# THE SOCIOECONOMIC BENEFITS, PRODUCTION AND CONSUMPTION STATISTICS OF MAGWINYA IN LIMPOPO PROVINCE, SOUTH AFRICA

## Onipe OO[1], Beswa D[2], and Jideani AIO[1*]

*Corresponding author email: Afam.Jideani@univen.ac.za
ORCID ID: https://orcid.org/0000-0002-9122-8697

Oluwatoyin O. Onipe https://orcid.org/0000-0003-3691-7040
Daniso Beswa: https://orcid.org/0000-0003-2277-9046

[1]Department of Food Science and Technology, School of Agriculture, University of Venda P/Bag X5050, Thohoyandou 0950. Limpopo Province, South Africa

[2]Department of Life and Consumer Sciences, School of Agriculture and Life Sciences, University of South Africa, P/Bag X6, Florida 1710, Gauteng Province, South Africa

**ABSTRACT**

*Magwinya*, a cereal fried dough, is a popular traditional snack widely consumed across various ethnic groups in sub-Saharan Africa, but little is known about its production and consumption in a scholarly context. It is against this background that the survey was carried out. This study examined production process, ingredient formulation, sales, characteristics and consumption of *magwinya* in Thohoyandou (South Africa), with the aim of developing a healthier form of *magwinya*. Out of the 30 *magwinya* production sites visited and 650 consumer questionnaires distributed, data were obtained from 29 sites and 634 consumers: a response rate of 97% and 98%, respectively was realized. Results revealed details on formulation, ingredients, processing methods, sales, consumption patterns and consumer preference of *magwinya*; and proposed considerations for development of a healthier *magwinya*. Cake wheat flour (55%) was the main ingredient used. Production process was non-automated as evidenced by manual mixing and fermentation processes (93%), coupled with low usage of electronic equipment (14%). With a daily turnover between ZAR500 – ZAR3000 ($35 - $210), there is a need to improve *magwinya* production through an automated production line, especially for large-scale producers of this product. The daily turnover indicated that *magwinya* production is a lucrative business contributing immensely to the livelihoods of, and financially empowering the producers, who were females (100%). Consumer data revealed *magwinya* to be a moderately liked food (46%) consumed at least twice a week (32%), as either a snack or main meal; with taste as the most favoured characteristic (79%). About 93% of consumers fell within <20 and 21-30 age groups. A greater percentage of consumers (75%) disliked the oiliness of *magwinya*; and with increasing awareness of the health implications of frequent consumption of fried foods; 87% of consumers affirmed purchase of low-fat *magwinya* if made available. Development of low-fat, nutrient-rich *magwinya* is therefore recommended to offer consumers a healthier variety.

**Key words**: *Magwinya*, *vetkoek, magwinya* production, South African cereal fried dough, low-fat *magwinya*, fried cereal snack

## INTRODUCTION

Surveys have been carried out on food processing [1] and food purchasing/consumption practices in relation to nutrition and health [2-7]. Data obtained from food consumption surveys can be an effective tool in the development and management of policies, formulation of strategies to ensure healthy food practices, boost food security, as well as having surveillance on nutrition [2, 8].

*Magwinya* also known as 'fat cakes or '*vetkoek*' in the Southern African region, is a deep-fried wheat dough and a popular traditional food in Africa [9-13]. It is usually sold by vendors on street corners [14], in high school tuck shops [8, 15] and university cafeterias. It has different nomenclature in other sub-Saharan African countries. For instance, it is called *puff puff* in Nigeria, *bofrot* in Ghana, *beinye* in Cameroon, *mandasi* in Malawi, *mikate* in Congo, *kala* in Liberia [16]. *Magwinya* can be eaten plain or with sweet/ savoury fillings such as cheese, curry, minced beef, snoek fish, jam, butter, polony, and/or *boerewors*. *Magwinya* is high in fat, sodium, calories and low in fibre [5, 15], and consumed by various age groups. According to Mamabolo *et al*. [17], *magwinya* was reported as one of the thirty major foods consumed by children aged 3 years. Furthermore, Kearney *et al*. [15] developed nutrient-rich *vetkoek* as a school feeding project for children between the ages of 6 – 13 years.

Production of *magwinya* begins with mixing of the ingredients -wheat flour, yeast, sugar, salt and water; followed by fermentation of the dough, extrusion or cutting (based on the consistency of the dough) into desired shape and finally frying until golden brown [18]. Processing of *magwinya* is mostly manual - this includes mixing and piping the dough into the oil with hands. Preparation method and recipe is usually at the discretion of the producer, thereby, leaving the method un-standardised. There are few available scholarly articles on *magwinya* processing and consumption, with the available ones focusing on oil uptake reduction through optimisation of processing conditions and product formulation using wheat bran [16], psyllium husk fibre and oat bran [18], which improved nutritional quality of *magwinya*. However, there are no scholarly articles on *magwinya* production and consumption in South Africa. Therefore, this study was carried out to generate data and provide information on *magwinya* processing, sales, and consumption. The data would be useful in policy decisions, food consumption statistics and further research on *magwinya.*

