



# REVIEW OF THE TRADITIONAL FERMENTED MILKS OF UGANDA AND PROSPECTS FOR STARTER CULTURE DEVELOPMENT

By

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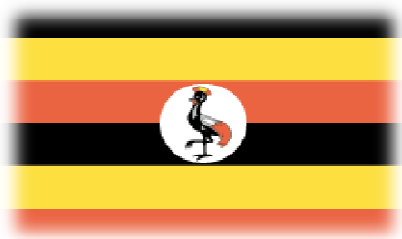
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Traditional Fermented Foods for Improved Quality and Food Safety”

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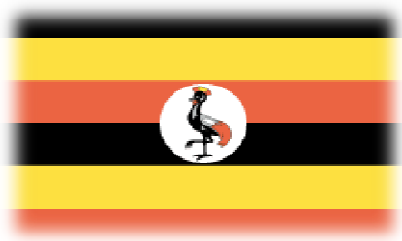
# Outline of the Presentation

- Introduction
- Traditional fermented milk products of Uganda
- Makamo & Kwerionik and the related products: Production process
- The microbiology of the 2 products
- Physicochemical characteristics
- Prospects for industrialisation
- Prospects for starter culture development
- Conclusions



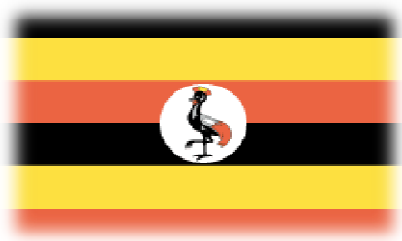
# Introduction

- Fermentation as a means of preservation has led to presence of various processes for traditional milk products in Africa
- TFMP may not have greater nutritional importance as compared to milk, but
  - nutrient concentration during processing
  - Availability to rural population
  - satisfy consumption habits
  - more varieties of dairy products availed



# Traditional Fermented Milks of Uganda

- Several traditional fermented milk products
- “*Moo dyang*” (butter) and “*Cak awac*” (buttermilk) from northern parts of the country
- “*Akele nu adwarak*” (sour milk) and “*Akinyet nakituk*” (butter) from eastern region (Itesot)
- “*Makamo*” from the western region and most common product
- “*Kwerionik*” eastern region

