THE ROLE OF TRADITIONAL FOODS IN FOOD-BASED DIETARY GUIDELINES - A SOUTH AFRICAN CASE STUDY ON MAAS (CULTURED MILK)

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Highlights:

- We examine food-based dietary guidelines, a policy tool for healthier food choices.
- Food-based dietary guidelines (FBDGs) can improve nutrition and food security.
- We examine the inclusion of traditional food, maas (cultured milk), in SA FBDGs.
- Maas is a nutritious, culturally relevant food in SA.
- Maas can contribute to food and nutrition security in SA.

ABSTRACT

With the revision of the South African food-based dietary guidelines (FBDGs) a new guideline specifically recommending the daily consumption of dairy products including maas (cultured milk) was introduced. This paper aims to evaluate the relevance of including maas as a traditional food product in the FBDGs. It was found that maas is a culturally relevant and traditional food product in South Africa. The nutrient profile of maas has changed notably over time since the first nutrient analysis was performed in 1995. The health benefits of maas, together with its popularity and its cultural relevance as part of the South African diet, make maas a suitable traditional food product to be included in the South African FBDGs.

1. INTRODUCTION

An unhealthy food environment leads to an increased prevalence of unhealthy food choices which in turn result in an increased risk of developing non-communicable diseases (NCDs), which in turn affects both food and nutrition security.

Globally, for many years the focus of the food environment has been on the production of enough inexpensive kilojoules for consumption. The main reason for this was the reoccurring prevalence of hunger and food insecurity over the past few decades (Labadarios, *et al.* 2011). Little emphasis was placed on encouraging variety in the diet, consumption of indigenous, traditional foods or the inclusion of other essential nutrients in the diet (Mozaffarian, 2014).

More recently, a better understanding and appreciation of local and traditional food cultures has emerged. Foods in traditional cultural settings are generally more nutritious and sustainable than those in commercial food markets and the food system in general (FAO, 2013). Studies have found that the inclusion of indigenous and traditional foods in the diet can contribute to public health by addressing the health and well-being of individuals and also the health of communities through the provision of a variety of nutrients in culturally acceptable ways. It also supports sustainability of these communities and society as a whole (Kuhnlein and Receveur, 2007).

Whilst the promotion of adequate energy intake is important for maintenance and growth, the promotion of the intake of nutrient-dense foods, including indigenous foods, that are easily accessible (and acceptable), is also important for reaching both food and nutrition security objectives (FAO, 1993).

1.1 Policy, public health and the food environment

The simplification of the food system over time focused on a limited selection of food commodities, often high in energy and lower in cost to adhere to food security objectives. This could be considered a possible cause for the increase in overweight and obesity statistics observed throughout the western world. This in turn led to an increased incidence of non-communicable diseases (Grundy *et al.,* 2004).

For the purpose of this study, the focus will be on a social policy tool, namely food-based dietary guidelines (FBDGs).

The main goal of FBDGs is to aid in the prevention of the development of nutrition-related diseases using a food-based approach through the inclusion of a variety of different foods acceptable to the specific population to improve nutrient intakes and food choices of consumers, ensuring food and nutrition security for all (FAO, 2012).

The FAO provided guidelines for the development of country-specific FBDGs which included the following guidelines: FBDGs must reflect the nutrition situation of a country; FBDG must use ordinary language that is easy to understand; FBDGs must provide practical advice for local customs, dietary patterns, economic conditions and lifestyles; and must be based on scientific evidence such as accurate and up to date food composition and consumption data. Furthermore, foods included in the guidelines must be affordable and accessible (FAO, 2012).

Implied in these guidelines is thus that there is a need to focus on culturally appropriate foods, traditional cuisines and aim to address undernutrition and the nutrition transition simultaneously (FAO, 1993).

1.2 The role of food composition in food-based dietary guidelines

Sound food composition data is essential to determine the relationship between health and nutrient intakes and also the relationship between nutrients and food. High quality food composition data is instrumental in the development of country-specific FBDGs (Leclercq *et al*., 2001).

Issues pertaining to current food composition databases that also influence the development of country-specific FBDGs include the absence of values for food categories as well as the accuracy of both food consumption and food composition data (Greenfield & Southgate, 2003). Foods and food groups, including traditional and indigenous foods, considered for inclusion in FBDGs must be assessed according to their nutritional composition.

2. SOUTH AFRICAN CASE STUDY: THE ROLE OF MAAS AS PART OF THE SOUTH AFRICAN FBDGs

South Africa (SA) is a middle-income country with a food environment dominated by cheap, palatable, highly energy-dense, nutrient-poor foods (Labadarios *et al*., 2011). The increased intake of these foods is accompanied by a higher incidence of NCDs. The incidence of obesity amongst men and women is estimated at 24.8% and 20.1% respectively. In contrast to the high obesity rates it is estimated that 15.4% of children are stunted (Shisana *et al.,* 2014).