## MATERIALS AND METHODS

### *Sample population and survey area*
The survey was carried out over a period of 4 months in Thohoyandou – the town with the largest population (> 64 000) in Vhembe District, of Limpopo Province, (South Africa). Thohoyandou was selected for the following reasons: (a) it has the largest population in the district; (b) the institution of this study is situated there; and (c) it has a diverse population as a result of University – a centre of attraction for people of various ethnicity, language and nationalities. Using street addresses recovered from Google maps, the sampling sites were re-categorised into 8 locations and coded as follows: (1) UVR, (2) PW, (3) PE, (4) BF, (5) VCR (6) CP, (7) VSR; and (8) SH. Thirty production

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sites were purposefully selected as representative of the major streets in Thohoyandou. Out of the 30 *magwinya* production sites sampled, one producer was unavailable for interview. Thus, data were obtained from 29 sites yielding a response rate of 97%. The 29 producers interviewed were pooled from the locations as follows: 13 at SH, 7 at UVR, 3 at PW, 2 at PE and 1 each at BF, VCR, CP and VSR (Table 1). These sites included major and minor streets, supermarkets, high school tuck shops, and university cafeteria. Consumers (650) were purposefully selected around the production sites where *magwinya* is produced and sold. This was done in order to capture the consumers in the vicinity of the producers sampled.

### Questionnaires

Two pre-tested structured questionnaires were developed to target producers and consumers, respectively. The production questionnaires were administered in the form of interviews in the local language, as majority of the producers had little or no formal education and only speak the local language. Information sourced from *magwinya* producers were demography (gender, age, level of education, employment, and location), production process (ingredients, measurement, mixing mode, fermentation, frying time and use of electronic equipment) as well as sales of *magwinya*. A self-administered questionnaire was given to consumers and it entailed questions pertaining to demographic information, consumption pattern, purchase habit and favourite characteristics of *magwinya*. A total of six hundred and fifty (650) consumer questionnaires were distributed. The Research Ethics Committee of the University of Venda (project number: SARDF/17/FST/03) approved this study.

### Data analysis

Data extracted from questionnaires were analysed by descriptive statistics, cross tabulations and presented as frequencies and percentages using SPSS version 24 (IBM Inc., Chicago, IL). Kruskal-Wallis non-parametric one-way analysis of variance was used for test of significance of the data among the producers [19]. Pearson's Chi square test of independence was used to measure the relationships between consumer data across age groups.

## RESULTS AND DISCUSSION

### Demography of Producers and Consumers
### Producers

All producers were females (100%); this implies that *magwinya* production is a women-dominated business/ trade. Four age groups (in years) were captured and ranked in the following order: 51 – 60 > 41 – 50 > 31 – 40 > 61+ with age group 51 – 60 at the highest (37.9%) and 61+ years the least (10.3%). Over half (62.1%) of the producers were without formal education; this evidently affected collection of specific information in terms of measurements, and flour-*magwinya* ratio output per day. In terms of production experience, 48.3% had above 15 years' experience while only 3.4% had less than 1-year experience. There were significant differences ($p < 0.05$) among the responses in each demographic parameter. Omemu and Aderoju [20] reported up to 20-year experience amongst street food vendors in Abeokuta, Nigeria.

### Consumers

From a total of 650 questionnaires administered to consumers, 634 (275 males and 359 females) were recovered – a response rate of 98% (Table 1). The age group of the respondents ranged from <20 to above 60 years. The highest consumption percentage was found among age group 21 – 30 at 49.2%. Six locations were covered including UVR (67.5%), SH (25.6%), PW (3.3%), VSR (1.4%), PE (1.3%), and BF (0.9%). Overall, 89.3% were high school and university students, 42.9% had Grade 12 qualification and 7.6% had a postgraduate qualification. This implies that *magwinya* consumption is popular amongst school learners. *Magwinya* is a common delicacy, among students because it is an affordable, ready-to-eat food which requires no further preparation by the consumer. This is evidenced by long queues at University cafeterias, high schools and other retail outlets in the mornings and lunchtime. In the process of developing a nutrient-dense food product for a primary school feeding project, *vetkoek* was chosen because it was classified as a food frequently consumed in the community [15].

### *Magwinya* production process

In this study, 79.3% (Table 2) learned *magwinya* production at home and the distribution of this response significantly ($p < 0.05$) varied from 4.3% at VCR and PE to 30.4% at UVR and 47.8% at SH. The results showed that cake flour is the most significantly used type of flour (55.2%), followed by bread flour (34.5%) while only a handful of producers use a mixture of both (10.3%). It is evident from this survey that the use of non-wheat flour is non-existent. About 96.6% of producers use a form of measurement which includes cup (69%), weighing scale (10.3%) and 20.7% instinctively to measure their ingredients, which can be attributed to several years of experience as confirmed by a high percentage (66.4%) of producers with over 15 years production experience. This makes the process a motor memory, and as such they require no measurement tool. *Magwinya* is basically produced from wheat flour, sugar, yeast, salt and water in varying proportions among producers. Other ingredients like margarine, coffee creamer, eggs, and baking powder are added by a few producers to distinguish the taste of their product from others. Some producers use a combination of two or three of the listed ingredients. A significantly greater proportion of producers (93.1%) mixed their *magwinya* dough manually (by hand); while, the use of electric mixer falls on the lower side (6.9%). This reveals that manual mixing is predominant in *magwinya* production, even at big stores that use up to 25 kg of flour daily. Dough fermentation time differs from one producer to another; and it significantly ($p < 0.001$) ranged from ≤30 min to overnight (48.3%).

