

**PREPARATION, STORAGE, AND UTILIZATION
OF MAHEWU (A NON-ALCOHOLIC MAIZE MEAL BEVERAGE)
IN NTAMBANANA, SOUTH AFRICA**

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ABSTRACT

Maize is among the top three grain crops in the world. In Africa, especially Southern Africa, maize is the basic ingredient in fermented soft porridge known as *Mahewu*. *Mahewu* is a refreshing drink, produced at the household level using various practices and ingredients as a fermentation enhancer. The underprivileged consume *Mahewu* as the main meal of the day and hence, *Mahewu* is a source of dietary nutrients for many populations in Africa and South Africa. The ingredient and practices of making *Mahewu* differ from one ethnic group to another. However, some of the indigenous practices are not well reported. These practices are fading away, hence, there is limited information on some indigenous practices. This paper reports some traditional practices of making *Mahewu* in Zulu-based households in Ntambanana, a rural municipality in KwaZulu-Natal, South Africa. An ethnographic research approach was adopted for the study to gain insight into the traditional practices of making *Mahewu*. Probing of key informants, interviews, and observations were complemented by four focus group discussions, within the range of 10-12 regular consumers of *Mahewu*. Four focus group discussions were conducted in Buchanana and Luwamba in Ntambanana; findings consistently reveal that *Mahewu* is popularly known as “*umdokwe*” and is consumed by all age groups beginning from four months to the aged. Irish potatoes (*Solanum tuberosum*), *imbiliso*, inserting a saucer, or a spoon deep down into the *Mahewu* container were mentioned and identified as fermentation enhancers which are lacking in other studies. Therefore, indigenous practices are diminishing while some practices are being lost between generations. Inadequate transfer of these practices might make the drink, to soon be accessible only commercially. To prevent this dilemma, the retention of traditional techniques of making *Mahewu* with sweet potatoes could promote food and nutrition security while retaining the indigenous practices. This study reports the preparation, storage, and utilization of *Mahewu*, a non-alcoholic maize meal beverage in Ntambanana, South Africa. It is recommended that campaigns promoting indigenous food consumption should form part of health, social development, as well as welfare, hence, food and nutrition interventions should be implemented in rural communities.

Key words: Cereal drink, *Imbiliso* fermentation indigenous, *Mahewu*, practices, storage *Umdokwe*



INTRODUCTION

Maize constitutes the main ingredient in the diet of most rural dwellers, especially among the underprivileged, developing settings in sub-Saharan African countries, including South Africa. Cereals such as maize make up more than 60% of the world's food harvest [1]. Maize contains a high amount of starch (65% to 75% carbohydrate weight), and low contents of proteins (6% to 12%) and fat (1% to 5%), with traces of minerals and vitamins [2]. Several studies report maize as being insufficient in most essential nutrients, including amino acids, some vitamins, and minerals, especially when it is consumed alone. Nevertheless, it is maintained that some indigenous processing and practices of indigenous food, such as the fermentation, offer health benefits as they make some nutrients available [3,4].

Fermented cereal-based foods can improve the bioavailability of vitamins and minerals and, hence, improve human nutrition and contribute to the food security of *Mahewu* consumers [5]. Although some of the traditional practices have not been documented, the fermentation of soft porridge (*Mahewu*) has been practised in the past thus, the making of *Mahewu* is an old technology for handling food to make it readily available, with better keeping quality and a unique satiating sensation [6]. *Mahewu*, especially the indigenously made beverage, contains dietary fibers, including crude, soluble, and insoluble fibers that have benefits for maintaining a healthy bowel, lowering cholesterol levels, and helping to control blood sugar levels [7].

Fermented foods, such as *Mahewu*, are now identified among the functional foods since they provide basic nutrients as well other numerous health benefits [7].