The first set of FBDGs for SA, consisting of 10 guidelines, was published in 2001 (Table 1) and did not include a specific dairy guideline. Milk was at the time included as part of the protein group (Table 1). Vorster *et al*. (2013[1]) indicated that the inclusion of milk as part of the protein group was due to the fact that the FBDGs focused on affordability for the largest part of the population. Another concern for the exclusion of a separate dairy guideline and only the inclusion of milk in the protein group was the possible high incidence of lactose intolerance amongst South Africans (Vorster *et al.,* 2013[1]).

The FBDGs were revised and republished in 2012 (Vorster *et al,* 2013[2]). A guideline focusing on specific dairy products was included (Table 1): The guideline reads: "Have milk, **maas** or yoghurt every day" (Vorster *et al,* 2013[2]). A specific guideline for dairy was included due to the consistent reports of low calcium and potassium intakes and the high prevalence of hypertension and NCDs amongst the South African population.

Reasons for the inclusion of maas in the dairy guideline include a recognition of the fact that it is a traditional food and widely consumed. Furthermore, nutritional benefits were considered. The beneficial health effects of the incorporation of probiotics in fermented milk can play an essential role in improving lipid profiles, the lower pH of fermented milk can delay gastric emptying which can result in appetite regulation, and the low sodium-to-potassium ratio is considered to be beneficial for the prevention of cardiovascular disease and hypertension were recognised (Vorster *et al.,* 2013[1]).

Table 1: Comparison of first set of FBDGs as published in 2001 the revised FBDGs published in 2012 in South Africa (Vorster *et al.*, 2001; Vorster *et al,* 2013[2])

Food Based Dietary Guidelines for South Africa	
First (2001)	**Revised (2012)**
Enjoy a variety of foods	Enjoy a variety of food
Be active!	Be active!
Eat plenty of vegetables and fruits every day	Eat plenty of vegetables and fruits every day
Eat dry beans, peas, lentils and soya regularly	Eat dry beans, split peas, lentils and soya regularly
Chicken, fish, meat, milk or eggs could be eaten daily	Fish, chicken, lean meat or eggs can be eaten daily
Eat fats sparingly	Use fat sparingly; choose vegetable oils rather than hard fats
Use salt sparingly	Use salt and food high in salt sparingly
Eat food and drinks containing sugar sparingly and not between meals	Use sugar and food and drinks high in sugar sparingly
Drink lots of clean safe water	Drink lots of clean, safe water
If you drink alcohol, drink sensibly	
	Make starchy food part of most meals
	Have milk, maas (fermented milk) or yoghurt every day

Since ancient times the fermentation of foods, including dairy, cereals and vegetables, has been used to preserve these foods and to improve their nutritional quality (Panesar, 2011). Maas production is based on the principle of fermentation of full cream cows milk through the activity of naturally occurring or added flora (Beukes *et al.* 2001; Panesar, 2011). The product is thick in consistency, white in colour and contains lumps once adequate fermentation has taken place (Beukes *et al.,* 2001). The traditional preparation of maas consisted of fermenting full cream cows milk in a calabash, clay pot, stone jar or basket (Beukes *et al.*, 2001). There are two commercial methods used for the production of maas - "in-container fermentation" and "tank fermentation". Both methods are based on the addition of a permitted starter culture to milk. The typical starter cultures used to produce commercial maas are mesophilic and include *Lactoococcus lactis* subsp. *lactis*, *Lactococcus lactis* subsp. *cremonis* and *Leuconostoc mesenteroided* subsp. *cremonis* (Beukes *et al.,* 2001). After adequate fermetation has taken placed, the product is packaged and consumed.

Maas is considered to be a part of the South African heritage and regarded as a supplementary staple food. The first scientific record of the traditional production of maas was recorded in 1939 (Beukes *et al.*, 2001). However, maas was part of the indigenous South African diet long before this time, and is considered to have therapeutic and social value to local communities. It generates income and improves food security by enabling the preservation of milk (and thus extending the shelf-life) in this fermented form (Beukes *et al.,* 2001).

However, very little information is available on the cultural importance of this unique product, and the role which this product can play to the diets of South Africans. The aim of the paper was the investigate the relevance of including this traditional food products as part of the SA FBDGs for healthy eating.

The objectives of the case study were:

- To determine the perception and acceptability of maas as a traditional food product as part of the South African diet by investigating consumption patterns.
- To determine an updated nutritional profile of maas and compare it to previously available data.

