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Lactic Acid Bacteria as Probiotics in Fish Culture: Isolated from Milk of Common Cattle Breeds Raised in Potiskum, Yobe State, Nigeria

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Abstract

This study was stressed on the detection of Lactic Acid Bacteria (LAB) and other normal gut flora that obtained from non-fish source (Fresh Cattle Milk) can play a very significant role in aqueous environment and as well bacteria-fish synergic relationship. This work were experimented in the Microbiology Laboratory of Yobe State University, Damaturu. The isolated bacteria can be used in prevention and control of pathogenic organisms in aquaculture. These includes six (6) bacterial species isolated from milk and might be tested for their potential used as probiotics. Therefore, the results revealed that Red Bororo was significantly higher represented in total viable count of 159 (15.9×10^{-10} Cfu/ml) than Adamawa Gudali, which had 153 (15.3×10^{-10} Cfu/ml). Thus, the number of occurrences, percentages, colony and colonies forming unit in respect of individual bacterium such as *Bacillus subtilis* with 6 (30%) having 54 (5.4×10^{-10} Cfu/ml) in Adamawa Gudali and Red Bororo were the same and not significantly different ($p > 0.05$), followed by *Lactobacillus acidophilus* with 5 (25%) possesses 52 (5.2×10^{-10} Cfu/ml) found in both milk samples, which did not significantly varies ($p > 0.05$) whereas, *Streptococcus agalactiae* had greater 3 (15%) and 19 (1.9×10^{-10} Cfu/ml) in Red Bororo is significantly different ($p < 0.05$) from Adamawa Gudali, which had lesser 9 (0.9×10^{-10} Cfu/ml) value. The *Escherichia coli* was significantly higher ($p < 0.05$) with 3 (15%) and having 15 (1.5×10^{-10} Cfu/ml) in Red Bororo than in Adamawa Gudali with lower value 13 (1.3×10^{-10} Cfu/ml) while *Staphylococcus aureus* having 4 (20%) and 13 (1.3×10-10 Cfu/ml) in both milk samples showed that they were not significantly different ($p > 0.05$) and Micrococcus luteus was significantly greater ($p > 0.05$) with the value of 2 (10%) and 12 (1.2×10^{-10} Cfu/ml) in Adamawa Gudali than in Red Bororo with 6 (0.6×10^{-10} Cfu/ml). These organisms were determined with Tryptic Soy Agar (TSA). Eosin Methylene Blue Agar (EMBA), deMan Ragosa and Sharpe Agar (MRS) and Mackonkey Nutrient Agar Media were used, respectively, they were analysed using standard bacteriological procedures. Also, data were analysed using descriptive statistics and analysis of variance at 5% (0.05%) confident interval. These microorganisms from non-fish origin are good candidates that are substitutes to chemotherapies which needs to be tested and compared with those of fish origin to assess their antagonistic effects in aquaculture or fish farming.

Keywords: Aquaculture; *Escherichia coli*; Lactic Acid Bacteria; *Lactococcus bacteria* and Probiotics

Introduction

Fish is an important source of humans' food, virtually a key component in natural food webs, physiologically contains valuable protein, fats, and fat soluble vitamins [1]. It also plays a vital contribution to gross domestic product and job creation in Nigeria [2].

Fish culture or aquafarming becomes a way out for bridging the gaps between its productions, demand, supply and sustainability conserve wild species composition and diversity worldwide.

Fisheries contribute significantly to the food security, socio-economic growth and development for developing and developed nations, especially, employment, local fish sales and foreign exchange earnings to provide better livelihood.

Feed is one of the important aqua-inputs in fish culture, of which its contribution accounts for an approximate percentage of 40-60% [3] and to some extent, 60-80% of production cost [4]. Thus, to attain sustainability, feasibility and profitability in the aqua-farm business, this might accrue a cost of production between 40 and 70% [5].

The higher qualitative feed is required to enhance the growth and health status of fish species with rising interest in culturing fish globally [6]. Fish feed is richer in essential nutrients required for the growth and proliferation of micro-organisms [7].

Rahaji is the most populated cattle breed, called Red Bororo but Bokoloji which is known as Gudali are fairly inhabited in Yobe State. They are raise for their multiple purposes characteristics. In Nigeria, Rahaji are the most numerous breed that constituted between 50 and 60% whereas Adamawa Gudali represented about 2% of the cattle breeds [8].