Out of producers that fermented overnight, 71.4% have >15 yr production experience and fall within ages 31 – 60 years. This implies that overnight fermentation seems to be a long-standing method. Fermentation is largely carried out on countertop (93.1%), while 6.9% make use of electric proofer. When asked about duration of the frying process, some producers had no idea, or had never timed the process. This is evidenced by number of producers (44.9%) who fry the dough 'until brown' as they could not give an approximate frying time. The others ranged from < 10 min to 'over 20 min'. The frying time is also dependent on the *magwinya* size. It takes about <10 min, 10 min and over 15 min for small, medium and large sizes of *magwinya* to be cooked, respectively. The shape of *magwinya* was predominantly round, at 93.1% (Figure 1), while only a few were flat-

shaped (6.9%). On the use of any electronic equipment, 13.8% responded 'yes' while 86.2% said 'no'. The equipment used in *magwinya* production included dough cutter, proofer and deep fryer. Of the 29 sites visited, only one location had an automated *magwinya* production line. This commences with mixing of dough with a dough mixer, followed by fermentation in a proofer, and then cutting into shapes with a dough cutter and finally cooking in a deep fryer. A research gap needs to be filled through the development of *magwinya*-production machine that can mix, proof and fry all in one unit. Moreover, most large-scale producers interviewed commented that if a production machine is available, they will opt for it in place of manual method of production. We, therefore, recommend the development of a *magwinya* production machine.

### *Magwinya* sales

The price of *magwinya* in the survey area depends on its size. The pricing varies from ZAR0.50 – ZAR0.90 ($0.07) for small *magwinya,* ZAR1.00 – ZAR2.00 ($0.14) for medium, and ZAR2.50 – ZAR3.00 ($0.20) for large *magwinya*. Due to the lack of a standardized equipment, *magwinya* yield per kg of flour varied from one producer to the other. The number of *magwinya* pieces per kg of flour made by producers is presented in Figure 2. Six producers made about 11 – 20 *magwinya* pieces (ranging from medium to large size) per kg of flour; while only one producer made over 50 small *magwinya* pieces per kg of flour. The variation in yield may be linked to processing losses and *magwinya* size differences. The information obtained from 24 producers, revealed that 17 make a daily turnover of ZAR500.00 ($35); 5 make between ZAR500.00 – ZAR1000.00 ($35 – $70) per day; and each one makes between ZAR2000.00 – ZAR3000.00 ($140 – $210) per day (Figure 3).
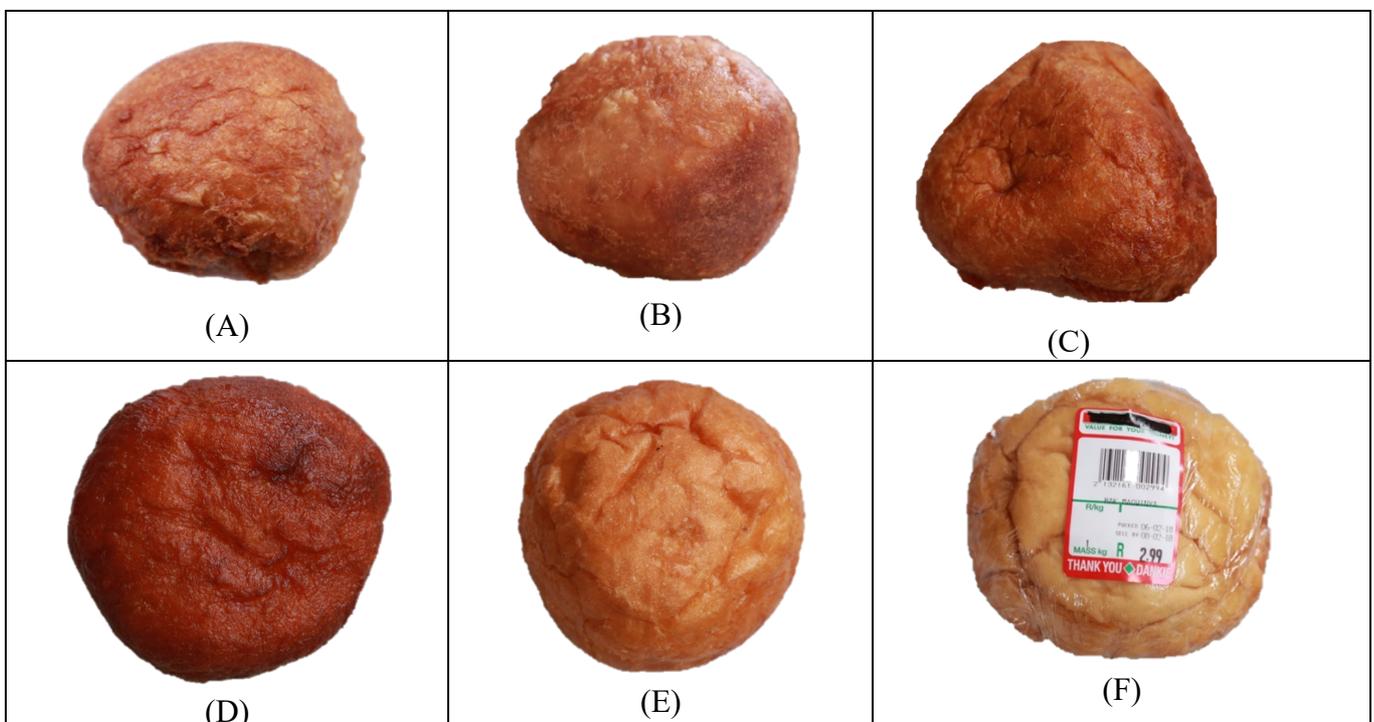