2.1 Materials and methods

Various techniques were used to gather data for this study. Consumer research, consumer databases and nutritional analysis of maas were utilized to gather information regarding the consumption and nutritional profile of maas.

2.1.1 Consumer information

Consumer and product related databases, Ipsos-Markinor and Target Group Index (TGI), were used to gather data regarding the South African population, specifically focusing on maas consumption patterns and usage. The Ipsos-Markinor study included a random sample of 3500 households from both rural and urban areas. Respondents included in the sample were 16 years and older. All races and geographical areas within South Africa were included. The data was weighted to fit the population profile.

The TGI study is based on consumer insights obtained by interviewing 15 000 adults annually, measuring more than 8 000 brands across 19 sectors in South Africa. The databases were used to determine demographic information including race, age, Living Standards Measure (LSM) and language.

The cross usage of maas with other food products (maize meal porridge and brown bread) reported in the national food consumption survey (Labadarios *et al.,* 1999) was also determined using the TGI database. Furthermore the past use of maas by consumers was also investigated. Data regarding the volumes and number of different brands present in South Africa were also determined using the TGI database.

2.1.2 Focus groups

Focus groups were held to determine maas consumption patterns, usage patterns and preferences amongst women who act as caregivers in rural South African communities. The study population for the focus groups included middle-aged women from lower to middle socio-economic groups from all nine provinces in South Africa who participated in two focus groups (n=15). Each participant ran a community centre that provide care and food for children and/or the elderly together with skills training for other members of the community. Women were chosen as the source of data for this study as they are responsible for the provision of food and also take care of the needs of the people in the community centres.

A qualitative research approach was used and focus group questions were designed. A semi-structured questioning route was followed to ensure consistency across both focus groups and allow for flexibility in accordance with the different discussion topics raised and the level of participation. Questions were aimed at gaining a better understanding of food consumption patterns in the respective communities and also to understand the perception regarding maas in the community.

To help the participants recall the dietary habits of their communities, each was given a document consisting of seven pages, one page per day with 4 columns. The headings of the respective columns on each page included *breakfast*; *morning snack; lunch*; *afternoon snack* and *dinner*. The participants were asked to complete the document, keeping in mind the dietary habits observed in their respective communities over the past month (April/May 2013). Questions regarding the use of maas within the household, the respective consumption habits of maas by the different members of the household, the believed dietary contribution and any health related perspectives on maas were included in the focus group questions.

Transcribed focus group discussions, comments on maas as part of the diet on flip charts, and individual worksheets were all incorporated in the analyticatal process.

2.1.3 Nutritional analysis

Maas samples were sampled over a period of four weeks directly from the manufacturing line of a prominent national maas producers in the country. Each week twelve samples from the beginning, the middle and the end of production were randomly selected and a composite sample of the week's samples was prepared for analysis (Samples 1-4). All samples were refrigerated at 4°C after sampling. During week 4 a composite sample of the samples collected over the four weeks was also prepared (Sample 5). Analyses were performed under controlled conditions using standardized methods.

Proximate, mineral composition and fatty acid profiles were determined. Proximate analysis and fatty acid profiles were determined by the ARC - Irene Analytical Services of the Agricultural Research Council (ARC) according to accredited methods. The mineral composition was determined by the Nutrilab of the Univeristy of Pretoria. In addition, the composite sample was analysed for vitamin A content and sugar profile by SGS laboratory. The proximate analyses of the samples were carried out to determine total moisture (Official method of analyses 935.29, AOAC 2000), fat (Rose-Gottlieg method) (Official method of analysis (AOAC 905.02-1973, AOAC 2000), protein (Kjeldahl method) (Official method of analysis 991.20, AOAC, 2000) and ash (Official method of analysis 986.25, AOAC 2000) (AOAC, 2005). The fatty acid profile was determined using the gas chromatography method of Christopherson and Glass (1969). The fat was extracted and trans-methylated with methanol-potassium hydroxide. Fatty acid methyl esters were extracted with n-hexane and analysed by gas liquid chromatography. The mineral composition samples were prepared for using the official AOAC method 935.13 (AOAC, 2005). Calcium, magnesium, copper, manganese, potassium, sodium, iron and zinc, was determined by using Atomic Spectrophotometry according to an adopted method by Giron (1973). Sample preparation for phosphorus was done using AOAC method 968.08. Ion chromatography was used to determine the mineral content (Official method of analysis 965.17, AOAC 2000)(AOAC, 2005).