Therefore, milk is described as a whitish, lacteal, secretory fluid discharge from the mammary gland of all dairy animals via teats. According to Pandey, et al. [9] and Muniyandi, *et al.* [10]. Thus, milk is an early mammalian infant's food prior to accepting and digesting any other types.

Probiotics are microbe-based additives that are added to fish feed in small quantities to maintain and enhance its safety and nutritional quality. It's an alternative to antibiotics in aquaculture [11]. Hence, it's isolated from microbes in substrates. It also, isolated from ecosystems, fresh dairy milk that's a significant source of LAB, belongs to the *Lactobacillus* genus [12,13]. It is considered as several additives employed into fish nutrition to improve energy spends that are derived from carbohydrates and incorporated with protein for growth, immunity, and disease resistance [14,15]. They are non-pathogenic, which benefits fish at the right doses and counteracts harmful microbes [16,17].

Pro-digestion activities of the probiotics lead to better performance of fish species; hence, higher doses cause stuntism and also probably might replace whole gut normal microbes of the fry [18]. Moreover, probiotics adversely result in serious problems in fish production [19]. The strains have been selectively evaluated for their potential to supplement and enrich feed for the benefits of aquaculture [3]. It's aseptically isolated, characterised, identified, and enumerated microscopically [20]. *Bacillus subtilis* and *Lactobacillus* species are lactic acid bacteria that belong to the same genus; they enhance non-specific immunity and resist diseases. *Escherichia coli* are fish G.I.T. bacteria with lower cell surfaces, hydrophobic in nature; in any given growth medium, they also have adaptive functions in the fish microflora [21].

This current study determined the presence of bacteria that can be used as probiotics that, when isolated and identified from dairy milk, might play an important role in fish culture.

Materials and Methods

Study Area

Badejo and Kusulwa cattle breeders communities located in Potiskum, Yobe State, Nigeria, that is situated between latitude 11^{0} 36` 58``N and longitude $11^{0}$ 6` 49``E along Gombe road.

Material Used and Reagents

The materials used are incubators, microscopes, glass slides, petri dishes, autoclave, conical flasks, test tube racks, wire loops, weighing balances, sample bottles, hand gloves, pipettes, nutrient agars, and deionised water.

Milk Samples Collection

The forty (40) fresh milk samples were sourced from the conventional manual milking method by herders close to Badejo and within Kusulwa at the onset of the rainy season; twenty (20) samples each from Adamawa-Gudali and Red-Bororo were collected for this study. These were performed aseptically at all locations directly from their used milking containers with a sterile plastic cup. The samplings were done between 6:00 a.m. and 7:00 a.m. for a period of 20 days. The samples were poured into sample bottles, chilled, packed, transported and analysed in the Yobe State University Damaturu Microbiology Laboratory.

Culture Media Preparation

The media were prepared in accordance with the manufacturer's reco^{-10}mmendation, in which, based on instruction 23g of the media powder, they were suspended into 1 litre of deionised water, mixed gently, and homogenised after being allowed to stand on the preparation table. The media solutions were sterilised using an autoclave at 121°C for 15 minutes, cooled to 45°C, then poured onto the sterile petri dishes, and the plates were kept for 2 hrs at room temperature and solidified.

Milk Samples Preparation

The samples prepared with a total of 10 sterile test tubes were dispensed; 1 ml of prepared inoculum was transferred into the first test tube containing 9 ml of deionised water (10^{-10}) dilution. Then, by the use of another sterile pipette, 1 ml of the resulted dilution was transferred into a second test tube that contained the same quantity; the procedure was repeatedly done up to the 10 times (10^{-10}) dilution.

Therefore, 1 ml of inoculum was discarded; this was done for each of the 20 milk samples from the Adamawa Gudali and Bunaji breeds that were aseptically measured, weighed and homogenised with 90 ml of deionised water. The ten (10)-fold serial dilutions were done in one (1) acetone water and plated out in different culture media.

