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# Processed Baobab (*Adansonia digitata* L.) Food Products in Malawi: From Poor Men's to Premium-Priced Specialty Food?

Dietrich Darr <sup>1,\*</sup> , Chifundo Chopi-Msadala <sup>2,\*</sup>, Collins Duke Namakhwa <sup>3</sup>,  
Kathrin Meinhold <sup>1</sup>  and Chimuleke Munthali <sup>2</sup>

<sup>1</sup> Faculty of Life Sciences, Rhine Waal University of Applied Studies, D-47533 Kleve, Germany; kathrin.meinhold@hochschule-rhein-waal.de

<sup>2</sup> Faculty of Environmental Sciences, Mzuzu University, Private Bag 201, Mzuzu 2, Malawi; chimuleke.munthali@gmail.com

<sup>3</sup> Polytechnic, Faculty of Commerce, University of Malawi, P. O. Box 278, Zomba, Malawi; cnamakhwa@gmail.com

\* Correspondence: dietrich.darr@hochschule-rhein-waal.de (D.D.); chifundochopi@gmail.com (C.C.-M.)

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**Abstract:** The baobab tree (*Adansonia digitata* L.) is an important source of non-timber forest products in sub-Saharan Africa. Its fruits contain high amounts of vitamin C, calcium, and dietary fibre. In addition, other parts of the tree are traditionally used for human consumption, particularly during lean seasons. In line with the increasing demand for natural, healthy, and nutritious food products, the baobab has great potential to contribute to human nutrition and rural livelihoods. In Malawi, where demand for baobab has substantially increased within the last decade, baobab fruits are being processed into a variety of food and non-food products, such as fruit juice, ice-lollies, sweets, and cosmetics. Yet, information on the sociodemographic background and quality preferences of baobab consumers is scanty. The current study, therefore, aimed to (1) map the diversity of baobab products available in Malawi; (2) determine consumer segments and their preferences for the most common baobab food products; and (3) examine the contribution of major attributes of processed baobab food products on their price. We employed a mixed-methods approach including the analysis of 132 baobab products and a survey of 141 consumers in formal and informal retail outlets, adopting multistage and purposive sampling. Qualitative and quantitative data were analysed using cluster analysis, cross tabulation, and hedonic regression. Results pointed to two distinct consumer segments for baobab food products, largely following the formal–informal product divide currently existing in Malawi. Both segments clearly differed with regard to preferred product attributes. We also showed that extrinsic product attributes such as packaging quality, labelling, conformity with food standards, or health claims provided distinct differentiation potential for baobab food manufacturers. In addition to providing empirical evidence for the transition of baobab food products into higher-value market segments, our results can help food processing enterprises to improve the composition and marketing of their baobab products.

**Keywords:** food processing industry; wild edible plants; neglected and underutilized species (NUS); Africa; urban consumers; marketing; product differentiation

## 1. Introduction

Wild edible plants collected from trees and forests are an important source of nutrition and income for communities in many parts of the world. Studies show that food products are among the most important product categories collected from forest and non-forest ecosystems, and they account for

approximately 30% of the total value of products derived from the environment [1]. Large parts of rural populations in Africa regularly collect and consume wild edible plants and generate substantial parts of their income from these resources [2–4]. While food from agricultural production nevertheless remains the prime source of energy and nutrition in most cases, wild food can make an important contribution to household nutrition and well-being in times of food scarcity and economic hardship.

Given the fact that wild edible plants are typically available from public or private lands at low cost, their use and consumption has primarily been associated with poor population strata [5]. Some authors also stress the importance of traditional knowledge of the ecology for use of these plants and hence associate their consumption primarily with elder and more traditional population groups [6]. A number of studies expand on the previous literature that primarily focused on rural contexts by investigating the contribution of wild food to urban and peri-urban populations in Africa. For example, Asase and Kumordzie [7] report that indigenous vegetables cultivated or collected from the wild were highly popular among urban residents in Ghana due to their availability, affordability, and medicinal value. Catarino et al. [8] found that five species of wild and semi-cultivated leafy vegetables including the dried leaves of *Adansonia digitata* and *Bombax costatum* were available at the largest food market in the capital city of Guinea-Bissau during the dry season. A study in Kampala, Uganda, found that wild plants were commonly used and mainly collected by residents with lower income [9]. A recent study in six African cities reported that wild food and medicine remain an integral part of diets for poor urban inhabitants [10]. These and similar accounts accentuate the importance of wild indigenous food as a supplementary diet and source of income for poor population strata in light of widespread rural and urban poverty.