Mahewu is produced through fermentation by lactic acid bacteria (LAB) [8]. It has been extensively established that food fermentation depends on actively growing lactic acid bacteria, which might be added as starter cultures or may grow naturally in the food matrix [9]. Lactic acid bacteria (LAB) are a group of gram-positive bacteria, which are united by a constellation of morphological, metabolic, and physiological characteristics. Lactic acid bacteria are major constituents of the microbial ecology or probiotic starter cultures used in making fermented foods. Lactic acid bacteria produce proton-motive force, mainly utilizing a membrane located H⁺-ATP at the expense of ATP [7,10]. The proton-motive force drives the uphill transport of metabolites and ions into the cell [7,10]. Maize is a substrate for fermentation because maize acts as a medium for the bacteria to biochemically act on food by providing the desired product that qualifies it among other functional foods.

Functional foods are whole, fortified/supplemented, enriched, or enhanced foods that provide health benefits beyond the provision of essential nutrients (vitamins and minerals). However, this is obtainable when consciously consumed in an adequate proportion as part of a dietary lifestyle. Functional foods are important for providing the body with the required nutrients, such as vitamins, fats, proteins, and carbohydrates, as well as medicinal benefits that are necessary for healthy survival [11]. Fermented foods are also reported as functional foods that normalize intestinal flora, prevent gut



infestation by bacteria, prevent colon cancer, and treat diarrhea in both children and adults [12,13].

Mahewu is a cereal fermented drink, of which its effects have been linked with increased digestibility of protein, an improvement in the nutritional and sensory quality of maize-based foods, and a reduction in the levels of toxic/carcinogenic mycotoxins [14]. A study reports that fermented maize (*Mahewu*) can enhance the immune system, and synthesize and enhance the bioavailability of nutrients [15]. Fermentation has been identified to alleviate symptoms of lactose intolerance, thereby reducing the risk and prevalence of certain diseases including allergies in vulnerable individuals. It also addresses the stimulation of lactation among breastfeeding mothers [3].

It helps to address diarrhea challenges and it prevents the threat of childhood diarrhea and antibiotic-induced diarrhea [16]. In recent times, probiotic foods are known to be milk- (dairy-) based. However, in the past, many fermented drinks and cereal-based fermented drinks had probiotic cultures [17]. The use of cereals, such as *maize*, as ingredients in probiotic food formulation as fermentable substrates for LAB constitutes dietary fiber supplementation, which has been explored [17]. Recent research was conducted on the laboratory trial of LAB, which was isolated from fermented cereal food, and it withstood the physiological challenges posed by the gastro-intestinal tract (GIT), which can colonize the GIT [17]. In controlled human trials [18], it has been demonstrated that cereal-based food like *Mahewu* can reduce or control diarrhea in children and adults. Water-soluble and insoluble β-glucan, arabinoxylans, oligosaccharides, and resistant starch are indigestible constituents of cereal, but they are fermentable dietary carbohydrates, which are used to grow probiotics LAB, and can provide prebiotic effects [17]. In sub-Saharan Africa and Southern Africa, there is a growing awareness of the importance and health benefits of functional foods containing probiotics. Probiotics refer to a product that contains single or mixed cultures of living micro-organisms, which, when consumed, can improve human health by enhancing the microbial balance in the gut [17]. It is reported that most of the probiotic organisms used in human food belong to the species *Lactobacillus* or *Bifidobacterium* [19]. Some of these probiotics can be obtained from the naturally fermented foods that are being gradually phased out with generations.

According to Myeni [20], some of the indigenous knowledge of food preparation and practices and methods of processing are slowly disappearing, perhaps due to a generational gap in knowledge transfer. Furthermore, the trends of consuming commercial food products that might not offer the same nutritional value, social value, and taste attributes are increasing [20].

The preparation of indigenous *Mahewu* involved adding one part of maize meal to seven parts of water and then boiling at 90°C, with occasional stirring, for 15 minutes. The resulting porridge is left to cool to approximately 40°C [21]. A study provided a chart on the traditional preparation of *Mahewu* as described in Figure 1.