Inoculation and Incubation

The prepared nutrient media plates were labelled as AG1, AG2… AGnth, and RB1, RB2… RBnth from the last dilution of 10^{-10}, while the prepared nutrient agar was inoculated with 0.1 ml of the test sample; a sterile disposable pipette was used. Prepared culture media were used for the isolation and inoculation of bacteria with sterile cotton wool. Total viable count (TVC) were enumerated for the experimental bacteria and the plates were incubated at 37°C for 24 hours [22]. The Tryptic Soy Agar (TSA), Eosine Methylene Blue Agar (EMBA), deMan Ragosa and Sharp Agar (MRS), and Mackonkey nutrient agar media were used; the presence of *Bacillus subtilis, Escherichia coli, Lactobacillus acidophilus, Micrococcus luteus, Staphylococcus aureus* and *Streptococcus agalactiae* were determined. These agar media relied on the species of selected bacteria that were intended to be used as probiotics for fish cultured because different organisms grown in different culture media. These were done as described by Janet, et al. [23].

Bacteriological, Biochemistry and Molecular Analysis

The isolates were rinsed in a petri dish, diluted, observed, characterised, identified and then serially diluted bacterial colonies were enumerated under microscopic examination. However, the isolates were molecularly analysed, gram-stained and biochemical tests were conducted. *Bacillus subtilis, Escherichia coli, Lactobacillus acidophilus, Micrococcus luteus, Staphylococcus aureus* and *Streptococcus agalactiae* were observed.

Results

Cattle Breed	No. of Colony (TVC) Cfu/ml	
Adamawa Gudali (AG)	153	15.3×10-10
Red Bororo (RB)	159	15.9×10-10

Foot note: No. = Number, TVC= Total viable count, Cfu=Colony forming unit, Ml = Milligramme

Table 1: Total Viable Count and Colony Forming Unit of Bacterial Species from the Milk Samples of Adamawa Gudali and Red Bororo.

AG Samples	Shape	Gram Reaction	Species	RB Samples	Shape	Gram Reaction	Species
AG1	Rod	+	*Bacillus subtilis*	RB1	Cocci	+	*S. aureus*
AG2	Rod	-	*Escherichia coli*	RB2	Rod	+	*B. subtilis*
AG3	Rod	+	*Bacillus subtilis*	RB3	Rod	+	*L. acidophilus*
AG4	Rod	-	*Escherichia coli*	RB4	Cocci	+	*S. agalactiae*
AG5	Cocci	+	*Streptococcus agalactiae*	RB5	Rod	+	*L. acidophilus*
AG6	Rod	+	*Lactobacillus acidophilus*	RB6	Rod	-	*E. coli*
AG7	Cocci	+	*Micrococcus luteus*	RB7	Rod	+	*B. subtilis*
AG8	Cocci	+	*Staphylococcus aureus*	RB8	Cocci	+	*M. luteus*
AG9	Rod	+	*Lactobacillus acidophilus*	RB9	Rod	+	*L. acidophilus*
AG10	Rod	+	*Bacillus subtilis*	RB10	Rod	+	*B. subtilis*
AG11	Cocci	+	*Staphylococcus aureus*	RB11	Rod	-	*E. coli*

AG12	Rod	-	*Lactobacillus acidophilus*	RB12	Rod	-	*L. acidophilus*
AG13	Rod	+	*Bacillus subtilis*	RB13	Cocci	+	*S. agalactiae*
AG14	Rod	+	*Lactobacillus acidophilus*	RB14	Rod	+	*B. subtilis*
AG15	Cocci	+	*Micrococcus luteus*	RB15	Rod	+	*L. acidophilus*
AG16	Rod	+	*Lactobacillus acidophilus*	RB16	Cocci	+	*S. aureus*
AG17	Cocci	+	*Staphylococcus aureus*	RB17	Rod	+	*B. subtilis*
AG18	Rod	+	*Bacillus subtilis*	RB18	Cocci	+	*S. agalactiae*
AG19	Cocci	+	*Staphylococcus aureus*	RB19	Rod	-	*Escherichia coli*
AG20	Rod	+	*Bacillus subtilis*	RB20	Rod	+	*B. subtilis*