An additional analysis was done on the composite sample (sample 5) that included analysis of the sugar profile and vitamin A content. The sugar profile determined included fructose, glucose, galactose, sucrose, maltose, lactose and trehalose, as well the total sugar. High Performance Liquid Chromatography (HPLC) was used to determine the presence and level of the sugars (Official method of analysis 982.14, AOAC 2000)(AOAC, 2005). The vitamin A level was determined by HPLC and UV detection (Hulshof, 2002).

Results were also compared with results from a study on maas composition done in 1995. The maas data is currently included in the Medical Research Food Composition tables based on the data from 1995. The 1995 study included 100 samples from 5 different geographical regions in SA (20 from each region). Nutrients analysed in 1995 and compared with 2014 data include protein, fat, ash, moisture, calcium, phosphorus, potassium, sodium and fatty acids (C8:0; C10:0; C12:0; C14:0; C14:1; C16:0; C16:1; C18:0 and C20:0). The 1995 and 2014 samples were anlyses by the same lab following normal lab practices. Proficiency testing was done to ensure that the results are comparable.

2.1.4 *Statistical analysis*

Nutrient data obtained from analysis was entered on a spreadsheet using Microsoft Excel (2013). The data was statistically analysed using Genstat for Windows 2003. The significance of all the variables measured for proximate analysis and fatty acid analysis for each sample was tested using analysis of variance (ANOVA). Data was also compared with the data previously measured and currently tabulated for South African maas products in the official Medical Research Council (MRC) Food Composition tables.

2.2 Results & discussion

2.2.1 *The role of maas in the typical South African diet*

The most popular dairy products in the dairy market, as identified by the Ipsos-Markinor (2014) study are fresh full cream milk, maas, regular yoghurt, gouda/cheddar cheese and Long Life (UHT) milk. Maas is part of the dairy category in SA and comprised 5% of the total liquid dairy category for the period of 2013-2014 (LACTODATA, 2014). There were about 80 maas brands available in SA at the time of publication of this study.

Consumer data from the 2014 TGI database indicated that two thirds (67%) of South African households consumed maas. TGI reported that 82.4% of maas consumers in SA were reported to be black and speak indigenous South African languages (TGI, 2014).

The Ipsos-Markinor study (2014) indicated that 90% of maas consumers were black. The average age of maas consumers according to the consumer database of TGI (2014) was between 24 and 35 years of age. The majority of maas consumers (30%) are between the ages of 35-49 years, with only 23% of maas consumers aged between 23-34 years. In terms of Living Standards Measure (LSM) distribution, the majority of maas consumers were between LSM 1 and 5, thus from the lower to the lowest socio-economic groups (Markinor, 2014).

The results indicate that 45.9% of maas consumers have dependent children living with them in the house (TGI, 2014). Amost 50% of the households consumed maas with maize porridge (Ipsos-Markinor, 2014). 91% of respondents in the Ipsos-Markinor (2014) survey indicated that maas is a suitable food product for the whole family. Furthermore, 60% of respondents also indicated that maas is good for growing children.

Focus group participants also indicated that maas is regarded as a healthy food product for children and as a snack for adults. 72% of respondents also indicated that they regard maas as a treat or a reward food (Ipsos-Markinor, 2014). Maas is however regarded as an adequate meal replacement for the household when meat stores are low (Ipsos-Markinor, 2014; Focus group research, 2013). This was confirmed by focus group respondents who reported that maas is given to the children in the household together with maize porridge or brown bread when meat stores are low.

The Ipsos-Markinor study indicated that 87% of dairy consumers viewed maas as a product that they grew up with. Focus group respondents confirmed this by indicating that maas had been part of their households for as long as they could remember.

It was also reported that 15% of maas consumers have maas more than once a week and at least 16% have it at least once a week. The incidence of maas consumption as reported by TGI (2014) ranged from 10.3% of households consuming maas at least once a day to 13.8% of households indicating that they consume maas at least once a week (Ipsos-Markinor, 2014). 87% of the maas consumers included in the sample always have maas in the house. Focus group participants indicated that maas was part of the monthly shopping basket. It can be concluded that maas is part of the heritage of the food culture of the majority of South African dairy consumers. The demographic profile of maas consumers and consumption patterns of maas by South African consumers indicated that maas is a culturally relevant food.

2.2.2 Nutritient composition of maas

Maas is produced from milk which is regarded as a good source of animal protein. The nutritional analysis of maas (Table 2) revealed the protein content of maas to be 3.34g/100g. Currently it is similar to that measured in 1995 and remains within the parameters set by the dairy regulations (R2581) (Table 6). Maas, as an animal source of protein, adheres to the criteria stipulated in legislation (R146, 2010) to be classified as a good source of protein. Maas contributes to the regular consumption of complete proteins in households where maas is served with brown bread or maize porridge. The intake of a complete protein source is essential to the growth and development of children in the household (Vorster *et al.,* 2014).