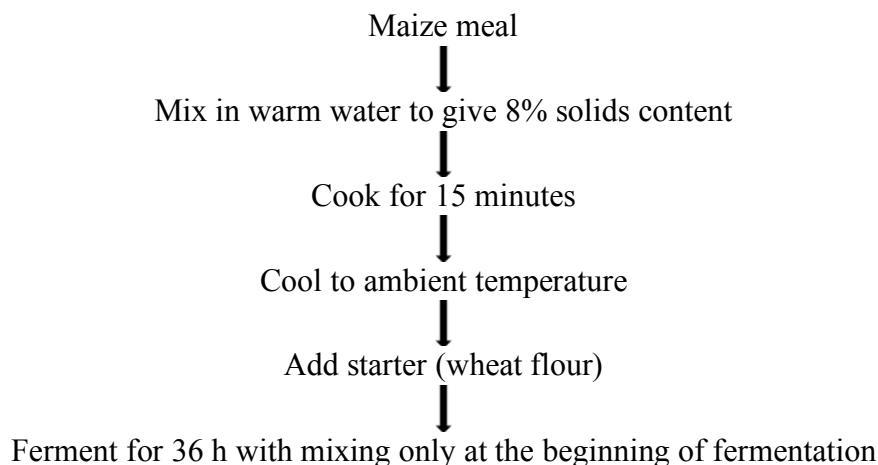


Figure 1: Flow chart for the traditional preparation of Mahewu [8]

Although procedures for the preparations of *Mahewu* are provided in the literature [8], there is a scarcity of detailed information on the indigenous processing and practices of *Mahewu*. The traditional practices of *Mahewu* beverages are usually unique to the locality in which they are produced and consumed. In the study area, several practices were identified which were not reported in other studies. For example, Irish potatoes (*Solanum tuberosum*), imbiliso, inserting a saucer, or a spoon deep down into the *Mahewu* container was identified as fermentation enhancers. Moreover, sweet potatoes were used to speed up fermentation and used to improve the nutritional value of traditional *Mahewu*. Starters highlighted in this study are not mentioned in other reports and could form the basis for further study. Therefore, this study focused on the preparation, storage, and utilization of *Mahewu*, a non-alcoholic maize meal drink produced in Ntambanana, KwaZulu-Natal, South Africa.

Description of the study area

The study was conducted in Buchanana in Ntambanana, which is one of the six local municipalities under the uThungulu District in KwaZulu-Natal. It is in the central part of the uThungulu District Municipality, and it is approximately 160 km north of Durban and can be accessed through the R34 highway from Empangeni. The municipality is surrounded by valleys that accommodate numerous rivers flowing either towards the Umfolozi River in the north or the UMhlathuze River to the south. The municipality covers an area of 1 083 km² and has a population of 94 194 people. In line with national and provincial trends, there are more females than males in the municipality, as the gender distribution is 187 287 for females, while 177 175 for males, according to the Integrated Development Plan (IDP), 2019/2020 [21]. Smallholder farmers consume their local maize and alternate it with the commercial maize during the planting period. Myeni [20] notes that the rural population also practises cattle farming and engages in other agricultural activities. The maize is used to prepare several maize-based food products that are consumed as main meals, snacks, and beverages, such as *Mahewu*.

MATERIALS AND METHODS

The quantitative and qualitative research methods were adopted to further explore and report the traditional practices of making *Mahewu*. An ethnographic study was also used in this research where key informants were interviewed, complemented by focus group discussions. An ethnographic approach is a method of gathering data through inductive, qualitative methods, including interviews, discussions, and participant observations, and representing such data from the perspective of the research participant [22]. During the ethnographic studies, four regular *Mahewu* producers and consumers of *Mahewu* from different localities (two local districts) of North Coast KwaZulu-Natal were interviewed. To further authenticate the information about the processes of making *Mahewu*, two areas were selected to verify the information from the local communities within this part of the province. Through the help of a research assistant, the interview was recorded and later translated into English by a competent Zulu speaker who could also speak English fluently. An ethnographic approach was adopted, whereby observations, interviews, and storytelling of old practices of *Mahewu* production were followed in the study area. Also, the researcher observed how women prepared *Mahewu* in the rural community and four focus group discussions of 10-12 members were conducted with the participants to gain more insights into the practices.

