

AN OVERVIEW ON THE PATHOGENIC MICROORGANISM ASSOCIATED WITH COMMONLY SOLD NONO IN NORTHERN NIGERIA

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ABSTRACT: Pathogenic has been reported globally due to contamination of milk and other related products. 'Nono' is the Fulani word for the locally fermented milk product (from cow) produced by Fulani cattle rearers and popularly consumed in Northern Nigeria. This paper reviews the literatures on the pathogenic microorganism associated species in Nono products in North Central Nigeria. The organism frequently encountered include; *Pseudomonads aeruginosa*, *Serratia mercenscens*, *Bacillus pumillus*, *Staphylococcus aureus*, *Salmonella* spp and *Bacillus alvei* these pose a serious threat to the health of nono consumers. It is therefore recommended that relevant authorities on food safety and food safety standards should monitor the production-line of nono sold to the public in order to ensure its safety for public consumption.

Keywords: Nono, Pathogenic Bacteria, Northern Nigeria.

1. INTRODUCTION

Milk has been described as a nearly perfect food because it contains the essential nutrients required by the body in appropriate proportions [1]. It is an aqueous colloidal suspension of proteins, fats, and carbohydrates that contains numerous vitamins and minerals [2]. Equally, it can be a vehicle for several pathogenic bacteria such as *Staphylococcus aureus* and *Salmonella* spp. [3-5]. Milk is an essential food of outstanding interest which has been taken by humans and preserved since the early times by fermentation [6]. Milk is of high nutritional value designed by nature for young animals. Milk has been reported to be a good growth medium for microorganisms by different researchers [7, 8]. Milk are usually preserved via fermentation by microorganisms such as lactic acid *streptococci* and *lactobacilli* which lowers the pH of the milk during fermentation thus suppressing the spoilage and the growth of pathogenic organisms [9]. Milk is utilized in the production of at least 400 different fermented products all over the world.

Fresh milk and other dairy products are traditionally staple food commodities for the nomadic population of Northern Nigeria and many other part of Africa [10]. Cow milk is utilized in the production of at least 400 different fermented products all over the world [11]. Manshanu, Kindirmoand Nono are fermented milk products mostly consumed by the Hausas (Fulanis) in northern Nigeria. Nono is a crude cultured whole milk whose fermentation may be brought about by a number of bacterial species from various sources. Kindirmois a full fat or partially skimmed cultured milk while Manshanu is fat from milk. In Nigeria about 90% of the dairy cattle belong to the Fulani agropasteurist and their women strictly control the processing and marketing of their milk and milk products [12]. Due to the low educational status of these women, these dairy products are handled poorly during processing and marketing exposing the products to microbial contamination. These informally marketed milk and milk products could then be sources of milk borne disease such as tuberculosis, diphtheria, listeriosis, brucellosis, and staphylococcal food poisoning [13], especially among urban residents who drink fresh milk sold by the Fulani women.

Nono" is the Fulani word for the locally fermented milk product (from cow) produced by Fulani cattle rearers and popularly consumed in Northern Nigeria. It forms (part of) the staple diet of a great majority of the local populace [14]. It is taken as a refreshing drink (plain) or with fura/dembu (cooked mashed millet balls) as a cereal drink. All milk and milk products have the potential to transmit pathogenic organisms to humans. People who prefer, for whatever reasons to drink fresh (raw) milk face the greatest risk of contact with these pathogens.