No significant differences in the fat content of maas were observed in the current data (Table 2). There was however a difference observed in the unsaturated and saturated fatty acid content. Saturated fat (2.2g/100g) was significantly higher, ($p \leq 0.05$) than the unsaturated fatty acids (1.03g/100g) (Table 4). Regulations (R146) stipulate that to make a “low in saturated fat” claim the product may contain no more than 1.5g of saturated fat per 100g. Maas will, therefore, not qualify for this claim nor for any content claims (e.g. “source of polyunsaturated fatty acids”) regarding unsaturated fatty acids.

It is however, important to note that in the lower socio-economic groups in SA, fat is a good energy source in the diet. 2.9% of children in SA are wasted (Sishana *et al.,* 2014). The fat content and associated energy (kJ) delivered from maas can play an essential role in increasing the energy intake of wasted children in SA. This should be investigated in terms of a weaning food for children as it is a culturally relevant food.

Significant differences in fatty acid content of maas were observed over the four week period during which samples were taken and analysed, with the exception of eicosapentanoic acid (EPA) (Table 3 and 4). Possible reasons for the variation in fatty acid content could be the source of milk used to make the different batches. As a generic agricultural commodity, variation in the composition of raw milk is observed due to breed, feed, climate and seasonal variation (Laben, 1963). This once again illustrates why it is important to sample the same product over a period of time, in order to be able to obtain reliable representative mean data.

Differences in total fat and fatty acid content were also observed between the 1995 data and current data. Current values are lower in total fat content compared to the 1995 values (Table 6). No change in the legislation (R2581) regulating the fat content of maas has occurred since 1995. Possible reasons for this might be similar to the reasons for variation that occurred over time in the current data. Natural variation occurs in dairy products due to changes in climate, breed of cow, season, region, etc. and it is therefore important to confirm the nutritional composition of dairy products on a regular basis (Laben, 1963). This would also contribute to the accuracy of nutrient intake data when it is based on nutrition composition data (Greenfield and Southgate, 2003).

A regulatory alignment of maas from a composition perspective was observed. Regulations pertaining to the addition of additives to foodstuffs prohibit the use of additives in maas, protecting the integrity and natural composition of the product. Furthermore, a notably lower sodium content was found in the current data compared to previous recorded values, which is a positive product attribute (Table 7), especially considering that 10.2% of South Africans suffer from hypertension (Shisana *et al.,* 2014). Due to this high incidence, regulations (R214) governing the salt content of food products were published in 2013 with the aim of lowering the salt intake of South Africans. Maas is not included in these regulations as these regulations are more focused on processed foods, however, in the light of the high hypertension incidence, lower sodium levels in any highly consumed food product may contribute to lowering sodium intakes.

Table 6 shows the mineral content of the maas samples tested over a 4 week period. The minerals are all present at 10% or lower of the prescribed Nutrient Reference Value (NRV) (R146, 2010). The calcium content is the highest at 123mg per 100g product (Table 6). Although currently lower than previously recorded (Table 6) calcium is still present at 9.5% of the NRV per 100g product. Serving sizes recommended on the packaging (250g) increase this amount to 23.7% of the NRV. Potassium and phosphorus content is also lower than previously recorded, while magnesium content was higher than previously recorded (Table 6). The natural variation of milk used for the production of maas analysed in 2014 and 1995 was probably different, and may be cited as a possible reason for the change in mineral content.

From a microbiological perspective the incorporation of probiotics into fermented milk (maas) has shown to have beneficial health effects especially on lipid profiles (Buttriss, 1997; Schelnbach, 1998). Schelnbach (1998) found that fermented milk can help delay gastric emptying due to its low pH. The delay in gastric emptying may also be beneficial for glycemic responses, industry has complied relatively well with the new labelling regulations, as well as appetite regulation. In the view of the high incidence of lactose intolerance, reported in African populations, including in SA, this may to some extent explain why maas remains a popular traditional food.

Lactose intolerance has been shown to be common amongst people from South-East Asia, the Middle East and some parts of Africa. Research has however shown that the intake of milk and dairy can be better tolerated if fermented dairy products or hard cheeses are consumed (Buttriss, 1997). The health benefits of maas, the prevalence of maas consumption and the cultural heritage of maas thus made it a viable food product for inclusion in the FBDGs of SA (Vorster et al., 2013[1]).