**Figure 1: Large sized round (A, B, C) and flat (D, E, F) *magwinya* from different locations (Image:1080x720 pixels)**

According to producers, *magwinya* production is a lucrative small-scale business which has empowered and sustained their livelihoods, and in turn participated in the economic growth of South Africa. Some of the roadside and school market producers commented that it is a good source of revenue for them, from which they have built houses, bought cars and raised their children. About 69% produce from Monday to Friday, most especially producers in high school tuck shops {13.8%} on Monday to Saturday (supermarkets and roadside vendors); and 17.2% everyday (supermarkets, University cafeterias and roadside vendors). A greater percentage of producers (82.8%) report peak sales in the morning (Table 3) because quite a number of consumers, especially students take *magwinya* for breakfast.
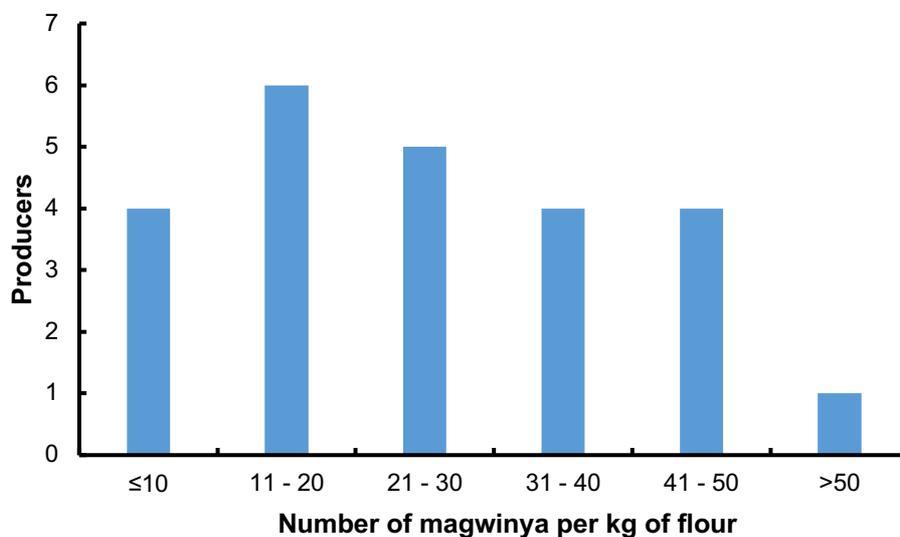


**Figure 2: Number of *magwinya* per kg of flour by producers in Thohoyandou area (n = 24)**

Overall, 86.2% of producers met their daily sales target; while 79.3% answered 'yes' to after-sale demand (Table 3). However, the after-sale demand did not necessarily compel producers to make more *magwinya,* due to a number of factors like inadequate manpower (29.2%), financial constraints (33.3%), tiredness (16.7%), production of other snacks (8.3%), and time limit (12.5%). In spite of these reasons, about 55.2% of producers had left-overs which were either thrown away (5.3%), resold (21.2%) or given away to homeless or hungry people (71.7%). One of the producers reported that left-over *magwinya* were stored in the refrigerator and microwaved prior to resale the following day. One reason why some producers throw away what is left over is mostly due to lack of refrigerators for storage. Only one of the production sites packaged the *magwinya* in an air-tight cling film wrap with a "sell-by date" of two days post-production (Figure 1F). This is because *magwinya* has a short shelf life of two days [15] and can go stale rapidly as a result of oil rancidity and retrogradation of starch granules [21].
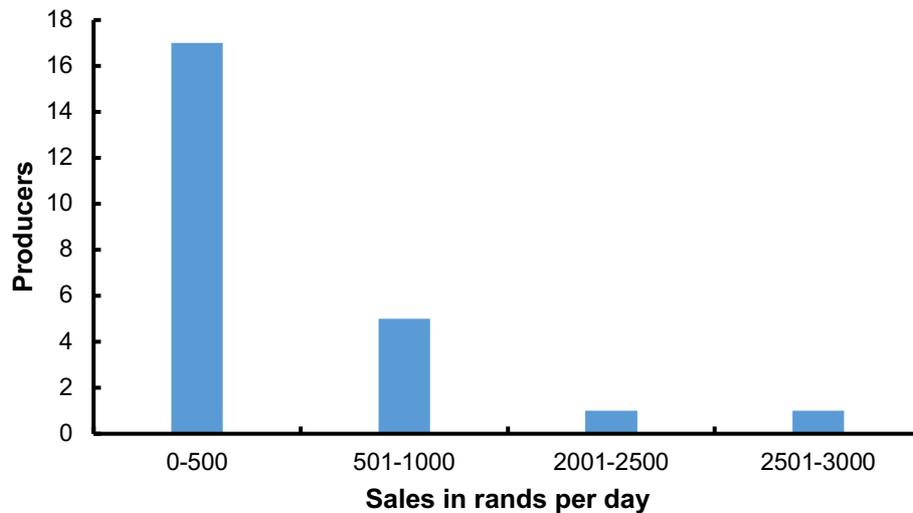
**Figure 3: Average daily sales by *magwinya* producers in Thohoyandou (n = 24)**