Data analysis

The information gathered from the key informant interviews was detailed through descriptive narrative analysis. The recorded information from interviews and focus group discussions was analyzed by descriptive content analysis, linking the themes and concepts.

Ethical clearance

Permission to carry out the research was obtained from the Department of Agriculture at the Luwamba Center in Ntambanana. Authorized permission was granted by the University of KwaZulu-Natal's Humanities and Social Science Research Ethics Committee (ethical clearance number: HSS/0559/01016) was obtained before the commencement of the study. Thus, the practices involved in the preparation, storage and consumption of *Mahewu* beverages were reported.

RESULTS AND DISCUSSION

Findings reveal that *Mahewu*, is a non-alcoholic fermented soft porridge but, also called “*umdukwe*”, which is regarded as a thirst-quenching drink in summer. Also, it was mentioned that *Mahewu* drink is “a hunger-filling drink” meaning it is consumed as a meal of the day as opposed to just being a thirst-quenching drink reported in other literature. It was further explained that “it is a convenient drink that is easily made within the shortest possible time” *Mahewu* is usually a cream-white fermented drink when it is made from white maize, but if it is made from other maize varieties, such as provitamin A biofortified maize, it could be yellowish, while the one made from sorghum would be brownish because of the inherent brown color of sorghum. Both cream white-colored and brownish colored *Mahewu amnyama* (Black *Mahewu*) were



popular in the study area. Although white maize is inadequate in essential nutrient , white maize *Mahewu* was the most popularly consumed beverage across all age groups.

Traditional practices and the processing of *Mahewu*

According to the key informants, the processing of *Mahewu* begins by drying the harvested maize to preserve it. When a meal or a beverage is to be made, the dried maize kernels are taken off the cob. The maize kernels are ground on a flat stone and crushed using a rectangular, oval, and easy to handle stone to crush the maize kernels to obtain *mealie meal*. The smaller stone crushes the maize with more rigorous hard pressing movements, while the woman grinding the kernels is kneeling. This process gives a coarse maize meal and takes off the outer coat of the maize as it is indigestible. Then, more grinding is done until the maize meal is finer (smoother).

It was emphasized in the study area that the old practices of grinding maize formed part of the house chores of the women, including the girls in the household. It is one of the skills that older women usually transferred to their daughters and grand-daughters, which is currently fading away. In traditional systems, the relationship between people involves the knowledge and the technologies being valued. Unfortunately, the advancement of modern technology is displacing some of the valued benefits, hence the need to report indigenous practices, even though it is claimed that advanced technology could bring forth greater conveniences [23]. However, the key informants attested “Nowadays, the old technology of grinding on the stone is outdated, and the households make use of other technologies, such as using the minced meat grinder, and those who have money, they send their maize to a local miller for milling”.