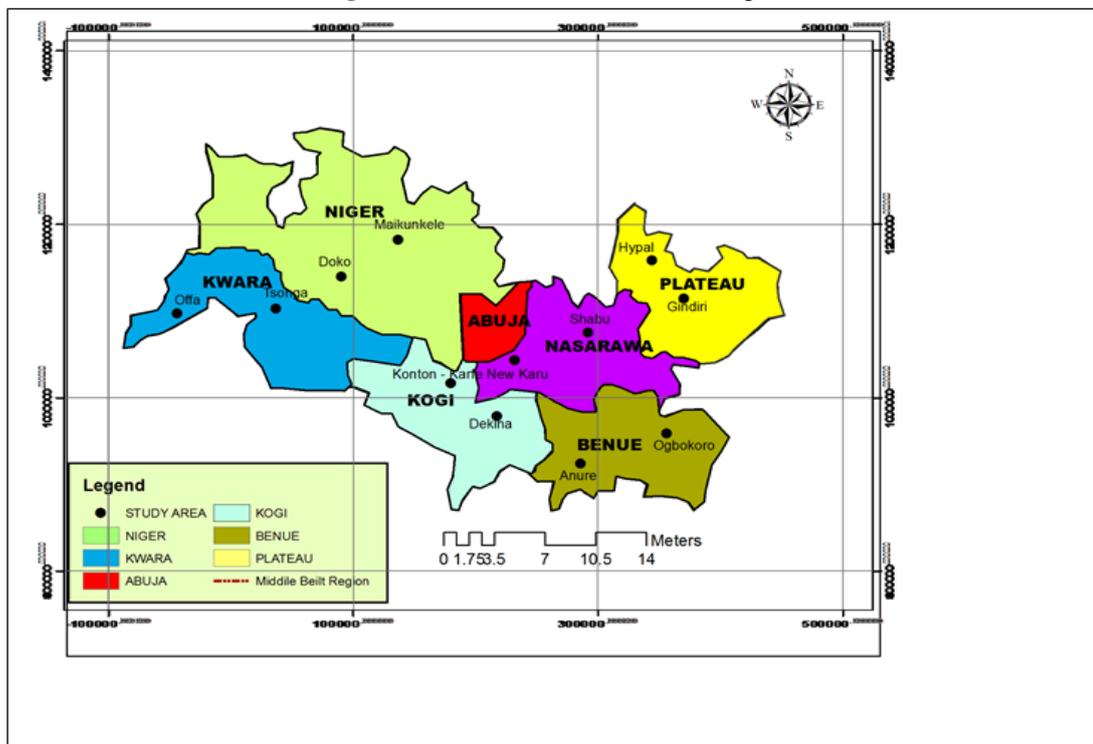
All over the world, cases of disease outbreaks have been reported due to contamination of milk and other related products by *Yersinia* species. In Montreal, Canada, 58 school children after a field trip developed illness from drinking raw milk in 1975. *Yersinia enterocolitica* serovar 0:5,27 was implicated. In

1976, there was a chocolate milk outbreak in Oneida, New York, involving children. This was the first food-borne outbreak reported in the United States with *Yersinia pseudotuberculosis* [15]. Later in the same year in New York, 217 school children reportedly became ill after drinking pasteurized chocomilk (syrup added after pasteurization). Thirtysix of them were hospitalized, 16 of whom underwent appendectomy. Causal organism was found to be *Yersinia enterocolitica* serovar 0:9. In the 1980s, outbreaks involving *Yersinia pseudotuberculosis* in Finland and Japan constituted most of the sporadic cases reported in literature [15]. A study of the microbiological composition of raw milk from 27 selected farms in the Camembert region of Normandy revealed that 36% of the samples tested positive for *Yersinia enterocolitica* [16]. In Nigeria, diarrhoea and gastroenteritis due to bacteria have been reported [17]. *Yersinia enterocolitica* and *Yersinia pseudotuberculosis* have also been detected in „nono“ in Bauchi Metropolis of North Eastern Nigeria. This study was aimed at investigating locally fermented cow milk (nono) on sale to the public in North Central, Nigeria for the presence of pathogenic microorganism associated species.

2. STUDY AREA

The study area is North Central Nigeria, it consists of the seven states situated geographically in the middle belt region of the country, spanning from the west, around the confluence of the River Niger and the River Benue. The region itself is rich in natural land features, and boasts some of Nigeria's most exciting scenery. It consists of Niger, Nassarawa, Kogi, Benue, Plateau, Kogi, Kwara and FCT. Kogi state lies at the latitude $7^{\circ} 45' - 7^{\circ} 51' N$ of the equator and Latitude $6^{\circ} 41' - 6^{\circ} 45' E$ of the Greenwich meridian (Figure 1). Nasarawa State lies on intersection of latitude $8^{\circ} 56' N$ and longitude $7^{\circ} 34' E$ situation in the north central region of Nigeria. It shares boundaries with Abaji, the federal capital territory to the west, Kokona Local Government Area to the east, Jaba Local Government Area of Kaduna state to the north (Figure 1). Niger State lies between Latitude $9^{\circ} 33' N$ and $9^{\circ} 40' N$, and Longitude $6^{\circ} 29' E$ and $6^{\circ} 35' E$ East on a geological base of undifferentiated basement complex of mainly gneiss and magnetite, is in the north-western region of Nigeria and it is the largest landmass of the states in the country.

Figure 1. Location of North Central Nigeria



Source: Ogah, et al. [18].

3. SURVEY ANALYSIS

Musliu and Aliyu [19] collected Five (5) different samples of fura da nono from five different selling points in Birnin Kebbi. Old market, New market, Gesse phase, Bello Way, Makeran Gandu. They were collected and transported in a sterile specimen bottle.

Similarly Dafur, et al. [20] collected Nono samples from ten (10) different markets all within Mangu Local Government Area. Thirty (30) samples were randomly purchased at intervals from nono sellers in each of Mangu market, Pushit market, Kerang market, Ampang market, Panyam market, Gindiri market, Mangun market, Kombun market, Chanso market and Kadunu market.