*Magwinya consumption*
Respondents were asked about their consumption habits relative to *magwinya* characteristics. About 46.1% reported 'like moderately' for *magwinya* (Table 4), with the highest significant ratings by age groups ≤20 and 21-30 (p = 0.001). On the frequency of *magwinya* consumption per week, 31.9% eat twice a week, 27% once a month, 22.9% every day and 18.3% thrice a week. Across all age groups, frequency of *magwinya* consumption was significantly different (p < 0.001). *Magwinya* is consumed either as a snack (39.9%), main meal (31.5%) and/or side dish (19.7%). Majority of consumers that ate *magwinya* as breakfast were in the ≤20 age group. About 28.5% ate *magwinya* as breakfast and 13.7% as lunch. Quite a number of high school learners and University students rely so much on *magwinya* as one / two of the meals of the day. Temple *et al.* [5] reported fat cakes as one of the unhealthy foods purchased by about 10% of their survey population. The size consumed depended on what is available to buy. Overall, 58% consume large size, especially at the UVR where a large chunk of the data pool was obtained.

Roadside and high school market producers sell small and medium size pieces (Figure 4) because of the cheap price (less than ZAR1), which meant learners could afford them. In terms of how *magwinya* is consumed, 34.5% of respondents reported plain consumption; while 33.9% sometimes consumed it plain or with another food; and 26.8% served it with either of the following: mango *atchar* (17.8%), French fries/ potato chips (11.4%), polony (9.8%), sausage also known as 'russian' (5.0%), fish (2.1%), cheese (1.9%), meat (1.1%), curry (0.8%), or avocado (0.2%). Some of these garnishes are unhealthy combinations with *magwinya*. For instance, a combination of potato chips and *magwinya* is not a healthy dietary option, because both are high in fats, sodium and calories [5]. This reflects an unhealthy diet choice among school learners. From a list of drinks taken alongside *magwinya*, sodas/fruit juice top the chart at 50.6% followed by tea (20%) – taken mostly during winter months, because consumers eat *magwinya* as a comfort food during the cold season.

**A**



**B**



**C**                                        **D**

**Figure 4:** *Magwinya* **samples (A) Flat vs round (B) various sizes and shapes (C) big and (D)small size (Image:1080x720 pixels)**

*Consumer purchase attributes*

Consumers purchased based on their location and producers in their environment. These purchase points included school cafeteria (30.6%), tuck shops (31.9%), high school markets (22.1%), roadside vendors (12.5%) and supermarkets (2.8). Reasons for purchase at a location included proximity to seller (31.9%), cleanliness of the vendor (25.1%), price (20.3%), size (17.5%), better taste (3.3%), and perceived less fat (1.3%). In comparison to other snacks, consumers chose *magwinya* for personal likeness (39.9%), satisfaction/ satiety (32.8%), and price (26.5%). On the list of favourite *magwinya* characteristics, taste topped the chart at 79.3%, smell – 9.9%, shape – 6.5%, and oiliness – 3.0% (Table 5). On overall likeness of *magwinya* oiliness, 74.4% responded 'no', 18.0% yes and 7.6% were undecided. This justifies a need for oil reduction in *magwinya*. Some consumers, especially university students, squeeze the oil out with tissue paper in order to remove the excess fat prior to consumption. From previous studies [5, 15], *magwinya* is reported to be energy-dense (183 kcal), low in fibre and high in fat (about 8 – 14 g per 50 g serving), and sodium (14 mg per 50 g serving). As earlier reported that consumers are increasingly becoming aware of the relationship between their health and diet, about 70.5% of our respondents responded 'yes' to their awareness of the health implications related frequent consumption of fried foods like *magwinya*; and as such, 74.9% said they would prefer a low-fat *magwinya* (p < 0.001, Table 6). To further affirm this, 86.6% said they would purchase low-fat *magwinya* if available. It is recommended that nutrient-rich and acceptable low-fat *magwinya* be developed. If this can be achieved and the product commercialized, healthier *magwinya* options will be available for the consumers. Recent studies from our research group on oil uptake reduction of *magwinya* via fibre enrichment has shown some promising results which can be scaled up for commercialization [16, 18].

## CONCLUSIONS

*Magwinya* is a popular African snack that has been in existence for a long time and is likely to continue for generations to come. *Magwinya* production and sales generate income for producers; while consumers get ready-to-eat food at their convenience. Thus, knowledge on its processing, sales and consumption patterns is a viable information repository for future research. Technological challenges still exist in production process due to lack of an automation system for mixing, proofing, frying and draining. From a health perspective, *magwinya* has low fibre content, and is high in fat, sodium, and calories (which make it an unhealthy food choice for consumers); but this has not stopped its frequent consumption, especially during the winter season. Nutrient-rich and acceptable low-fat *magwinya* should be developed. If this can be achieved and the product commercialized, healthier *magwinya* options will be available for the consumers. Considering the fourth industrial revolution, we recommend the development of *magwinya*-production machine encompassing mixing, proofing, frying and draining unit operations.