During the study, it was observed that there were food retail stores where fortified maize meal was sold. However, some people still relied on their local maize varieties and seasonally purchased commercial (fortified) maize meal. Fortified maize meal offers more nutritional value, because essential nutrients have been added to it through fortification. At the same time women are relieved from strenuous household chores. The implication is that some fundamental components of traditional practices for making these indigenous foods, including the indigenous *Mahewu* beverage, are gradually being phased out. This is because of a gap in sharing or the failure to transfer indigenous knowledge systems of food processing between generations. Therefore, there is a need to report the traditional processes and practices, which is the focus of this study. Furthermore, there are commercial *Mahewu* beverages that are widely available in local markets; however, the consumers indicated “we prefer our local *Mahewu* drink”, referring to the *Mahewu* made from their own grown maize, rather than the commercially purchased maize meal acquired from the retail stores. Also, it has been identified that the commercially made *Mahewu* had an unpleasant after-taste, unlike the traditional product. Thus, *Mahewu* is still prepared at the household level, but the indigenous, locally made *Mahewu* from the own-grown maize was reported to have a distinct refreshing sour taste, which is appreciated by the rural community, as claimed by informants: “We appreciated the traditional *Mahewu* more than the one in the mall”. The traditional practices for making traditional *Mahewu* beverage are unique to each locality in this study, for example, the use of Irish potatoes (*Solanum tuberosum*), *imbiliso*, inserting a saucer or a spoon deep down into the *Mahewu*



container were identified as fermentation enhancers. Moreover, sweet potatoes were used to speed up fermentation and they are also used to improve the nutritional value of traditional *Mahewu*. The starters highlighted in this study were not mentioned in other reports, which could form the basis for further study. Hence, awareness of the traditional practices through reporting the practices could form biases for further study and be an opportunity to retain the household practices of making and consuming *Mahewu* drink. *This is* because the sensory attributes, such as taste, tend to influence the utilization of food products among households.

Traditional preparation and fermentation process of *Mahewu* in rural KwaZulu-Natal

According to the key informants, in the traditional *Mahewu* recipe, measurements were not quantified, as they were not a priority to them. The focus group discussants affirmed “we use our eyes to fetch the quantity of mealy maize, we just see with our eyes the amount of water and the sugar for the *Mahewu* that would be enough for the people in the house”. Since the processing of *Mahewu* has become part of their skills, generally, recipe quantities and time for preparation were usually estimated as the need arises. It was gathered that looking at the texture of the porridge while it is cooking, its smell (a certain aroma indicates its rawness) and the mouthfeel, indicate how well it is cooked. Using a wooden spoon, one would feel the texture and be able to detect if the porridge is well cooked or not.

A modified standardized recipe for 1L *Mahewu*

Using the local white maize, *Mahewu* was prepared based on the traditional method as described by a key informant from the study area. Ingredients for a liter of *Mahewu* included 120 g of (white) mealy maize, 1 250 MLS of water, and 50 g of sugar. The procedure was as follows: 900 mL of water was measured and boiled to reach a boiling point of 100°C; 120 g of maize meal was mixed with 200 mL of water to form a paste, which was poured into the boiling water and a slurry porridge was obtained. The heat was reduced to medium, while occasional stirring of the porridge was continued, and the porridge was cooked for about 20-25 min. The heat was turned off, after which the porridge was occasionally stirred for about 35 to 40 min, and was left to cool to a tepid temperature of 40°C. Then 50 g of sugar was dissolved in 150 mL of tap water was added to the cooked porridge, which was poured into a plastic container with a perforated lid. The porridge was placed in a closed cupboard and was fermented after 96 h. Weather plays a vital role in the natural fermentation of *Mahewu*; this *Mahewu* was made during the cold weather, hence, the period of fermentation. In warm weather, the normal fermentation period is usually 24h. Hence, the weather is an important factor in natural fermentation of any food. About 10ml of the fermented medium (*Mahewu*) was removed into a sterile beaker and the pH was measured using an electronic pH meter. The pH values of the samples were recorded in triplicate for validity, and the corresponding mean and standard deviation were recorded as described in Table 1.

***Mahewu* cooking and related issues**

According to the key informants and the focus group discussants, the cooking technique and working time were very important factors that could affect the texture



and consistency of the finished product (*Mahewu*). During the focus group discussions, the discussants repeatedly mentioned “there is a difference in the cooking time for normal soft porridge and that of soft porridge used for *Mahewu* drink”. It was insightful that there were special technique and a sequence that needed to be followed to achieve the desired quality product (*Mahewu*). During the first 10min of cooking, the porridge should be boiled rapidly, after which the heat should be lowered. This implies that the longer the period of cooking on low heat, the creamier the finished product (*Mahewu*) would be. Although the longer cooking period could be a benefit to obtaining a complete gelatinized starch, when commercial (fortified) white maize is used, the prolonged cooking time could destroy the sensitive nutritional value of the beverage [24].

