aureus, Eschericia coli, Bacillus cereus* and *Pseudomonas aeruginosa* (Atanda and Ikenebomeh, 1988).

This paper therefore seeks to provide an overview on the current state of different aspects of research on microorganisms in West African dairy products in the light of their positive impact on human health.

Microbiological characteristics

'Nunu' is a spontaneously fermented milk product yoghurt-like in nature, produced by the Fulanis in Ghana. It is processed by pulling fresh un-pasteurized milk together from lactating cows and allowed to ferment over twenty-four (24) to forty-eight(48) hours in calabashes(Akabanda *et al*., 2010).

According to the authors, the microbiota found from zero hour to forty-eight hours of fermentation ranged from 4.00 and 9.00 log cfu/ml for Lactic acid bacteria (LAB) and 1.0 and 7.0 log cfu/ml for yeast.

By their assertion the dominant LAB species were; *Lactococcus, Lactobacillus, Leuconostoc, Streptococcus, Enterococcus and Lactobacilli*. The work confirmed that Enterobacteriacae numbers decreased from 5.19 to 0.01logcfu/ml from the zero hour to the forty-eight hour.

Yeast species isolated in the work were; *Sacchromyces cerevisiae, Sacchromyces pastorianus, Candida kefyr, Yarrowia lipolytica, Candida stellate* and *Kluyveromyces maximus.*

Tabble 1: Microbial counts of 'nunu'

Fermentation time (hours)	TPC Log cfu/ml	LAB Log cfu/ml	Yeast Log cfu/ml	Enterobacteriaceae Log cfu/ml
0	7.3±1.05	4.69±0.37	6.63±0.85	5.19±0.63
12	6.92±0.77	6.43±0.44	6.27±0.63	4.66±0.65
24	6.68±1.19	7.91±0.36	3.64±0.73	3.09±0.69
36	6.62±0.52	8.33±0.28	2.43±1.11	1.53±1.36
48	5.59±0.69	8.82±0.32	1.22±1.34	0.00±0.00

Key: TPC= total plate count, LAB= lactic acid bacteria, cfu = colony forming units

Source: Akabanda *et al*., (2010)

The authors concluded that, there was no standard method of processing, as such product quality varied from one processor to the other. Also Good Manufacturing Practices were not observed and so the final product seemed to be compromised. However, they recommended 'nunu'is safe for consumption. Since pathogenic bacteria decreased from5.19 to 0.01logcfu/ml at the end of fermentation.

Lactic acid bacteria counts in 'Nyarmie' from the twenty-fourth hour to the forty-eight hour was between 8.2 to 7.1 $\log_{10}$cfu/ml. This product is similar to 'nunu', except that the milk is pasteurized before fermentation. The dominant LAB species isolated included: *Leuconostoc mesenteriodes, Streptococcus thermophiles, Lactobacillus delbruckii spp, Lactococcus bulgaricus. Lactococcus helveticus spp* was not revealed by cultivation, but by PCR-DGGE analysis. *Sacchromyces cerevisieae* and *Candida species* were the only yeast species isolated and their counts also decreased from 7.45$\log_{10}$ cfu/ml at the 24h to 6.94$\log_{10}$ cfu/ml at the 48h(Obodai and Dodd, 2005). The dominance of Lactobacillus species, *Streptococcus thermophilus*, and Lactobacillus delbruekii species are likely to have an influence on the aroma and flavor of the product as confirmed in previous works(Randazzo *et al*., 2002). Future work should be done the carbohydrate patterns which were close relatives in the PCR bands to the mentioned isolates.

Strains isolation and identification of microbiota in fermented milk in Burkina Fasso, included: *Leuconostoc, Streptococcus, Lactobacillus* and *Pediococcus.* The most predominant was the genus *Lactobacillus* (*L. fermentum*, *L. acidophilus* and *L. delbroekii*) (Savadogo *et al*., 2004).These results were confirmed by previous works(Hammes and Vogel, 1995).