## ACKNOWLEDGEMENTS

**Table 1: Demographic information of *magwinya* producers and consumers**

| Information | Producers (n = 29) | Consumers (n = 634) | Significance |
|---|---|---|---|
| **Location** | | | <0.001 |
| UVR | 7 | 428 | |
| PW | 3 | 21 | |
| PE | 2 | 8 | |
| BF | 1 | 6 | |
| VCR | 1 | - | |
| CP | 1 | - | |
| VSR | 1 | 9 | |
| SH | 13 | 162 | |
| **Age** | | | <0.001 |
| ≤ 20 | - | 278 | |
| 21-30 | - | 312 | |
| 31-40 | 5 | 31 | |
| 41-50 | 10 | 10 | |
| 51-60 | 11 | 1 | |
| 61+ | 3 | 2 | |
| **Gender** | | | <0.001 |
| Male | - | 275 | |
| Female | 29 | 359 | |
| **Education** | | | <0.001 |
| No formal schooling | 18 | - | |
| < Grade 12 | | 242 | |
| Grade 12 | 7 | 272 | |
| Diploma | 3 | 12 | |
| Degree | 1 | 60 | |
| Postgraduate | | 48 | |
| **Experience (yr)** | | | <0.001 |
| <1 | 1 | - | |
| 1-5 | 6 | - | |
| 6-10 | 5 | - | |
| 11-15 | 3 | - | |
| >15 | 14 | - | |
| **Occupation** | | | <0.001 |
| Student | - | 566 | |
| Worker | - | 64 | |
| Unemployed | - | 4 | |

*Kruskal-Wallis one-way ANOVA ($p < 0.05$)

**Table 2: *Magwinya* production process**

| Information | Frequency | Percentage | Significance* |
|---|---|---|---|
| Where magwinya production was learnt | | | |
|   Catering school | 1 | 3.4 | <0.001 |
|   Home | 23 | 79.3 | |
|   Place of work | 3 | 10.3 | |
|   Self-taught | 2 | 6.9 | |
| Flour type used | | | |
|   White bread flour | 10 | 34.5 | |
|   Cake flour | 16 | 55.2 | |
|   Bread + cake flour | 3 | 10.3 | |
| Ingredient measurement | | | |
|   Yes | 28 | 96.6 | < 0.001 |
|   No | 1 | 3.4 | |
| Measurement type | | | |
|   Cup | 20 | 69.0 | <0.001 |
|   Weighing scale | 3 | 10.3 | |
|   Instinct | 6 | 20.7 | |
| Use of other ingredients | | | |
|   Margarine | 1 | 16.7 | 0.20 |
|   Eggs | 1 | 16.7 | |
|   Premix | 1 | 16.7 | |
|   Marg/egg/premix/Creamer | 1 | 16.7 | |
|   Marg/egg/premix | 1 | 16.7 | |
|   Baking powder | 1 | 16.7 | |
| Type of mixing | | | |
|   Manual | 27 | 93.1 | <0.001 |
|   Electronic | 2 | 6.9 | |
| Fermentation time (min) | | | |
|   ≤30 | 7 | 24.1 | <0.001 |
|   45 | 3 | 10.3 | |
|   60 | 3 | 10.3 | |
|   120 – 180 | 2 | 6.9 | |
|   Overnight | 14 | 48.3 | |
| Frying time (min) | | | |
|   <10 | 3 | 10.3 | <0.001 |
|   10 | 8 | 27.6 | |
|   15 | 3 | 10.3 | |
|   20+ | 2 | 6.9 | |
|   Until brown | 13 | 44.9 | |

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| | | | |
|---|---|---|---|
| Proofing mode | | | |
| Countertop | 27 | 93.1 | <0.001 |
| Proofer | 2 | 6.9 | |
| Magwinya shape | | | |
| Round | 27 | 93.1 | <0.00 |
| Flat | 2 | 6.9 | |
| Use of electronic equipment | | | |
| Yes | 4 | 13.8 | <0.00 |
| No | 25 | 86.2 | |
| Equipment type | | | |
| Deep fryer | 3 | 75.0 | 0.10 |
| Cutter/fryer/proofer | 1 | 25.0 | |

*Kruskal-Wallis one-way ANOVA (P < 0.05)

**Table 3:** *Magwinya* **sales data**

| Information | Frequency | Percentage (%) | Significance* |
|---|---|---|---|
| **Days of production/ sales** | | | |
| Everyday | 5 | 17.2 | <0.001 |
| Mon-Fri | 20 | 69.0 | |
| Mon-Sat | 4 | 13.8 | |
| **Peak sales** | | | |
| Morning | 24 | 82.8 | <0.001 |
| Morning+ noon | 5 | 17.2 | |
| **Meet sales target** | | | |
| Yes | 25 | 86.2 | <0.001 |
| No | 4 | 13.8 | |
| **After sales demand** | | | |
| Yes | 23 | 79.3 | <0.001 |
| No | 1 | 3.5 | |
| Sometimes | 5 | 17.2 | |
| **Production limitation reasons** | | | |
| Manpower | 7 | 29.2 | <0.001 |
| Finance | 8 | 33.3 | |
| Tiredness | 4 | 16.7 | |
| Other snacks | 2 | 8.3 | |
| Time | 3 | 12.5 | |
| **Leftovers** | | | |
| Yes | 16 | 55.2 | <0.001 |
| No | 10 | 34.5 | |
| Sometimes | 3 | 10.3 | |
| **What happens to leftovers** | | | |
| Thrown away | 1 | 5.3 | <0.001 |
| Resold | 4 | 21.1 | |
| Given away | 14 | 73.7 | |