Shittu, et al. [21] collected three samples from eleven different products comprising of six yoghurts and five ‘Nono’ products were collected. Branded yoghurts from Tipper garage, Yoruba road, Sawmill park, Oja-oba, Zango and the main campus were obtained and unbranded ‘Nono’ (from Zango, Campus, Oja-oba, Sawmill Park and Post office) were collected within Ilorin metropolis from seven randomly selected locations.

Philip, et al. [14] A total of five (5) nono samples were collected in sterile bags from different locations around Unguwan Rimi Market, Kaduna State. Samples were transported to the laboratory in a cold box and stored in a refrigerator at -4°C for isolation of LAB.

Shiaka, et al. [22] made five visits to each of the five sampling places at regular intervals (weekly basis) in which fresh milk samples (15ml) were collected at random from sellers. A total of 25 visits were made and 25 samples collected during the period of study. The samples of “fura da nono” collected in each site were labeled for identification and were placed in a cooler containing ice park.

Similarly Abaukaka, et al. [17] total of 150 samples were collected from different individual (the Milklers) from Angwa-Fulani market and other part of Bida metropolis where other milk-products are sold. 50 samples were collected each for, Kindirimo, Nono and wara. Approximately 10mls of each sample were aseptically collected into sterile screw capped sterile universal sample bottle. Cow milk products (Kindirimo, Nono and Wara) were drawn from pooled containers containing milk products which are sold to the public within Bida Metropolis.

4. RESULTS

The result of the total viable bacteria count of the samples (OM, MM, GE, BW and MG) was shown in Table 1. The results obtained ranged from 4.0 x 10⁴cfu/ml to 7.0 x 10⁴cfu/ml with GE having the highest microbial load.

Table 1. Total viable bacterial count

Samples	Viable count (cfu/ml)		
	Plate 1	Plate 2	Average
OM	4.0x10 ⁴	4.0 x10 ⁴	4.0x10 ⁴
MM	4.2x10 ⁴	4.3x10 ⁴	4.25x10 ⁴
GE	7.0x10 ⁴	7.0x 10 ⁴	7.0x10 ⁴
BW	5.1x10 ⁴	5.1x 10 ⁴	5.1x10 ⁴
MG	5.0x10 ⁴	5.4x10 ⁴	5.2x10 ⁴

Cfu/ml: Colony Forming Unit per millilitre.

KEY: OM; Old Market, MM; Main Market, GE; Gesse, BW; Bello Way, MG; MakeranGwandu

Source: Musliu and Aliyu [19]

Table 2. 35 Bacteria Were Isolated In All The Samples.

Designation	Bacteria Isolates	OM	MM	GB	BE	MA	Total	%
BAC 1	<i>Pseudomonads aeruginosa</i>	4	3	0	1	2	8	22.86%
BAC 2	<i>Serratia mercescens</i>	1	1	0	1	0	3	28.57%
BAC 3	<i>Bacillus pumillus</i>	2	2	1	0	1	6	17.14%
BAC 4	<i>Staphylococcus aureus</i>	2	1	1	2	3	9	25.71%
BAC 5	<i>Salmonella spp</i>	1	0	0	1	0	2	5.71%
BAC 6	<i>Bacillus alvei</i>	2	1	2	1	1	7	20%

Source: Musliu and Aliyu [19]

Table 3. Biochemical characterization of bacteria isolated from nono samples in Mangu L.G.A

Bacteria	TSIA medium												
	OX	UR	CI	ID	CA	CO	Slope	Butt	H2S	Gas	G L S		
<i>Escherichia coli</i>	-	-	-	+	+	-	Y	Y	-	+	+	+	<i>Salmonella spp.</i>
-	-	+	-	-	-	R	Y	+	+	+	-	-	<i>Shigella spp.</i>
-	-	-	R	Y	-	-	+	-	-	-	-	-	<i>Staphylococcus aureus</i>
Y	Y	-	-	+	+	+	<i>Pseudomonas aeruginosa</i>	+	-	+	-	-	R
-	-	-	-	-	-	-	-	-	-	-	-	-	R

Source: Dafur, et al. [20]

KEY: OX = Oxidase test; UR=Urease test; CI=Citrate test; ID= Indole test; CA=Catalase test; CO= Coagulase test; TSIA= Triple Sugar Iron Agar test; H2S = Hydrogen Sulphide Production; GLU= Glucose fermentation; LAC = Lactose Fermentation; SUC= Sucrose fermentation; Y=Yellow colour (acid production); R=Red Colour (Alkaline Production); + = Positive test; - = Negative test

Table 4. The Total Bacterial Count and pH of the yoghurt and ‘Nono’ samples

Samples Codes	Mean Total Bacterial Count (cfu/mL)	pH
Yg1	9.05 ± 0.29×10 ²	4.01
Yg2	6.51 ± 0.30×10 ²	4.51
Yg3	5.13 ± 0.15×10 ²	3.56
Yg4	3.28 ± 0.10×10 ²	4.10
Yg5	4.17 ± 0.15×10 ²	4.06
Yg6	9.46 ± 0.13×10 ²	4.13
No7	1.09 ± 0.007×10 ³	4.00
No8	1.32 ± 0.132×10 ³	4.33
No9	3.20 ± 0.026×10 ³	4.33
No10	2.26 ± 0.085×10 ³	4.39
No11	1.37 ± 0.027×10 ³	4.27

Source: Shittu, et al. [21].