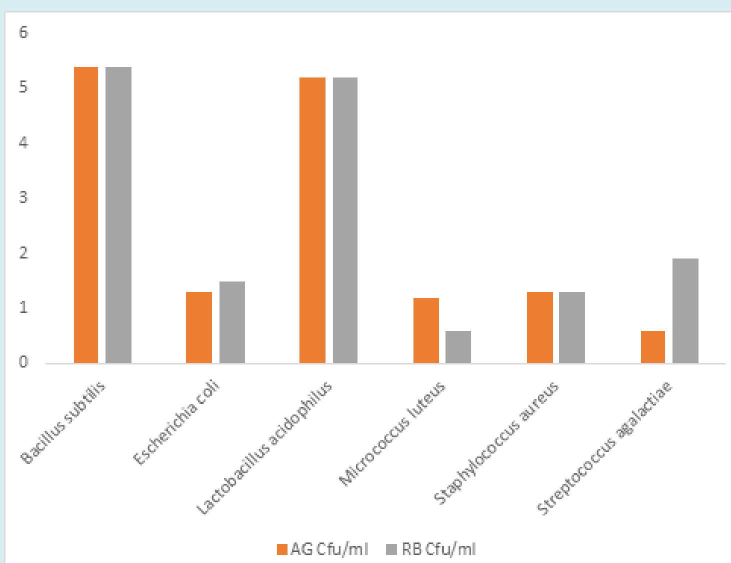
Foot note: AG=Adamawa Gudali, RB = Red Bororo, - = Negative, + = Positive

Table 2: Bacteria Identified from Adamawa Gudali and Red Bororo Cattle Breeds' Milk.

Isolated Bacteria	Adamawa Gudali Milk		Red Bororo Milk	
Species	No. of Colony	Cfu/ml	No. of Colony	Cfu/ml
Bacillus subtilis	54	5.4×10-10^a	54	5.4×10-10^a
Escherichia coli	13	1.3×10-10^b	15	1.5×10-10^a
Lactobacillus acidophilus	52	5.2×10-10^a	52	5.2×10-10^a
Micrococcus luteus	12	1.2×10-10^a	6	0.6×10-10^b
Staphylococcus aureus	13	1.3×10-10^a	13	1.3×10-10^a
Streptococcus agalactiae	9	0.9×10-10^b	19	1.9×10-10^a
Mean and Standard Error	25.50±8.72	2.55±0.87	26.50±8.55	2.66±0.86

Foot note: No. = Number, Cfu=Colony forming unit, ml = milligramme

Table 3: Isolation and Enumeration of Bacterial Species from the Milk Samples of Badejo and Kusulwa.



Footnote: AG=Adamawa Gudali, RB=Red Bororo, Cfu=Colony forming unit, ml=millilitre.

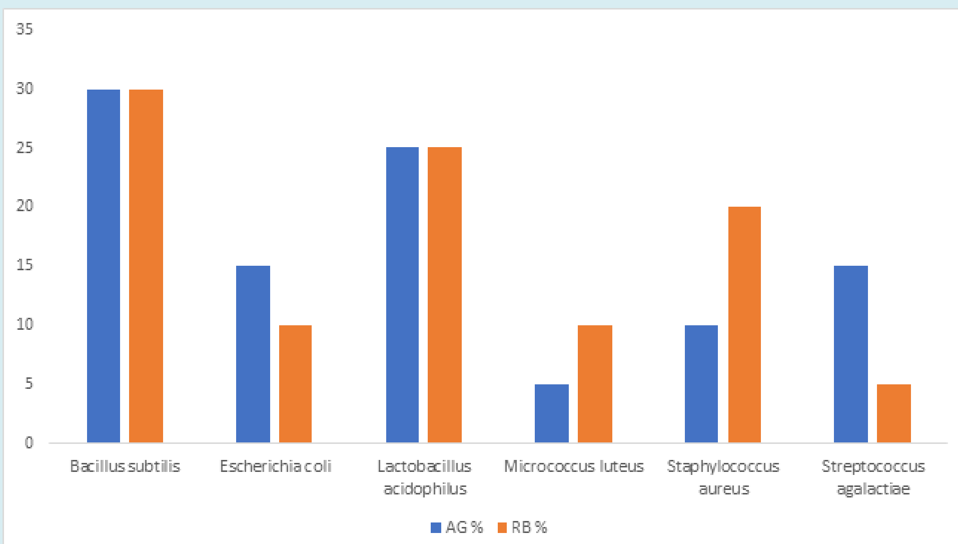
Figure 1: Colony forming unit of Bacterial Species from the Milk Samples of Badejo and Kusulwa.