'Nono' is a product of unpasteurized spontaneously fermented bovine milk. The fermentation period is 24h(Eka and Ohaba,1997; Olasupo *et al*., 1996).

The microbial population isolated after fermentation were mainly *Lactobacillus species*. The organisms were: *Lactobacillus bulgaricus, Lactobacillus lactis, Lactococcus acidiphilus, Streptococcus thermophilus, Streptococcus cremoris, Pediococcus halophilus* and *Pediococcus cerevisiae*(Sani *et al*., 2013). Detection of *Enterobacter aergenes, Enterobacter cloacae, Klebsiella* and *Serratia species* in the product indicates possible faecal contamination and could be assigned to non-adherence to Good Manufacturing Practices (GMP) (Utermann, 1998). Other pathogenic organisms isolated of public health concern included: *Staphylococcus aureus,* and *Bacillus cereus*(Olasupo *et al* ., 2002).

Nutrition

The nutritional properties in fermented milk included: High density Lipoproteins(HDL),Low density lipoproteins(LDL),triglycerides, cholesterol, protein, albumin, globulin, glucose water and ash(Obi and Ikenebomeh, 2007).

Table 2: Nutritional status of milk samples during fermentation

Fermentation time(h)	Nutritional parameters									
Time (h)	Cholesterol (mgL^{-1})	Triglyceride (mgL^{-1})	HDL mgL^{-1})	LDL mgL^{-1})	Total protein (mgL^{-1})	Albumin (mgL^{-1})	Globulin (mgL^{-1})	Glucose (mgL^{-1})	Water (mgL^{-1})	Ash (mgL^{-1})
0	24.10	16.10	11.0	11.30	35.00	7.90	27.10	3.90	880.00	18.60
4	24.00	14.50	11.40	9.70	34.00	7.10	26.90	4.00	871.00	31.40
8	22.00	12.60	11.80	7.68	30.50	6.00	24.50	4.20	864.22	47.00
12	20.90	11.30	12.00	6.60	26.10	5.00	21.10	4.40	855.00	63.70

Key: HDL= High Density Lipoprotein, LDL = Low Density Lipoprotein, Mg/l = Milligram per Ml^{-1}
Source: (C.N.Obi and M.J. Ikenebomeh, 2007)

Consumption of 'nono' may help in treating heart related diseases, especially high blood pressure(Obi and Ikenebomeh, 2007).

Fermented milk is also said to contain vitamin B_{12} ,folic acid and biotin produced by propionibacteria (Hugenholtz *et al*., 2013). Nevertheless the product contains conjugated linoleic acid(CLA) which has antiatherogenic and antioxidant properties(Chinadurai *et al*., 2013).

Safety

The nutritional composition of milk makes it very ideal for human nutrition. May be the same reason makes it a preferred substrate for the habitation of microorganisms, both beneficial and pathogenic alike (Altekruse *et al*., 1998, Da Silva *et al*., 1998; Hartman,1997; Nebedum and Obiakor, 2007).

On the other hand, fresh milk also contains microbiota associated with food borne diseases(Adesiyun *et al*., 1995; Headrick *et al*., 1998; Steele *et al*., 1997).

Pasteurization of fresh milk in Food Safety Guidelines globally, before distribution is conflicting with the processing and distribution of 'nono' in open calabashes. This practice may account for the numerous pathogenic microorganisms in West African dairy products (Ogbonna, 2001).

Conclusion

Most of the results showed that, fermentation did not eliminate all the pathogenic microorganisms in fermented dairy products as such, pasteurization should be key during processing. The adherence to Good Manufacturing Practices (GMP) should also be an important factor.

The results also showed that, the products abound with a lot of nutrients with varying health benefits.

Perspectives

Future research should focus on Standardizing processing practices, manufacture of simple but efficient equipment for: pasteurization and packaging. Training of the processors should also be emphasized.

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