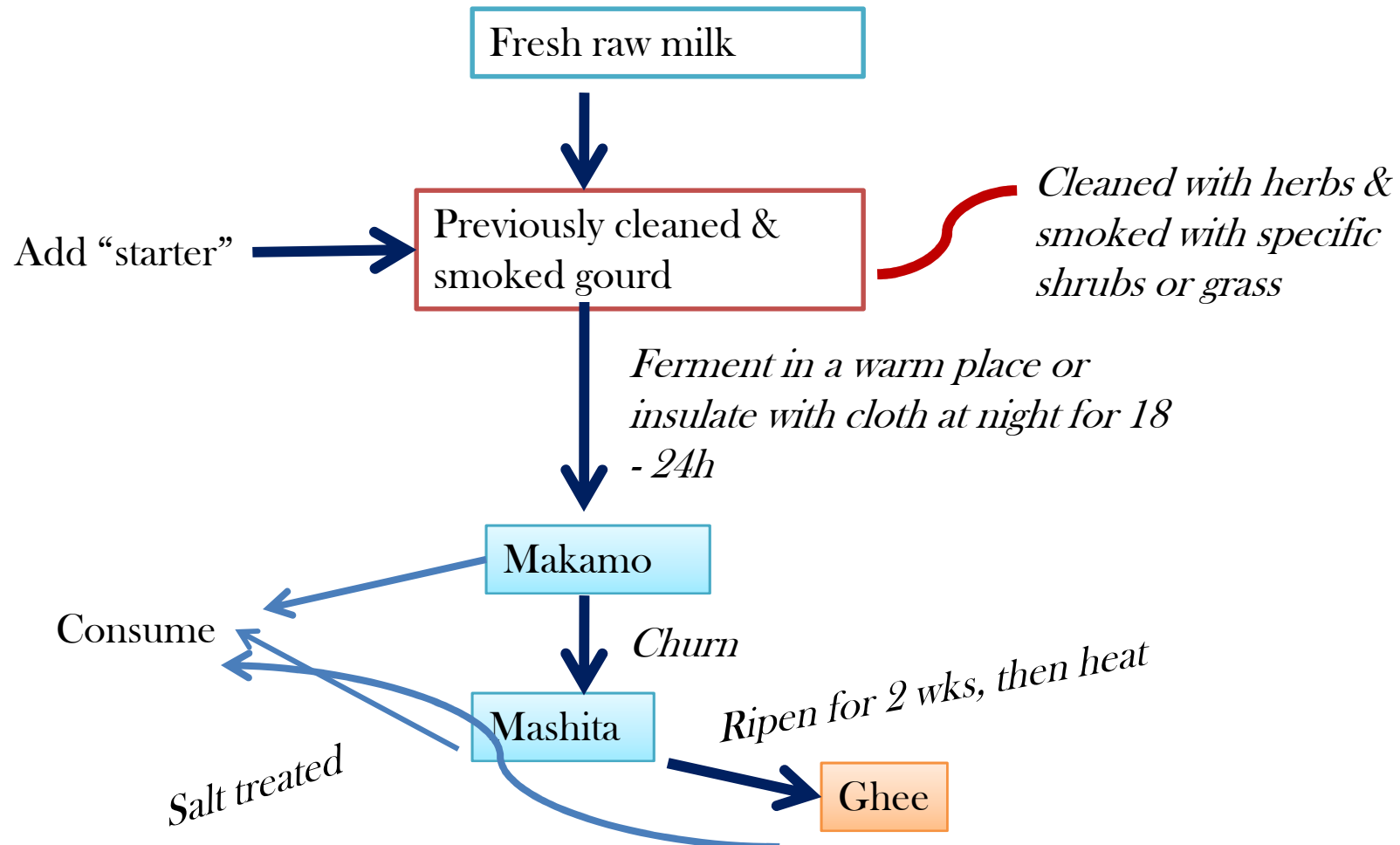


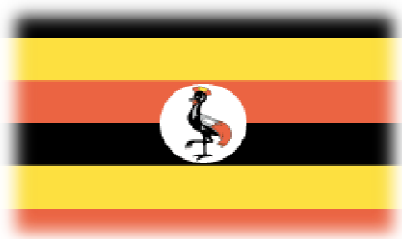
# “*Makamo*” and its related products

- Fermented milk with a mild sour and a typical pleasant cultured milk taste
- Together with “*Mashita*” (butter), are the most commonly produced indigenous products
- Mainly prepared by the Bahima ethnic group in Western Uganda
- “*Mashita*” is obtained by churning “*Makamo*”
- While Ghee or “*Samuli*” is made by heat clarification of “*Mashita*”



# Production process for “Makamo”





# Production process for “Makamo” cont’d

- Starter is either from the previous “*Makamo*” batch, obtained from relatives or friends; or is
- Specially prepared referred to as “*Enkamyo*” prepared by any of the 2 below
  - Adding a small quantity of sugar to some raw milk or an inner skin from the bark of a special local shrub to milk and left to ferment normally. Once coagulated it is used as the inoculum
- Starter is good if it is thick; has a typical flavor assoc. with good quality “*Makamo*”; & is free from visible gas production



# Production Process for “Kwerionik”

Cold raw or boiled milk

Previously cleaned, dried  
& smoked gourd

*Ferment at ambient temperature  
16 -28° C for 2 -7 days*

*Cleaned with warm water  
& charcoal from specific  
shrubs added*

Kwerionik

*Whey removed and milk added every 2 -4 days*

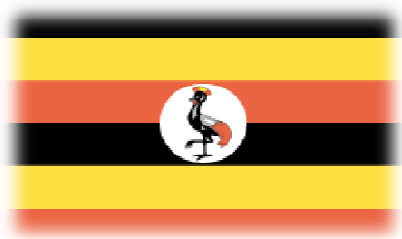
Katanik

*Whey removed and milk added every 2 -4 days*

Consume

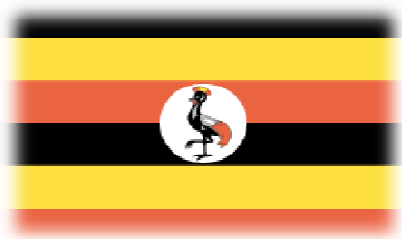
*Mixed with  
porridge or  
blood*

Chekap-mwaka



# *“Kwerionik”* Production cont’d

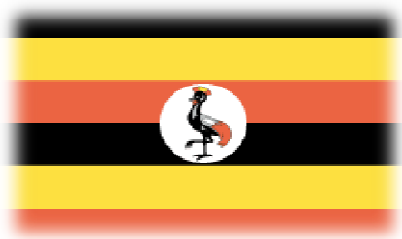
- No starters are added, probably organisms are already established in the gourd
- Coagulation of milk occurs in 1-3 days
- The curd floats on top and whey is decanted off after removing the top-most layer
- Whey removal and addition of milk is done at an interval of 2 -4 days
- Product can be harvested or consumed any time after 4 days of fermentation.