Table 2: Proximate analysis of maas (per 100g)

Nutrient	Unit	Week 1	Week 2	Week 3	Week 4	Composite sample	p-value
Energy	kJ	-	-	-	-	236	-
Protein	g ± SD	3.29 ±0.0353	3.29 ±0.0353	3.22 ±0.0141	3.29 ±0.0354	3.22 ±0.0212	0.122
Ash	g ± SD	0.69[ab] ±0.00	0.725[b] ±0.00707	0.7 ±0.00	0.705[ab] ±0.0212	0.68[a] ±0.00	0.041
Dry Matter	g ± SD	11.3[ab] ±0.00	11.9[c] ±0.00	11.0[c] ±0.0212	11.6[bc] ±0.311	11.23[ab] ±0.00707	0.007
Total sugar	g	-	-	-	-	3,57	-
Fructose	g	-	-	-	-	0	-
Glucose	g	-	-	-	-	0	-
Galactose	g	-	-	-	-	0	-
Sucrose	g	-	-	-	-	0	-
Maltose	g	-	-	-	-	0	-
Lactose	g	-	-	-	-	3.57	-
Trehalose	g	-	-	-	-	0	-
Fat	g ±SD	3.27 ±0.0201	3.67 ±0.0212	3.24 ±0.00707	3.24 ±0.0141	3.25 ±0.00	0.291

[*a,b,c] Means in the same row with different superscripts differ significantly

Table 3: Fatty acid analyses of maas (per 100g)

Nutrient	Unit	Week 1	Week 2	Week 3	Week 4	Composite sample	p-value
C8:0	g ± SD	0.0241[c] ±0.0000952	0.0138[a] ±0.000276	0.019[b] ±0.00	0.38[d] ±0.00	0.0185[b] ±0.000707	p<0.001
C10:0	g ± SD	0.0781[b] ±0.00016	0.0572[a] ±0.000315	0.086[c] ±0.00	0.106[d] ±0.00	0.0815[bc] ±0.00354	p<0.001
C11:0	g ± SD	0.00180[b] ±0.000273	0.00102[a] ±0.000038 8	0.002[b] ±0.00	0.002[b] ±0.00	0.002[b] ±0.00	p=0.002
C12:0	g ± SD	0.107[b] ±0.000309	0.076[a] ±0.000066 7	0.129[d] ±0.00	0.137[e] ±0.00	0.116[c] ±0.00424	p<0.001
C13:0	g ± SD	0.00297[b] ±0.0000405	0.00203[a] ±0.000046 7	0.003[b] ±0.00	0.004[c] ±0.00	0.003[b] ±0.00	p<0.001
C14:0	g ± SD	0.385[b] ±0.000244	0.263[a] ±0.000267	0.404[bc] ±0.00	0.419[b] ±0.00	0.388[c] ±0.0141	p<0.001
C14:1	g ± SD	0.0351[b] ±0.000138	0.0241[a] ±0.000176	0.035[b] ±0.00	0.038[c] ±0.00	0.035[b] ±0.00141	p<0.001
C15:0	g ± SD	0.0388[b] ±0.000224	0.027[a] ±0.000037 2	0.038[b] ±0.00	0.038[b] ±0.00	0.037[b] ±0.00141	p<0.001
C15:1	g ± SD	0.00890[b] ±0.000139	0.00610[a] ±0.00015	0.009[b] ±0.00	0.009[b] ±0.00	0.0085[b] ±0.000707	p<0.001
C16:0	g ± SD	1.091[b] ±0.000336	0.842[a] ±0.000262	1.07[b] ±0.00	1.14[b] ±0.00	1.08[b] ±0.0389	p<0.001
C16:1	g ± SD	0.054[cd] ±0.000042	0.0388[a] ±0.000349	0.051[b] ±0.00	0.056[d] ±0.00	0.052[bc] ±0.00141	p<0.001