Key: Yg = Yoghurt No = ‘Nono’

Results of five (5) species of genus *Lactobacillus* were successfully isolated from samples of fermented cow milk (nono) using MRS media. [14]. Isolate :

Lactobacillus rhamnosus, *Lactobacillus acidophilus*, *Lactobacillus bulgaricus*, *Lactobacillus lactis*, *Lactobacillus salivarius*.

Shiaka, et al. [22] obtained from Staphylococcal counts for the duration of five weeks, In the first week, the highest count was obtained from “fura da nono” samples collected from Investment house (11.8 × 10⁵cfu/ml) and the lowest count from the Federal University (4.8 × 10⁵cfu/ml). In the second and third week the highest counts were obtained from the sample collected from Yalwawa (11.2 × 10⁵cfu/ml and 21 × 10⁵cfu/ml) respectively and the lowest was from the sample collected from Hakimi street while the lowest for the third week was that from Federal University (5.8 × 10⁵cfu/ml). The highest count in the 4thweek was 21 × 10⁵cfu/ml and the lowest count: 1.0 × 10⁵cfu/ml were both obtained from the Main market and Federal University respectively. The highest count (9.6 × 10⁵cfu/ml) was obtained from Yalwawa in the 5th week while the lowest count (4.0 × 10⁵cfu/ml) was obtained from Investment.

Table 5. Frequency of Bacteria Isolates identified in 150 Cow milk products (Kindirimo, Nono and Wara) samples collected within Bida metropolis

Isolates	Wara (%)	Nono (%)	Kindirimo (%)	Total (%)
Escherichia coli	14.0	0	0	14.0
Proteus species	10.0	0	0	10.0
Pseudomonas species	2.0	0	0	2.0
Staphylococcus aureus	10.0	2.0	0	12.0
Coagulase Negative Staphylococcus	22.0	10.0	6.0	38.0
Klebsiella species	8.0	0	0	8.0
Enterobacter species	4.0	0	0	4.0
Streptococcus species	12.0	0	0	12.0
Lactobacillus species	10.0	2.0	0	12.0
Listeria species	6.0	0	0	6.0
Alkaligenes species	2.0	2.0	0	4.0

Source: Abaukaka, et al. [17]

5. DISCUSSION

The result obtain shows that there are presence of pathogenic microorganism that may be potential source of food borne infection and some related diseases for the consumers of this product in the sampling areas. The total viable bacteria counts in all samples were out of standard. According to NAFDAC 2009 the microbial limited for total liable colony count is 1.0x10² cfu/ml and *Escherichia coli* should not be present in all samples.

[20]. From the findings of this study, it is concluded that due to the presence of some pathogenic microorganisms which exceeded the limit stipulated by the authorities except that of *Staphylococcus aureus*, it does appear that the safety of nono produced and marketed in the study area as at the time of this research cannot be guaranteed for human or public consumption and can be a source of milk-borne infections.

Lactic acid bacteria were successfully isolated from fermented cow milk (nono).

Discussion *Staphylococcus aureus* was isolated from this study and its presence suggested the extent to which the milk is contaminated either by the animal, environment or/and the milking utensils. Presence of pathogenic bacteria in milk and milk products such as *Staphylococcus aureus* have been a major concern to the public all over the world [23].

Abaukaka, et al. [17] study was designed to assess the bacterial quality of cow milk products (Wara, Nono and Kindirimo) sold within Bida metropolis, Niger state, Nigeria. This is due to the fact that cow milk products produced and sold by nomadic Fulanis in bida and other parts of Nigeria are not regulated by any agency e.g. NAFDAC (National Agency for Food and Drug Administration and Control), SON (Standard Organization of Nigeria), FDA (Food and Drug Administration) etc. and such products may pose health hazard due to the contamination with pathogens.

6. CONCLUSION

The growth of these pathogenic organisms and their toxins in local dairy cattle products is an indication of poor sanitary practices in the production of fresh milk and its products. It is however noted that the types of organisms and their concentration in these fresh milk and milk products from the four studied locations should be of great concern to the health authorities as these pose serious public health problems to consumers. Safety of food consumers is however of utmost importance. All hands must be on deck to have this assured at all times.

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