Starter cultures and fermentation enhancers

In most communities, the fermentation of food undergoes natural fermentation processes, whereby ingredients for food preparation and fermentation practices are based on the available agricultural raw materials within the domain thus a natural fermentation starter may differ from one ethnic group to another. During the focus group discussions, various starter cultures used for *Mahewu* were mentioned. Cultures for food fermentation processes that contain microbial bacteria are commonly called starters [17, 25]. The starters contain good bacteria, such as probiotics, and when added to the food products can grow through multiplication in the food products under controlled conditions [25]. During fermentation, bacteria produce substances that give fermented products their unique sensory properties, such as acidity (pH), taste, aroma, and consistency [25]. Another fermentation technique revealed in the study was that, in the past, fermentation was based on the use of a starter culture that was prepared by the steeping of the maize kernels in water for two days. Then the kernels were crushed with a stone or a manual grinder, and the crushed maize kernels were cooked in boiling water until they were creamy, which gave the porridge its unique sour taste and smell. The porridge was left to cool, which could be used as an enhancer and inoculator for the fermentation processes.

Another enhancer of *Mahewu* is old *Mahewu*, known as “*imbiliso*”, which has been preserved for enhancing the fermentation of the subsequent *Mahewu*. This *imbiliso* is added to the soft porridge, thus making new *Mahewu*; the *imbiliso* is, thus, used as a starter to speed up the fermentation process.

Furthermore, key informants and the focus group discussants mentioned that sugar was added as a fermentation enhancer, but the secondary purpose was to improve the taste. Irish potatoes (*Solanum tuberosum*) were also mentioned as a fermentation enhancer of *Mahewu*, which is usually added to replace sugar and to speed up the fermentation processes. The Irish potatoes (*Solanum tuberosum*) are dropped into the cooked porridge at a warm temperature just before it cools to a lukewarm temperature, and once the *Mahewu* is fermented, the Irish potatoes are removed. It is reported that the Irish potatoes speed up the fermentation processes such that the porridge can ferment in less than 48 h. Under normal conditions, it was reported that *Mahewu* without potatoes ferments within three days or more, depending on the degree of sourness taste desired. However, it was informed that most times, the period for fermentation depends on the



weather condition of the day, as fermentation can be faster under warm weather conditions, than in colder weather conditions. Bacteria and yeast are also involved in the fermentation of food, thus a higher temperature, and the absence of oxygen, will increase the release of more carbon dioxide, therefore, forming a greater number of bubbles. However, as soon as the temperature exceeds this point, the rate of respiration decreases [10].

Although microorganisms for fermentation need enough warmth to grow and thrive, too much warmth can also stress organisms, such as yeast. Also, if it is too cold, the yeast will be slow to activate [26]. Thus, as the temperature increases, the fermentation rate accelerates, and more organoleptic attributes are produced because the metabolic intermediates are excreted from the microorganism. Historically, natural fermentation involving lactic acid bacteria is the old technology of fermenting cereal-based beverages like *Mahewu*, which has been and is still being appreciated, especially in the rural communities [3,10]. The modern enhancer contemporarily used is yeast, which is added when the cooked porridge is lukewarm.