Nutrient	Unit	Week 1	Week 2	Week 3	Week 4	Composite sample	p-value
C17:0	g ± SD	0.0279[d] ±0.000136	0.01925[a] ±0.000351	0.027[cd] ±0.00	0.023[b] ±0.00	0.025[d] ±0.00141	p<0.001
C17:1	g ± SD	0.000137 ±0.000193	0.0000965 ±0.000136	0.00	0.00	0.0045 ±0.00636	p=0.496
C18:0	g ± SD	0.42[c] ±0.000042	0.385[b] ±0.000344	0.406[bc] ±0.00	0.358[a] ±0.00	0.39[b] ±0.0141	p=0.001
C18:1n9t	g ± SD	0.00	0.00	0.00	0.00	0.00	
C18:1n9c	g ± SD	0.902[c] ±0.000068	1.20[d] ±0.000296	0.843[b] ±0.00	0.766[a] ±0.00	0.828[b] ±0.0304	p<0.001
C18:2n6t	g ± SD	0.0152[b]c ±0.00026	0.011[a] ±0.000053	0.017[d] ±0.00	0.014[b] ±0.00	0.0155[c] ±0.000707	p<0.001
C18:2n6c	g ± SD	0.0558[a] ±0.000239	0.239[d] ±0.0000544	0.056[ab] ±0.00	0.062[c] ±0.00	0.0595[bc]± 0.00212	p<0.001
C18:3n6	g ± SD	0.00103 ±0.00004	0.00023 ±0.00033	0.001 ±0.00	0.001 ±0.00	0.078 ±0.109	p=0.484
C18:3n3	g ± SD	0.0118[a] ±0.000277	0.0118[a] ±0.000284	0.014[b] ±0.00	0.014[b] ±0.00	0.0135[b] ±0.000707	p=0.003
C20:0	g ± SD	0.00689[a] ±0.000154	0.0179[b] ±0.000185	0.007[a] ±0.00	0.006[a] ±0.00	0.0065[a] ±0.000707	p<0.001
C20:1	g ± SD	0.00113[a] ±0.000184	0.009241[c] ±0.000341	0.001[a] ±0.00	0.001[a] ±0.00	0.002[b] ±0.00	p<0.001
C20:2	g ± SD	0.000793[bc] ±0.000292	0.000245[ab] ±0.000346	0.00[a] ±0.00	0.001[c] ±0.00	0.001[c] ±0.00	p=0.013
C21:0	g ± SD	0.000996 ±0.00000532	0.000944 ±0.0000799	0.00 1±0.00	0.001 ±0.00	0.001 ±0.00	p=0.499
C20:3n6	g ± SD	0.00222[a] ±0.000309	0.00175[a] ±0.000352	0.002[a] ±0.00	0.003[b] ±0.00	0.002[a] ±0.00	p=0.0012
C20:4n6	g ± SD	0.000106[a] ±0.000149	0.0000781[a] ±0.000111	0.00[a] ±0.00	0.02[b] ±0.00	0.00[a] ±0.00	p<0.001
C20:3n3	g ± SD	0.00	0.00	0.00	0.00	0.00	
C22:0	g ± SD	0.00279[b] ±0.000294	0.00593[c]± 0.0000973	0.002[a] ±0.00	0.002[a] ±0.00	0.002[a] ±0.00	p<0.001
C20:5n3	g ± SD	0.00192± 0.00011	0.000933± 0.0000945	0.001± 0.00	0.001± 0.00	0.0015± 0.000707	p=0.099
C22:1n9	g ± SD	0.000125± 0.000177	0.000229± 0.000323	0.00	0.00	0.00	p=0.579

Nutrient	Unit	Week 1	Week 2	Week 3	Week 4	Composite sample	p-value
C22:2	g ± SD	0.000939 ±0.0000864	0.000905 ±0.000135	0.001 ±0.00	0.001 ±0.00	0.001 ±0.00	p=0.587
C23:0	g ± SD	0.00	0.00	0.00	0.00	0.00	
C24:0	g ± SD	0.001149^{a} ±0.000211	0.00309^{b} ±0.000110	0.001^{a} ±0.00	0.001^{a} ±0.00	0.001^{a} ±0.00	p<0.001
C24:1	g ± SD	0.000071^{a} ±0.0001	0.000846^{b} ±0.000218	0.002^{c} ±0.00	0.002^{c} ±0.00	0.002^{c} ±0.00	p<0.001
C22:6n3	g ± SD	0.00	0.00	0.00	0.00	0.00	

^{*a,b,c} Means in the same row with different superscripts differ significantly

Table 4: Summary of fatty acid groups for maas (per 100g)