At the same time, there is increasing evidence that wild food products are also an integral component of the diets of wealthier consumer segments. While poor households tend to spend a higher proportion of their income on wild food, wealthy households can afford to consume more of these products in absolute terms. Likewise, the consumption of wild food considered to be luxury products such as bushmeat is often more common among higher-income population strata [11]. In addition to this, economic growth and the emergence of an urban middle class have created a group of consumers who largely purchase rather than produce or collect the food products they consume [10,12]. Given culturally rooted food preferences and eating habits, wild edible plants remain an important part of their diets. At the same time, an increasing number of urban consumers in Africa seems to appreciate the health and cultural benefits of wild indigenous food [13]. As a consequence, wild food and medicine are commonly consumed by higher-income urban populations in many African cities [10]. Aworh [14] reported of the growing acceptance of indigenous leafy vegetables among the urban elite in Kenya and elsewhere in Africa, as indicated by their increasing availability in fine dining restaurants and large urban supermarkets. In a similar vein, Garekae and Shackleton [15] reported that wild edible plants were not perceived as “food for the poor” by the majority of urban residents in two towns in South Africa. However, studies show that African traditional food products often remain poorly integrated into formal markets, supply chains, and retail outlets to date, as many of these products are mostly sold by street vendors or at fresh markets rather than by shopkeepers [16,17]. Moreover, Cloete and Idsardi [6] demonstrated that there are distinct differences between lower and higher income groups with regard to the particular wild edible plant species consumed. This underlines the ongoing differentiation and fragmentation of consumer segments with their respective tastes and product preferences, and the need for detailed and case-specific analyses.

The baobab (*Adansonia digitata* L.) is an indigenous fruit tree species widely occurring in the semi-arid parts of Africa. Due to its potential contribution to food security and household well-being it has been recommended as a priority species for domestication and commercialization [18,19]. Its fruit pulp contains high amounts of carbohydrate, dietary fibre, vitamin C, calcium, magnesium, and potassium [20,21]. Besides its fruits, various other parts of the tree are important for a diversity of traditional uses including food, fodder, medicine, cosmetics, and craft products [22,23]. Consequently, the importance of the baobab tree for household nutrition, food security, and income, particularly of the disadvantaged rural populations, has been highlighted in the literature, e.g., [24,25]. In Malawi, where demand for baobab has substantially increased within the last decade, the baobab fruits are being processed by both formal and informal enterprises to produce a variety of food and non-food products, such as fruit juice, ice-lollies, sweets, and cosmetics. Yet, little is known about the customers who purchase processed baobab food products, their preferred quality attributes, and the impact of these attributes on product price. To contribute to improved baobab commercialization, this paper aimed to (1) map the diversity of baobab products currently available in formal and informal markets in Malawi; (2) identify and characterize the main consumer segments and their preferences; and (3) determine the factors affecting the price of the two most commonly available baobab food products, i.e., baobab pulp powder and baobab juice. It is expected that our results can contribute to promoting the further commercialization and value-added processing of baobab fruit pulp in Malawi and other countries with significant resources of baobab and a developing baobab-processing sector.

## 2. Materials and Methods

Data were collected from nine districts, including the three major cities of Malawi, namely Mangochi, Blantyre, Mwanza, Balaka, Ntcheu, Salima, Lilongwe, Mzuzu, and Karonga (Figure 1). These districts were purposively selected as they (a) represent the centres of *Adansonia digitata* L. production and processing in Malawi, and, hence, a variety of processed products was known to be sold in these locations; (b) cover the entire north–south expansion of the country; and (c) represent a diversity of environmental and socio-economic conditions along the urban to peri-urban to rural continuum. A mixed-methods approach was employed to study consumer preferences and product characteristics. Data from 141 consumers and 132 products were collected in formal and informal retail outlets, such as supermarkets, hypermarkets, specialty stores, mini-marts, filling stations, open markets, hospital canteens, religious centres, and roadside vendors using structured questionnaires. All subjects gave their informed consent for inclusion before participating in the study. The study was conducted in accordance with the approval by the Malawi National Commission for Science and Technology (protocol number P.10/17/216). While retail outlets were purposively selected, the consumer survey was carried out in 20 retail outlets using a quota sampling procedure [26]. The samples were continuously expanded using snowballing until the target sample size was reached. To determine the consumer segments, two-step cluster analysis was used as a classification tool. Cross-tabulation and Cramer's V were used to identify relationships between demographic factors and preferred quality attributes using the SPSS software version 20. Multiple regression method was used to analyse quantitative data using a stepwise regression procedure to identify the best set of quality variables predicting the dependant variable, price.