*Kruskal-Wallis one-way ANOVA ($P < 0.05$)

## Table 4: *Magwinya* characteristics

| Information | Frequency | Percentage (%) |
|---|---|---|
| Magwinya likeness | | |
|    Like extremely | 97 | 15.3 |
|    Like very much | 168 | 26.5 |
|    Like moderately | 292 | 46.1 |
|    Neither like nor dislike | 77 | 12.1 |
| Consumption frequency | | |
|    Everyday | 145 | 22.9 |
|    Twice a week | 202 | 31.9 |
|    Thrice a week | 116 | 18.3 |
|    Once a month | 171 | 27.0 |
| How magwinya is eaten | | |
|    Main meal | 200 | 31.5 |
|    Snack | 253 | 39.9 |
|    Side dish | 125 | 19.7 |
|    All of the above | 56 | 8.8 |
| Main meal type | | |
|    Breakfast (B) | 181 | 28.5 |
|    Lunch (L) | 87 | 13.7 |
|    Dinner (D) | 4 | 0.6 |
|    B + L + D | 27 | 4.3 |
|    B + L | 8 | 1.3 |
| Size consumed | | |
|    Small | 83 | 13.1 |
|    Medium | 167 | 26.3 |
|    Large | 368 | 58.0 |
|    All of the above | 16 | 2.5 |
| Eat magwinya plain | | |
|    Yes | 219 | 34.5 |
|    No | 170 | 26.8 |
|    Sometimes | 215 | 33.9 |
|    Most of the time | 30 | 4.7 |
| Magwinya garnish (n=317) | | |
|    Curry | 5 | 0.8 |
|    Fish | 13 | 2.1 |
|    Meat | 7 | 1.1 |
|    Polony | 62 | 9.8 |
|    Cheese | 12 | 1.9 |
|    Russian | 32 | 5.0 |
|    Atchar | 113 | 17.8 |
|    Potato chips | 72 | 11.4 |
|    Avocado | 1 | 0.2 |
| Accompanying drink (n=629) | | |
|    Soft drink/Juice | 321 | 50.6 |
|    Coffee | 46 | 7.3 |
|    Tea | 127 | 20.0 |
|    Energy drink | 17 | 2.7 |
|    Water | 118 | 18.6 |

**Table 5: *Magwinya* consumer purchase attributes**

| Responses | Frequency | Percentage (%) |
|---|---|---|
| **Where *magwinya* is purchased** | | |
| School cafeteria | 194 | 30.6 |
| School tuck shop | 202 | 31.9 |
| Roadside vendors | 79 | 12.5 |
| School market | 140 | 22.1 |
| Supermarket | 18 | 2.8 |
| **Reasons for purchase** | | |
| Proximity | 202 | 31.9 |
| Price | 129 | 20.3 |
| Cleanliness | 159 | 25.1 |
| Size | 111 | 17.5 |
| Better taste | 21 | 3.3 |
| Less fat | 8 | 1.3 |
| ***Magwinya* purchase compared to other snacks** | | |
| Price | 168 | 26.5 |
| Personal likeness | 253 | 39.9 |
| Satisfaction | 208 | 32.8 |
| Cravings | 3 | 0.5 |
| **Favorite *magwinya* characteristics** | | |
| Taste | 503 | 79.3 |
| Shape | 41 | 6.5 |
| Smell | 63 | 9.9 |
| Oiliness | 19 | 3.0 |
| **Like *magwinya* oiliness** | | |
| Yes | 114 | 18.0 |
| No | 472 | 74.4 |
| To an extent | 48 | 7.6 |
| **Prefer *magwinya* with less oil** | | |
| Yes | 475 | 74.9 |
| No | 47 | 7.4 |
| **Awareness of health implications of fried food consumption** | | |
| Yes | 447 | 70.5 |
| No | 143 | 22.6 |
| To an extent | 44 | 6.9 |
| **Will purchase low-fat *magwinya*** | | |
| Yes | 549 | 86.6 |
| No | 83 | 13.1 |

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**Table 6: Consumer responses across age groups**