# Microbiology of “*Makamo*” & “*Kwerionik*”

Microflora category	Counts (log cfu ml <sup>-1</sup> )	
	“ <i>Makamo</i> ”	“ <i>Kwerionik</i> ”
Mesophilic Aerobes	7.1	7 - 8
LAB on MRS	7.4	7 - 9
LAB on M17	7.4	5 - 8
Citrate metabolising bacteria	6.4	ND
Coliforms	2.0 (40% <1)	<30 at 10 <sup>0</sup>
Yeast & molds	4.2	4 - 6 (no molds)

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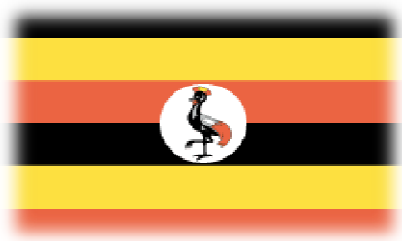
# LAB in “*Makamo*” & “*Kwerionik*”

## “*Makamo*”

- *Lactobacillus plantarum*
- *Leuconostoc mesenteroides*  
ssp *mesenteroides*
- *Leuconostoc mesenteroides*  
ssp *dextranicum*
- *Lactococcus lactis* ssp *lactis*  
biovar *lactis*
- *Lactococcus lactis* ssp *lactis*  
biovar *diacetylactis*
- *Lactobacillus helveticus*

## “*Kwerionik*”

- *Lactobacillus plantarum*
- *Lactobacillus paracasei* ssp  
*paracasei*;
- *Leuconostoc mesenteroides*  
ssp *mesenteroides*
- *Lactobacillus casei* ssp *casei*
- *Enterococcus faecalis/ faecium*
- *Lactococcus lactis* ssp *lactis*



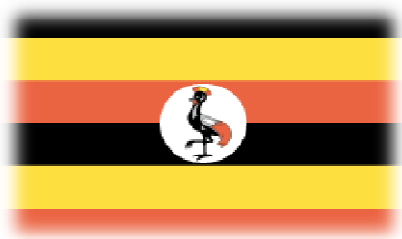
# Yeast and Molds in “*Makamo*” & “*Kwerionik*”

## “*Makamo*”

- *Saccharomyces cerevesiae*
- *Galactomyces geotrichum*
- *Kluyveromyces marxianus*
- *Trichosporon pollulans*
- *Saccharomyces dairensis*, *S. sake*, *S. klyveri*
- *Candida parapsilosis*, *C. rugosa*; *C. stellata*
- *Trichosporon delbrueckii*
- *Lodderomyces elongisporus*
- *Pichia nakasei*; *Rhodotorulla glutinis*

## “*Kwerionik*”

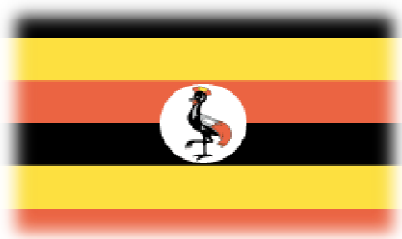
- *Candida krusei*
- *Candida kefyr* (*Kly*)
- *Pichia ohmeria*
- *Candida intermedia*
- *Candida lusitaniae*
- *Candida pelliculosa*
- *Candida lambica*
- *Candida guilliermondii*
- *Candida holmii*



# Physico-chemical properties of “*Kwerionik*”

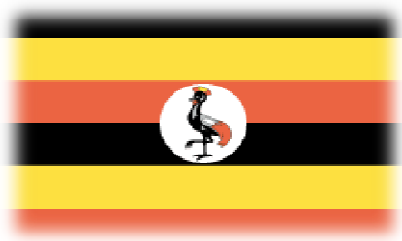
Age of product	pH	TTA	Moisture content	Total solids	Fat content
7d	3.82	1.7	87.5	12.5	1.6
14d	3.9	1.4	84.8	15.2	1.7
21d	4.0	2.8	81.7	18.3	4.8
1m	3.59	2.53	80.3	19.7	7.9
2m	3.57	3.36	80.9	19.1	8.1
3m	3.71	4.51	77.1	22.9	7.3
6m	3.72	5.5	74	26	9.9
12m	3.47	10.2	58.1	41.9	11.2