**Figure 1.** Location of the study districts.

### 3. Results

#### 3.1. Product Categories

Seventy-eight processed baobab products were identified in the investigated formal and informal retail outlets (Figure 2). They comprise a number of food products made of baobab pulp, as well as cosmetics products mainly made of baobab seed oil, which is not recommended for use in food products due to its content of cyclopropanoic fatty acids [27]. Sixteen different product types were found to be characterized as fruit drinks (bottled and frozen juice, i.e., ice lollies), pulp powders, sweets, and personal care products (soaps and oils). Nine of 16 product types were traded through the informal outlets, whilst formal retail outlets were selling the complete set of 16 product types. Table 1 provides a brief overview of the baobab products currently available in the Malawian market. In line



with our prime interest in baobab food products, we disregarded the available cosmetics products in all further analyses.



**Figure 2.** Examples of baobab products from the Malawian formal and informal markets. **1A–D:** Baobab juice products; **1E:** formally processed baobab ice-lollies; **2A:** Informal baobab juice packaged in recycled plastic bottles; **2B:** Baobab sweets sold in informal outlets; **2C,D:** Informally processed baobab ice lollies; **2E:** Packaged pulp in sacks for wholesale. **3A,F:** Baobab oil; **3B:** Baobab soap; **3C:** Assorted lip balm; **3D:** Baobab Spongi soap; **3E:** Baobab body cream sold in high-end shops; **4A,C,E:** Baobab pulp powder sold in pharmacies; **4B:** Baobab coffee powder made from seeds; **4D,F:** Baobab jam; **5A:** Baobab sweets sold in supermarkets; **5B:** Baobab chocolate sold in high-end flea markets; **5C:** Baobab sweets sold in high-end markets; **5D:** Baobab pulp powder sold in high-end flea markets.

The investigated baobab products differed widely in terms of their extrinsic and intrinsic product attributes. For example, baobab juice products made by formal food processing companies were available in 250 mL, 500 mL, and 1 L polyethylene terephthalate (PET) plastic bottles of proprietary design with brand and nutrition labels (Figure 2(1A–D)) and sold widely through various retail outlets. Baobab juice made by informal food processing enterprises was sold in recycled 500 mL plastic bottles without labels (Figure 2(2A)). Likewise, baobab fruit pulp powder was sold in plastic bags or bottles with health-claim labelling in pharmacies (Figure 2(4A,C,E)) and packaged or in bulk without health-claim labelling in the informal market (Figure 2(2E,5D)).

**Table 1.** Characteristics of processed baobab products in Malawi.

| Product Type                   | Number of Products Identified | Main Product Features   | Estimated Baobab Content | Main Retail Outlet  | Price (MKW)              |
|--------------------------------|-------------------------------|---|--------------------------|---|--------------------------|
| Baobab fruit powder            | 25                            | Packaged or in bulk, some products with organic certification.                          | 100%                     | Open markets, street vendors, supermarkets.               | 800–3500 (500 g)         |
| Malambe sweets                 | 12                            | Coloured sweetened pulp pieces, packaged in plastic bags (15–70 g).                     | 90%–100%                 | Schools, supermarkets.                                    | 10 (15 g)                |
| Baobab ice-lollies             | 11                            | Frozen baobab juice raw or sweetened and coloured, packaged in plastic tubes (35–50 g). | 20%–30%                  | Street side vendors, churches, informal markets, schools. | 10 (10 g)                |
| Baobab juice, bottled          | 7                             | Packaged in 250–1000 mL PET or recycled PET bottles, with or without MBS certification. | 40%–60%                  | Supermarkets, filling stations.                           | 500–750 (500 mL)         |
| Baobab coffee powder           | 3                             | Packaged in branded plastic jars (180–200 g).   | 100%                     | Supermarkets, pharmacies.                                 | 1800–3500 (200 g)        |
| Baobab jam                     | 3                             | Packaged in branded plastic jars (350–500 g).   | 15%–20%                  | Supermarkets  | 1900–2500 (500 g)        |
| Baobab pure oil                | 3                             | Packaged in 100 mL glass or PET bottles.  | 100%                     | Supermarkets, pharmacies.                                 | 2000–3500 (50 mL)        |
| Baobab lip balm                | 3                             | Packaged in wooden cases (12 g).  | 100%                     | Specialty shop, flea market.                              | 2000–3500 (12 g)         |
| Baobab soap                    | 2                             | Packaged in plastic or branded paper wrap (110–170 g).                                  | 15%–50%                  | Specialty shop, high-end tourist gift shops.              | 500 (170 g)–6500 (110 g) |
| Baobab delight smoothie        | 2                             | Packaged in PET bottles (250 mL).   | 30%                      | Supermarkets.   | 300 (250 mL)             |
| Baobab smoothie served in cups | 2                             | Served in polystyrene cups (100–150 mL).  | 30%                      | Restaurants, fast-food shops.                             | 200–2000 (300 mL)        |
| Baobab wine                    | 1                             | Packaged in 750 mL glass bottles.   | 10%–15%                  | Agriculture fair/ trade exhibits.                         | 6000 (750 mL)            |
| Malambe face powder            | 1                             | Plastic jar (25–40 g).  | 60%                      | Local markets.  | 500 (40 g)               |
| Baobab body cream              | 1                             | Wooden jar (250 g).   | 30%                      | High-end tourist gift shops.                              | 6500–12,000 (250 g)      |
| Baobab chocolate               | 1                             | White chocolate bar wrapped in paper.   | 15%                      | Flea markets, tourist centres.                            | 2000–3500 (100 g)        |
| Baobab body lotion             | 1                             | Imported from France.   | 100%                     | Drug stores, pharmacies.                                  | 25,000 (400 mL)          |
| Total                          | 78                            |   |                          |   |                          |