| Information | | ≤20 | 21-30 | 31-40 | 41-50 | 51-60 | 61+ | Sig* |
|---|---|---|---|---|---|---|---|---|
| | | | | Age | | | | |
| *Magwinya* likeness | Like extremely | 41 | 47 | 6 | 2 | 0 | 1 | <0.001* |
| | Like very much | 111 | 52 | 5 | 0 | 0 | 0 | |
| | Like moderately | 87 | 183 | 14 | 6 | 1 | 1 | |
| | Neither like nor dislike | 39 | 30 | 6 | 2 | 0 | 0 | |
| Consumption frequency | Everyday | 94 | 44 | 6 | 0 | 0 | 1 | <0.001* |
| | Twice a week | 93 | 93 | 13 | 3 | 0 | 0 | |
| | Thrice a week | 40 | 74 | 1 | 1 | 0 | 0 | |
| | Once a month | 51 | 101 | 11 | 6 | 1 | 1 | |
| How *magwinya* is eaten | Main meal | 102 | 88 | 7 | 2 | 0 | 1 | 0.05* |
| | Snack | 96 | 131 | 19 | 6 | 0 | 1 | |
| | Side dish | 62 | 57 | 3 | 2 | 1 | 0 | |
| | All of the above | 18 | 36 | 2 | 0 | 0 | 0 | |
| Main meal type | Breakfast (B) | 90 | 80 | 8 | 2 | | 1 | 0.65 |
| | Lunch (L) | 53 | 33 | 1 | 0 | | 0 | |
| | Dinner (D) | 3 | 1 | 0 | 0 | | 0 | |
| | B + L + D | 8 | 17 | 2 | 0 | | 0 | |
| | B + L | 4 | 4 | 0 | 0 | | 0 | |
| Size consumed | Small | 62 | 18 | 1 | 2 | 0 | 0 | <0.001* |
| | Medium | 121 | 29 | 11 | 3 | 1 | 2 | |
| | Large | 83 | 261 | 19 | 5 | 0 | 0 | |
| | All of the above | 12 | 4 | 0 | 0 | 0 | 0 | |
| Eat *magwinya* plain | Yes | 51 | 141 | 20 | 6 | 0 | 1 | <0.001* |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | No | 106 | 57 | 4 | 3 | 0 | 0 | |
| | Sometimes | 108 | 99 | 6 | 1 | 0 | 1 | |
| | Most of the time | 13 | 15 | 1 | 0 | 1 | 0 | |
| *Magwinya* garnish | Curry | 3 | 1 | 0 | 1 | 0 | 0 | 0.06 |
| | Fish | 4 | 8 | 0 | 1 | 0 | 0 | |
| | Meat | 4 | 3 | 0 | 0 | 0 | 0 | |
| | Polony | 44 | 15 | 3 | 0 | 0 | 0 | |
| | Cheese | 5 | 7 | 0 | 0 | 0 | 0 | |
| | Russian | 25 | 6 | 1 | 0 | 1 | 1 | |
| | Atchar | 63 | 44 | 3 | 2 | 0 | 0 | |
| | Potato chips | 54 | 17 | 1 | 0 | 0 | 0 | |
| | Avocado | 1 | 0 | 0 | 0 | 0 | 0 | |
| Accompanying drink | Soft drink/Juice | 149 | 158 | 10 | 3 | 1 | 0 | 0.15 |
| | Coffee | 24 | 19 | 2 | 1 | 0 | 0 | |
| | Tea | 40 | 70 | 11 | 4 | 0 | 2 | |
| | Energy drink | 10 | 6 | 1 | 0 | 0 | 0 | |
| | Water | 52 | 58 | 6 | 2 | 0 | 0 | |
| Where *magwinya* is purchased | School cafeteria | 34 | 148 | 9 | 3 | 0 | 0 | <0.001* |
| | School tuck shop | 56 | 128 | 12 | 5 | 0 | 1 | |
| | Roadside vendors | 49 | 22 | 5 | 1 | 1 | 1 | |
| | School market | 135 | 3 | 2 | 0 | 0 | 0 | |
| | Supermarket | 4 | 11 | 3 | 0 | 0 | 0 | |
| Reason for purchase | Proximity | 72 | 115 | 11 | 3 | 1 | 0 | 0.13 |
| | Price | 75 | 49 | 4 | 0 | 0 | 1 | |
| | Cleanliness | 68 | 78 | 9 | 3 | 0 | 1 | |
| | Size | 56 | 47 | 6 | 2 | 0 | 0 | |
| | Better taste | 6 | 13 | 1 | 1 | 0 | 0 | |
| | Less fat | 1 | 7 | 0 | 0 | 0 | 0 | |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Magwinya* purchase compared to other snacks | Price | 86 | 74 | 7 | 1 | 0 | 0 | <0.001* |
| | Personal likeness | 124 | 116 | 9 | 4 | 0 | 0 | |
| | Satisfaction | 68 | 120 | 15 | 3 | 1 | 1 | |
| | Cravings | 0 | 1 | 0 | 1 | 0 | 1 | |
| Favourite *magwinya* characteristics | Taste | 227 | 259 | 20 | 5 | 0 | 1 | 0.03* |
| | Shape | 17 | 15 | 7 | 1 | 0 | 1 | |
| | Smell | 27 | 30 | 2 | 3 | 1 | 0 | |
| | Oiliness | 6 | 12 | 1 | 0 | 0 | 0 | |
| | All of the above | 0 | 3 | 0 | 0 | 0 | 0 | |
| Like *magwinya* oiliness | Yes | 76 | 31 | 3 | 2 | 1 | 1 | <0.001* |
| | No | 189 | 256 | 21 | 6 | 0 | 0 | |
| | To an extent | 13 | 25 | 7 | 2 | 0 | 1 | |
| Prefer *magwinya* with less oil | Yes | 183 | 262 | 24 | 6 | - | - | <0.001* |
| | No | 36 | 10 | 1 | 0 | - | - | |
| Awareness of health implications of frequent fried food consumption | Yes | 183 | 236 | 21 | 6 | 0 | 1 | 0.06 |
| | No | 77 | 56 | 5 | 3 | 1 | 1 | |
| | To an extent | 18 | 20 | 5 | 1 | 0 | 0 | |
| Will purchase low fat *magwinya* | Yes | 218 | 294 | 28 | 9 | 0 | 0 | <0.001* |
| | No | 59 | 17 | 3 | 1 | 1 | 2 | |

*Pearson's Chi square test of significance at P < 0.05

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