Besides the use of Irish potatoes as a fermentation enhancer, it was informed that sweet potatoes were also used for two purposes, namely, to boost the nutritional value of *Mahewu* because the rural community believes that maize *Mahewu* gives mostly energy, while the sweet potato is rich in vitamins and minerals, and to speed up the fermentation processes, which in turn, enhances the taste of the drink. By implication, the rural communities have ways of fortifying, enhancing, or supplementing indigenous staple foods that are believed to be low in nutrients. However, some of this information is scarcely reported in the literature. This means that the indigenous people of old times had their peculiar technology of nutritionally improving their staple foods. Thus, rural people did practise the science of nutrition when preparing their local diets, which might not have been reported. However, the lack of knowledge transfer between the older and the younger generations might be a factor contributing to some of the indigenous practices fading away; some would rather buy the commercial *Mahewu*, which they complained to have an after-taste. Thus, key informants believe that their indigenous *Mahewu* is still preferred to the commercial *Mahewu*.

Mahewu traditional storage and practices in the rural household

It was mentioned that the container used for the storage of *Mahewu* plays an important role in the fermenting process. Calabashes, earthen pots, and plastic containers were deemed more appropriate than the stainless steel or aluminum containers of their contemporaries. As claimed by the focus group discussants, the stainless steel or aluminum containers have a cold effect, thus, they tend to slow down the fermentation processes. Also, according to the key informants, the calabashes and earthen pots provided a tastier sensory attribute to the beverage compared to that of the plastic containers. This implies that these storage materials also have a great influence on the taste of the final product (*Mahewu*).

According to key informants, modern cooling facilities, like the fridge, were not available in the past. Therefore, *Mahewu* drink was kept in a cool area, mostly in the round mud huts (house) where floors were polished using cow dung. The cow dung



polish had a cooling effect in the house. However, during that era, the calabashes and the earthen pots helped to cool the drink hence, complemented the flooring. Currently, with the exception of the underprivileged participants, it was indicated that some households had refrigerators hence, the *Mahewu* was kept in the refrigerators, while those households that lacked modern cooling equipment use plastic containers hence, they make only enough *Mahewu* that could be consumed immediately.

Furthermore, it was reported that some of the practices that ensure the quality and shelf-life of the beverage protected it from ‘Mother Nature’ during the fermentation process in that, they believed that a thunderstorm could cause it to separate. Hence, great care was taken via traditional methods, including inserting a saucer or a spoon deep down into the *Mahewu* container.

Utilization of *Mahewu* among the rural communities of KwaZulu-Natal

It was mentioned in the focus group discussions that *Mahewu* was consumed by all age groups, starting from four months. *Mahewu* is classified as a beverage, it is a light meal and due to its unique sensory attributes, including having a refreshing attribute and the ability to quench thirst, *Mahewu* also provides wholesomeness, satisfies hunger, and is a convenient food. Although *Mahewu* provides consumers with the bulk of calories and limited essential nutrients, nevertheless, just like any other maize-based foods or beverages, when they are not fortified or consumed along with other food sources containing vitamins and minerals, the beverage on its own could be classified as less nutritious [15, 27]. In sub-Saharan Africa, South Africa included, nutrient deficiencies of vitamin A, iron, iodine, zinc, and protein are a major challenge, leading to the world’s most common burden of disease, impairing and claiming lives, and hindering economic growth and development of many nations [26]. Therefore, over-reliance on compromised maize food products, which are largely starch-based and are consumed without food sources rich in essential nutrients, appears to expose the most vulnerable group (young children, pregnant and women of reproductive age). These individuals are predisposed to non-communicable diseases, as well as health challenges brought about by vitamin and mineral deficiencies, which are preventable health challenges [26]. Traditional maize grinding process (using a stone) and method of fermentation have been reported to avail some nutritional content, such as protein and other vitamins that tend to be bound by antinutrient factors [20]. Additionally, since synthetic nutrients are added to the fortified commercial maize meal, it may provide more nutritional content as compared to the own-grown maize. However, this justification is not conclusive, as this study did not conduct any comparative nutritional analysis of the commercial mealy maize made *Mahewu* and the local (own-grown) maize homemade *Mahewu*.