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# Prospects for industrial production of these products

- Increased marketability and high demand in urban areas esp. for “*Makamo*”
- Small-scale milk processing units operate in the urban areas, utilize starter cultures (commercial & “*Makamo*” culture)
- Several entrepreneurs in position to invest and take up the technologies developed
- MOs from “*Kwerionik*” and “*Makamo*” have been isolated & characterised



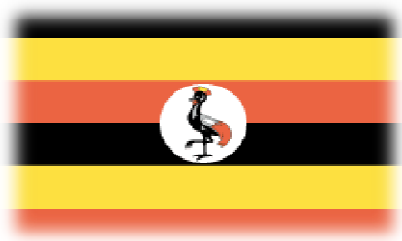
# Prospects for industrial production of these products

- Success of the locally processed fermented milk is hindered by the poor & variable quality of the product
- Use of specific starter culture enable controlled fermentation for good quality & shorter fermentation process
- Need for extensive screening of the products to identify suitable starter culture candidate strains
- Evaluation of some of the processing steps such as smoking



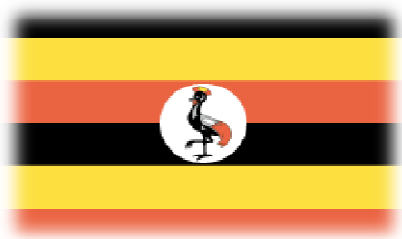
# Strategies for development of traditional milk products

1. Ensure safe milk supply (animal d'se control)
2. Enhance hygienic practices for milk production
3. Establishment of village based processing units
4. Improvements in processing equipment to achieve better efficiency and product quality
5. Training of milk producers and milk processors to enhance their knowledge and skills



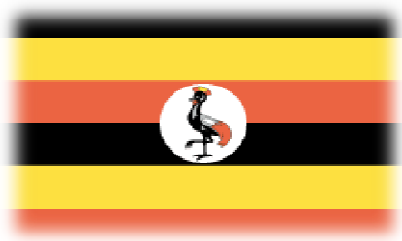
# Prospects for starter culture development

- For industrial processing, starter culture strains have been identified & characterized, not the case in most indigenous fermentations
- Dairy starters categorized as traditional and defined starters
- Traditional starters are further subdivided into artisanal and mixed strain starters
- Artisanal starter cultures consist of unidentified mixtures of LAB derived by back-slopping



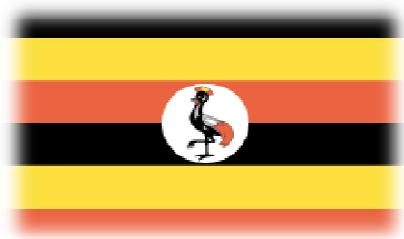
# Artisanal starter cultures

- Depend on processing conditions & antagonism among the components of the original microflora to select the desired strains
- Their composition is complex, variable and often poorly defined
- The artisanal starter cultures are advantageous since they are a potential source of strains with interesting characters such as phage resistance and production of inhibitors; but may contain phage carrying and lysogenic strains



# Prospects for starter culture development

- Frequent sub-culturing of artisanal cultures affect the composition as well as performance
- Hence the need to develop commercial mixed-strain starters (MSS) by propagating artisanal cultures under laboratory conditions
- MSS contain several strains of each component species that vary in certain properties e.g. acid production and flavor components
- Given the microflora of “*Makamo*” & “*Kwerionik*”, prospective starters should be the mesophilic MSS



# Conclusions

- “*Makamo*” has better prospects for starter culture development (widely consumed, artisanal starter)
- Since natural selection govern absolute composition of starters, screening of artisanal starter cultures will enable development of MSS
- Strains for biomass production should be selected according to centrifugability, LA production and resistance to bacteriophages (need to be done)
- Improve processing equipment instead of gourds
- Processing level, is it at house hold level or small-scale processors? This relate to resources needed



# Acknowledgements

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Thank U - Asante