Bacterial Species	AG No. of Occurrence	%	RB No. of Occurrence	%
Bacillus subtilis	6	30	6	30
Escherichia coli	2	10	3	15
Lactobacillus acidophilus	5	25	5	25
Micrococcus luteus	2	10	1	5
Staphylococcus aureus	4	20	2	10
Streptococcus agalactiae	1	5	3	15
Total	20	100	20	100

Bacterial Species	AG No. of Occurrence	%	RB No. of Occurrence	%
Bacillus subtilis	6	30	6	30
Escherichia coli	2	10	3	15
Lactobacillus acidophilus	5	25	5	25
Micrococcus luteus	2	10	1	5
Staphylococcus aureus	4	20	2	10
Streptococcus agalactiae	1	5	3	15
Total	20	100	20	100

No. = Number, %=Percent, AG= Adamawa Gudali and RB=Red Bororo.

Table 4: Percentage distribution and occurrence of Bacteria identified from the milk samples of Adamawa Gudali and Red Bororo.



Footnote: AG=Adamawa Gudali, RB=Red Bororo, %=Percent.

Figure 2: Percentage Occurrence and Distribution of Bacterial Species from the Milk Samples of Badejo and Kusulwa.

Results' Interpretations

In this study research, the bacterial load in Red Bororo was significantly higher represented in total viable count of 159 (15.9×10-10) than Adamawa Gudali, which had 153 (15.3×10-10 Cfu/ml) as shown in Table 2, whereas, the gram stains indicates that, the *Bacillus subtilis* and *Lactobacillus acidophilus* are rod-shaped gram-negative bacteria, whereas *Staphylococcus aureus* and *Streptococcus agalactiae are* gram-positive bacteria that possess *cocci-shaped*, while *Micrococcus aureus* is a gram-negative bacterium with *a cocci* shape and *Escherichia coli* is a gram-negative rod-shaped bacterium, as shown in Table 1.

Therefore, in this work, the number of colonies and colonies forming unit in respect of individual bacterium such as *Bacillus subtilis* 54(5.4×10^{-10}Cfu/ml) in Adamawa Gudali and Red Bororo were the same and did not significantly varied (p>0.05), followed by *Lactobacillus acidophilus* with 52 (5.2×10^{-10} Cfu/ml) found in both milk samples which did not significantly varies (p>0.05), whereas *Streptococcus agalactiae* greater 19 (1.9×10^{-10} Cfu/ml) in Red Bororo significantly different (p<0.05) from Adamawa Gudali which had lesser 9 (0.9×10^{-10} Cfu/ml) value. The *Escherichia coli* was significantly higher ($p < 0.05$) at 15 (1.5×10^{-10} Cfu/ml) in Red Bororo than 13 (1.3×10^{-10} Cfu/ml) that had lower value, while *Staphylococcus aureus* had 13 (1.3×10^{-10} Cfu/ml) in both milk samples, showing that significantly were not different ($p > 0.05$) and *Micrococcus luteus* was significantly greater ($p > 0.05$) with the value of 12 (1.2×10^{-10} Cfu/ml) in Adamawa Gudali, which had significant value than Red Bororo with 6 (0.6×10^{-10} Cfu/ml), as shown in Table 3.

However, in this study, the number of occurrences and percentages of bacteria isolated in the milk samples of Adamawa Gudali and Red Bororo are shown in Figure 3 & Table 4. The *Bacillus subtilis* possesses 6 (30%) in both samples, whereas *Lactobacillus acidophilus* had 5 (25%) in two different samples, while *Staphylococcus aureus* have 4 (20%) in the samples of Adamawa Gudali than Red Bororo with 2 (10%). *Escherichia coli* was higher with 3 (15%) in the Red Bororo sample than Adamawa Gudali with 22 (10%), but *Streptococcus agalactiae* followed the same pattern with 3 (15%) in sample of Red Bororo than the Adamawa Gudali with 1 (5%) and finally, *Micrococcus luteus* had a greater value of 2 (10%) in the sample of Adamawa Gudali than Red Bororo with 1 (5%).