Nutrient	Unit	Week 1	Week 2	Week 3	Week 4	Composite sample	p-value
Saturated fatty acids	g ± SD	2.19^{b} ±0.00	1.71^{a} ±0.000077	2.20^{b} ±0.00	2.25^{b} ±0.0347	2.20^{b} ±0.00	p<0.001
Mono Unsaturated fatty acids	g ± SD	1.00^{b} ±0.00	1.28^{c} ±0.000264	0.942^{a} ±0.00	0.897^{a} ±0.0354	0.951^{b} ±0.00	p<0.001
Poly Unsaturated fatty acids	g ± SD	0.074^{a} ±0.00	0.255^{d} ±0.000135	0.075^{a} ±0.00	0.085^{c} ±0.000707	0.082^{b} ±0.00	p<0.001
Trans fatty acids	g ± SD	0.015^{bc} ±0.00	0.011^{a} ±0.000053	0.017^{c} ±0.00	0.013^{ab} ±0.00141	0.016^{c} ±0.00	p=0.001
Cis fatty acids	g ± SD	0.958^{c} ±0.00	1.44^{d} ±0.00035	0.899^{ab} ±0.00	0.851^{a} ±0.0332	0.91^{bc} ±0.00	p<0.001
Omega 3 fatty acids	g ± SD	0.013^{a} ±0.00	0.0122^{a} ±0.000329	0.015^{b} ±0.00	0.0155^{b} ±0.000707	0.015^{b} ±0.00	p<0.001
Omega 6 fatty acids	g ± SD	0.075^{a} ±0.00	0.252^{c} ±0.00002	0.075^{a} ±0.00	0.081^{b} ±0.001414	0.081^{b} ±0.00	p<0.001
Omega 9 fatty acids	g ± SD	0.902^{c} ±0.00	1.20^{d} ±0.000027	0.843^{b} ±0.00	0.789^{a} ±0.0325	0.0849^{bc} ±0.00	p<0.001
EPA C20:5n3	g ± SD	0.002 ±0.00	0.000933 ±0.0000945	0.001 ±0.00	0.0015 ±0.000707	0.002 ±0.00	p=0.05
DHA C22:6n3	g ± SD	0.00	0.00	0.00	0.00	0.00	-

^{*a,b,c} Means in the same row with different superscripts differ significantly

Table 5: Mineral analysis of maas (per 100g)

Nutrient	Unit	Week 1	Week 2	Week 3	Week 4	Composite sample
Calcium	mg	140	130	130	140	123
Phosphorus	mg	90	90	90	90	87.6
Magnesium	mg	20	17	18	20	18.5
Copper	mg	0.019	0.019	0.0197	0.026	0.0247
Iron	mg	0.231	0.197	0.21	0.211	0.0204
Manganese	mg	0.041	0.043	0.038	0.034	0.0383
Zinc	mg	0.456	0.311	0.467	0.524	0.0513
Potassium	g	0.16	0.15	0.17	0.17	0.163
Sodium	mg	47	45	43	40	38.3
Selenium	mcg	2.73	2.05	2.09	2.11	2.08
Vitamin A	mcg	-	-	-	-	26.9

[*a,b,c] Means in the same row with different superscripts differ significantly

Table 6: Comparison of data from 1995 and the current study

Nutrient	Unit	Current study	1995	
		Average	**Average**	**SD**
Protein	g	3.22	3.3	±0.228
Ash	%	0.680	0.683	±0.182
Moisture	%	89.8	87.7	±0.808
Fat	g	3.25	3.62	±0.542
Fatty acid profile:				
C8:0	g	0.0185	0.0033	±0.00363
C10:0	g	0.0185	0.997	±0.173
C12:0	g	0.116	0.118	±0.0217
C14:0	g	0.338	0.394	±0.0808
C14:1	g	0.0350	0.0332	±0.00459
C16:0	g	1.08	1.02	±0.184
C16:1	g	0.0520	0.0393	±0.00581
C18:0	g	0.390	0.436	±0.0743
C20:0	g	0.0065	0.0158	±0.00633
Minerals				
Calcium	mg	123	162	±28.4
Phosphorus	mg	90.0	92.9	±28.4
Magnesium	mg	20.0	14.3	±2.26
Potassium	g	160	190	±9.52
Sodium	mg	47.0	56.7	±32.6

3. CONCLUSIONS AND RECOMMENDATIONS

A separate dietary guideline for dairy products was included in the revised South African FBDGs in 2012, which read: “have milk, maas or yoghurt every day”. This guideline stresses the importance of the inclusion of dairy in a prudent diet, and includes specific mention of a traditional, unique cultured milk product, namely maas. As nutrient considerations become increasingly important, the importance of diversity and variety in human diets are more often being highlighted. The inclusion of culturally relevant and traditional foods in policies and programmes such as FBDGs could improve the consumption of healthier foods that meet dietary requirements. The nutritional profile of such traditional foods should, therefore, also be considered.

The study showed that maas is a food product considered to be healthy by South Africans and that it is commonly consumed as part of the South African diet. Food composition data further indicates that the nutritional profile and health benefits associated with maas may have changed over time, but that it remains a source of protein, energy and important minerals. The consumption of maas is very likely to continue in future because it forms part of the traditional South African diet. As a nutrient-dense, culturally relevant food, it is rightfully included in the South African FBDGs and can potentially promote food and nutrition security.

The change in nutrient profile of maas serves as evidence that food composition may vary over time. Further research relating to the nutrient analysis of other food products included in the FBDGs is suggested to ensure that the revised FBDGs are based on timely, scientific evidence, relevant to the South African population to successfully promote food and nutrition security.

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