Perceived health and nutritional benefits of *Mahewu*

When the participants were probed about the nutritional elements of the *Mahewu* drink, they responded “*Mahewu* gives us energy”. Some said it contained mainly starch and fiber. It has been stated that maize constitutes the bulk of carbohydrates and fiber [6], but the literature also reports that fermentation of foods releases several B vitamins, including niacin (Vitamin B3), pantothenic acid (Vitamin B5), folate (Vitamin B9), and vitamins B1, B2, B6 and B12 [3, 7]. Furthermore, the participants believed that the



consumption of *Mahewu* aids digestion processes and relieves constipation. They also believed that the making of *Mahewu* is a local way of preserving their indigenous food. The literature indicates that natural fermentation processes preserve the food products, as well as the food nutrients, breaking down the food, thereby making them more digestible and able to produce nutrients of great importance, such as the B vitamins, Omega-3 fatty acids, and various probiotics [3,7]. It is reported that during fermentation, the bacteria in the food synthesize vitamins and minerals; the bacteria possess biologically active peptides with enzymes, such as proteinase and peptidase, and some non-nutrients [7]. These compounds are well recognized as biologically active peptides that are produced by the bacteria and are responsible for fermentation and are well known for their health benefits. The compounds include peptides, conjugated linoleic acids (polyunsaturated fatty acid), which have been identified to lower blood pressure, possess an anti-microbial effect, have an anti-carcinogenic, anti-microbial, antioxidant, anti-microbial antagonist, and anti-allergenic properties, and have anti-fungal, anti-inflammatory, anti-diabetic, and anti-atherosclerotic activity [7]. The findings of this study confirm that traditional knowledge still has an element of science in it, which might not have been reported before.

CONCLUSION

The study reports the preparation, storage, and utilization practices of traditional *Mahewu* in Ntambanana KwaZulu-Natal South Africa. Ingredients and practices that are scarce in other studies were identified. The ingredients for *Mahewu* are usually estimated to produce enough quantity for the household hence, there is no standard recipe. The traditional practices of making *Mahewu* involve the harvesting of maize, the kernels are taken off from the maize cob, and grinding is done on a flat stone to obtain a *mealie meal* as grinding of maize formed part of the house chores for women, including the girls, in many households. Various communities have diverse ways of fortifying, enhancing, or supplementing their staple foods, that are low in nutrients. In this study, various enhancers for *Mahewu* were reported, which includes the use of Irish potatoes (*Solanum tuberosum*), sugar, and *imbiliso* that is, (an old *Mahewu*, which is saved for future use as a fermentation enhancer) was used. Also, the use of sweet potatoes appeared to improve the nutritional composition, while speeding up the fermentation (*imbiliso* could be acting as starter culture). Also, calabashes, earthen pots, and plastic containers were deemed more appropriate for storing *Mahewu* than the stainless steel or aluminum containers of the contemporaries. The cooking techniques and working time were important factors that could affect the texture and consistency of the finished product (*Mahewu*). Hence, traditional *Mahewu* from own-grown maize was reported to have a distinct refreshing sour taste, which is most appreciated. But information about indigenous practices is scarce and it was apparent that there were variations in the recipes used. If traditional technology of *Mahewu* processing and the heritage of food systems must be retained and passed on to the younger generation, documentation of indigenous practices and processing of food products cannot be overemphasized. This study, therefore, highlighted a standardized recipe for 1L *Mahewu* which was developed in a laboratory setting. Though *Mahewu* can provide nutrients for the consumers, regular consumption, especially as the main food of the day without fruit and vegetables, can expose consumers to hidden hunger.



(micronutrient deficiency) challenges. Dissemination of information on the appropriate utilization of locally available food materials endowed with essential nutrients to enhance food systems is hereby recommended.

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Conflict of Interest: The authors declare that they have no conflict of interest.



Table 1: pH value of the 1-liter Mahewu sample measured in triplicate and the standard deviation

Sample	1	2	3	Average	Standard deviation
Conventional <i>Mahewu</i>	3.56	4.56	4.57	4.56	0.0047



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