Discussion

Fresh Dairy milk is the most available source of lactic acid bacteria, often, commonly been found from cattle breeds kept or raised. In this study, the isolated and identified bacteria are of non-fish source; however, they are of lactic acid origin that are employed in fish culture as probiotics. This is commensurate with Muniyandi, *et al.* [10]; Yeshambel [24]. The application of probiotics in fish production is of cognisance attainment due to its potentiality in enhancing growth, quality of water and bolstering disease resistance. This is corroborated with Yaslikan, *et al. [25]*. Apart from these attributes, it improves flesh and carcass quality. Nonetheless, other probiotics utilised in fish production are originated from terrestrial environment, rarely be from their immediate media on which host fish species dwells. This is in agreement with Doan, et al. [26].

In this current study research, however, the overall bacterial load between milk samples revealed that the Red Bororo was significantly represented higher ($p < 0.05$) total bacterial count as compared with Adamawa Gudali's samples had shown in Table 2, similar research also revealed higher TBC in the Gudali breed [12]. Contrarily, the findings of Luka, *et al. [27]* was reported lower bacterial count in the same Bokolooji breeds in Nigeria. At this juncture, these milk samples exhibit higher contamination with bacterial load when compared with the several studies that isolated bacteria from cattle milk. Thus, the sources of microbial contamination in milk might be due to infected animals, milk handling processes, equipment, handlers and storage. This is corroborated with the findings of Luka, *et al.* [27].

Therefore, this work had reported the total bacteria counts and colonies forming unit per millilitre in respect of breeds differed significantly ($p < 0.05$), whereas individual bacterium revealed that *Bacillus subtilis* did not vary significantly ($p > 0.05$). Likewise, *Lactobacillus acidophilus* reported similar in both milk samples, which did not significantly differed ($p > 0.05$) had showed in Table 3 and disagreed with the findings of Frunza, *et al.* [28]. In accordance with Aldohail, et al. that isolated the same bacteria from yoghurt in Malaysia. This is contrary to the work of Ogunshe, et al. [29] that isolated *L. fermentum* from fermented food known as Fufu while *L. plantarum* from fermented beverage called Ogi. Consequently, LAB might be used as probiotics due to their symbiotic relationship with the host. This is also agreed with Ishthiaq, et al. [30]. Although this could be attributed to their antagonistic behaviour towards fish pathogens. This is in line with Khidirova, *et al.* [31], though this work is juxtaposed with the study of Folorunsho, et al. [32], which isolated four *Lactobacillus* species from fish and similar to reports of Jimoh Di, et al. [33].

Furthermore, the probiotic bacteria: *acidophilus* can improve the health condition of aquatic organisms and counterbalance microbes. This was matched with views of Adesina, *et al.* [34]. In addition, LAB: *B. subtilis* that constituted in such as commercial probioticsYuge® and AQUA PHOTOS [18,35], probiotic starter contains and *B. subtilis* and *Lactobacillus species [36]* enhances growth and survival of *C. gariepinus* They can be used to control streptococcosis in fish [37,38]. The intestinal microflora of fish determined by the environmental factors. Thus, temperature encourages fermentations to proliferate LAB. This is in conformity with Updhyayi.

Moreover, in these findings, *Streptococcus agalactiae* significantly greater ($p < 0.05$) in Red Bororo in comparison had shown in Table 3. This was contrasted with Kelany, *et al.* [39] that isolated higher CFU/ml from farmed tilapia. This could be due to different substrates and hygienic nature of the rearing facilities. Hence, *B. subtilis* is resistant against *S. agalactiae* infection that causes mortality in cichlids [40-43]. This disease is known as streptococcosis [44]. This might cause economic losses, and this is agreed with Kelany, et al.[39].

In this study, thus, *Staphylococcus aureus* consisted of the same CFU/mL in both milk samples, and not significantly differed ($p > 0.05$) is depicted in Table 3. This disagreed with Ayuba, *et al.* [45]. According to Abdel-Gawad, et al. [46]; Adegunleye, et al. [47] who isolated staphylococcus species from fresh fish and water samples. It also from contaminated fish [48]. It causes pathogenicity and mortality in man, livestock, and fish [49]. Althugh, *S. aureus* and *S. agalactiae are* gram-positive bacteria that possessed *cocci* shape and weheras, *E. coli* is a gram-negative rod shape had shown in Table 1, and this was in line with Emily*, et al. [50]*.

