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Science and technological development of *Omashikwa;* Namibian traditional fermented butter milk

By

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DECLARATION

I declare that this thesis which I hereby submit for the degree of PhD at the University of Pretoria is my own work and has not previously been submitted by me for a degree at any other University or institution of higher education.

Peter George Bille

DEDICATION

This is dedicated to my family; Mrs. Monica Bille, daughters Marylyne and Gloria and sons Dennis and David for their support, prayers and encouragement during the five years I have been toiling, as a part time student, for the study.

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ABSTRACT

Science and technological development of *Omashikwa;* Namibian traditional fermented buttermilk

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In Namibia, *Omashikwa* traditional fermented buttermilk made with the root of *Omunkunzi* (*Boscia albitrunca*) tree by local farmers is one of the most important rural food products. It provides nutrition, jobs and generates income for food security for the community. As a traditional fermented product, it is unusual as it has a viscous consistency and low syneresis. However, the quality of *Omashikwa* is inconsistent and is characterized by high acid taste, low pH, rancid flavour, root taste and smell and contains filth.

In this research, the production process of *Omashikwa*, physico-chemical properties of the traditional and laboratory prepared *Omashikwa* and the role of the root of *B. albitrunca* tree in *Omashikwa*, viscosity, syneresis, microbiology and sensory properties were studied and compared in order to improve the quality of *Omashikwa* for wider community use and for poverty alleviation. Omashikwa was found to have a protein content of about 3.3%, fat 1.6%, moisture 90%, lactose 4.6%, ash 0.7%, total solids 8.7%, lactic acid 0.9% and a pH of 3.3

The quality of traditionally processed *Omashikwa* (TO) was compared with the laboratory processed *Omashikwa* (LO), which was made without the root. Traditional fermentation was carried out with raw milk and under rural conditions. After fermentation the milk was agitated vigorously to churn into butter, whereas LO was made with pasteurized (65ºC/30 min) and filtered milk, and cream was scooped off after fermentation instead of churning. LO had a significantly ($p < 0.05$) higher pH (4.44) compared to traditional *Omashikwa* (pH 3.25), lower acidity (0.68%) compared to 0.92% of TO. Fat content was higher in LO (2.44% fat) compared to 1.56% fat in TO. LO was free from filth and had higher viscosity (2.98 Pa.s) compared to 2.54 Pa.s and lower syneresis (14.4ml/24 ml) compared to 19.6ml/24ml of TO.

It was found that extract from *B. albitrunca* root showed a low pH of 4.7 and exhibited bacterial inhibition properties on Total Plate Count Agar ring test. The root appear to specifically inhibit *Escherichi coli, Staphylococcus aureus* and Clostridium species. It also had a high content of soluble carbohydrates (hydrocolloids or gum) (19.4%).

Significant difference ($p < 0.05$) in total aerobic counts was observed in TO of 6.62 log cfu/g compared to 8.62 log cfu/g of LO and lower lactic acid bacterial counts, 6.58 log cfu/g compared to 7.87 log cfu/g of LO. Probably the most affected microorganisms in TO were the non acid formers, as lower pH of TO and inhibitory compounds in *Omunkunzi* root could have reduced them. Coliforms, yeasts and moulds counts were not significantly different ($p<0.05$). No pathogenic bacteria were found in either product. The lactic acid bacteria identified belonged to the genera *Lactobacillus (Lb.) (Weissella), Leuconostoc (Leuc.), Lactococus (Lact.) and Streptococcus (Str.)* Twenty representative strains of LAB isolates were identified to species level; three belonged to the species *Lb. delbrueckii* subsp. *lactis* and two belonged to *Lb. plantarum* and two to *Weissella confusa* (former *Lb. confuses).* Three belonged to *Str. salivarius thermophilus,* three to *Leuc. lactis,* and two to *Leuc. mesenteroides* subsp. *mesenteroides.* Three belonged to *Lact. lactis* subsp. *lactis* and two belonged to *Lact. lactis* subsp. *cremoris.*

Significant differences ($p < 0.05$) in descriptive and consumer sensory attributes scores were observed between traditional and laboratory *Omashikwa.* Sensory attributes scores of TO on

the levels of syneresis was 3.4 compared to 2.9 for LO, filth 3.0 compared to 1.8 in LO, rancidity scores were 3.4 in TO compared to 1.8 in LO, and bitterness 4.2 in TO compared to 2.5 in LO. Aroma scores were 2.6 for TO and 4.2 for LO, viscosity 2.5 (TO) and 3.8 (LO) and texture 2.7 for TO compared to 4.2 for LO. There was an 80% preference score given to the laboratory *Omashikwa* by the young consumer panelists.

The results of this study indicate justification of using *B. albitrunca* root in the processing of *Omashiwa* by the rural community to improve the quality of *Omashikwa* in terms of flavour, smell and consistency compared to other traditional fermented milk products and in the absence of modern technology. However, application of good manufacturing practices on unit operations, particularly heat treatment of milk prior to fermentation, use of lactic acid starter cultures, maintenance of good hygiene and sanitation including packaging, seem to be the effective methods to improve and sustain the quality and safety of traditional fermented buttermilk *(Omashikwa)* for a wider market and better price.

Namibia Dairies Ltd, just like any other dairies in the region and elsewhere, manufactures buttermilk, a byproduct of butter that is fermented with mesophilic lactic acid cultures and branded as *Omashikwa* for the purpose of marketing. It has nothing to do with traditional *Omashikwa* as such; *B. albitrunca* root is not added and is processed by using modern industrial method. In addition, additives such as preservatives (potassium sorbate), stabilizers (pectin) and sugar are added and packed for distribution.

This research project therefore investigated the processing technology, physico-chemical, microbiological, viscosity and sensory quality of traditional *Omashikwa.* The remedial measures to curb inconsistency and poor quality experienced in *Omashikwa* processed in Namibia were also investigated and scientific measures were proposed for production of quality *Omashikwa* for marketing to a wider community.

Since laboratory processing method of *Omashikwa* gave a better quality product compared to traditional method in terms of microbiological quality, sensory attributes, viscosity, filth content, syneresis and general appearance, laboratory processing technique of processing *Omashikwa* is therefore recommended as an alternative and appropriate processing method for small scale production in the rural set up to improve the quality of *Omashikwa*.

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