Nevertheless, this work reported the number of occurrences and percentages of bacteria isolated in the milk samples of Adamawa Gudali and Red Bororo have shown that the *B. subtilis* constituted higher percentage had showing in Figure 3 and Table 4. Correspondingly, this was contrasted with the commercial probiotic "Yuge®" that contains 200 million CFU/g of *B. subtilis* reported by Abubakar, et al. [18]. Also, in these findings, *L. acidophilus* and *S. aureus* have followed the same pattern and this is in line with O'Gara [51] and Matuszewska*, et al. [49]*. Although, *E. coli* was significantly higher ($p < 0.05$) in Red Bororo than Adamawa had shown in Table 3, and this is in agreement with Ayuba, et al. [45]. Although, this is relatively lower and contrasted to the findings of Luka, et al. [23]. Thus, higher bacterial load might be due to the poor hygienic nature of the water used to clean utensils by the milkers and dusty particulate faecal matters surrounded the premises. Defiantly, Kato, et al. [52] who reported that *E. coli* were also isolated from the guts of *C. gariepinus* and *O. niloticus*. This might be due to a specific function in their gastrointestinal tract. This is agreed with the study of Burtseva, et al. [53]. In accordance with Dinara, et al. [54] who reported that 64G strain of *E. coli* has no toxicity and is non-infectious.

Notwithstanding, beneficial bacteria are also proven to improve immunity, intestinal health, tolerates infections, prevent and resist diseases in fish species [55-57]. Probiotics enhance growth performance and survival in fish species [18,40,41,58]. Inaddition, minimise stresses, it also improves reproduction, engulfs and removes heavy metals in fish [59]. In this research work, *Micrococcus luteus* was significantly greater ($p < 0.05$) in the milk sample of Adamawa Gudali comparatively had shown in Table 3. *M. luteus* is a gram-negative bacterium with *Cocci* shape had depicted in Table 1, and this was confirmed by Ayuba, et al. [45]. Contrarily, Kato *et al.* [60] *isolated* from fish's parts. According to Azza, *et al.* [61], *M. luteus* inhibits *Vibrio vulnificus.* It's found naturally in aqueous environments [62]. It also emerges as pathogenic bacterium [63]. Henceforth, *Micrococcosis* is similar to *Staphylococcosis* and *Streptococcosis* in terms of economic loses in aquaculture. This was corroborated with Pekalaa, et al. [64]; Matuszewska, et al. [49]. Thus, lactic acid bacteria are used to treat *S. agalactiae* [65,66].

Conclusion and Recommendations

This present study revealed that the Lactic Acid Bacteria (LAB) that were isolated from the milk of Red Bororo and Adamawa Gudali as an alternative to those found in fish source samples, fermented substrates, etc., play an important role in the survival, growth performance, and physiological functions of the cultured fish species as a result of the mutual relationship between the host and these microbial candidates that are subsequently used in lieu of chemotherapy. In this study, the lactic acid bacteria (LAB) detected from dairy milk suggested using them as probiotics in fish culture, though previously, bacteria determined from other similar breeds were never recommended for this purpose [67-70]. Therefore, the total bacterial counts were significantly higher in Red Bororo than Adamawa Gudali, and these entail bacteria from non-fish sources were isolated, characterised, identified, counted, and colonies forming units were reported higher in this research as compared to the similar work from milk and milk products, unlike those that were reported from different fish organs and parts as well. Lactic acid bacteria from other available sources at any given locality should be analysed to determine their presence, total bacterial count, individual viable count, and molecular level.

Moreover, most of the probiotics used in aquaculture were sourced from fish body parts reported by several authors; thus, *bacillus* species such as *Bacillus subtilis* and *Lactobacillus acidophilus* were previously tested by many researchers to challenge the pathogenicity of *E. coli as* well as *Lactococcus* bacteria: *Micrococcus luteus, Staphylococcus aureus,* and *Streptococcus agalactiae* are known to cause economic losses; thus, the *Lactococcus* bacteria could be used to fight infectious bacteria in intensively managed fish species. In a nutshell, probiotics are significant in growth performance, survivability, defence mechanisms against foreigners in the body systems, as well as pathogenic microorganisms and disease resistance due to their antagonistic effects.

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