MKW 860 = EUR 1 at the time of fieldwork. Average per-capita income in Malawi amounted to MKW 293,700 (EUR 342) in 2018 [28].

While in principle, a large variety of processed baobab food products exists in Malawi, some of these products were more widely available and hence more commonly consumed by a diversity of consumers than others. For example, baobab chocolate was only available in high-end delicacy stores in Lilongwe and Blantyre, and baobab wine was presented at an agricultural product fair. Such products represented relatively recent product innovations that were sold in very low quantities only, according to the shop owners. In contrast, baobab fruit juice was known to consumers throughout the country across various population strata and sold in significant quantities through numerous formal and informal retail channels. This may reflect the overall popularity of fruit juices, for their ease of consumption, which supply desired vitamins and nutrients in times of growing consumer interest for healthy food products.

### 3.2. Sociodemographics of Consumers and Preferred Attributes

For further analyses, we therefore select baobab juice (bottled and frozen) as a reference product to elicit sociodemographic consumer profiles. The results of the cluster analysis showed that there were two distinct segments of baobab juice consumers. These were primary and secondary school pupils, below 10 years of age on average with low income and concern for healthy food; and adults, 35 years on average, with more than half having completed higher education and being characterized by strong concern for healthy food (Table 2). Both segments consumed baobab juice products irregularly and in small quantities; thus, these products did not constitute an essential part of their diets. School pupils, for example, mostly consumed the frozen baobab juice as an occasional snack during school breaks, which they mostly purchased from informal channels like roadside vendors. To keep unit cost low and the product price affordable for their target group, these vendors tended to use cheap ingredients such as artificial colorants and sweeteners of questionable quality. The adult consumer segment, in contrast, purchased the product mainly through formal retail outlets like supermarkets. The majority of consumers of both segments stated that they consumed baobab juices throughout the year. As indicated by the Silhouette measure of cohesion and separation of  $>0.5$ , the analyses separated the segments with reasonable accuracy.

**Table 2.** Sociodemographic profiles of the baobab juice consumer segments in Malawi.

| Characteristic                 | School Pupils          | Adults            |
|--------------------------------|------------------------|-------------------|
| Sample (N)                     | 54 (76.1%)             | 17 (23.9%)        |
| Mean age                       | 9.6 ± 1.89 years       | 35.1 ± 8.69 years |
| Family status #                | Single (100%)          | Married (64.7%)   |
| Education level #              | Primary school (98.1%) | Diploma (52.9%)   |
| Monthly income (MWK)           | ≤1500 (100%)           | >300,000 (29.4%)  |
| Monthly consumption # (litres) | ≤2 (94.4%)             | ≤2 (58.8%)        |
| Concern for healthy food #     | Weak (66.6%)           | Strong (64.7%)    |

# Median categories.

### 3.3. Quality Attributes Preferred by Different Baobab Juice Consumer Segments

Cross-tabulation results and Chi-square tests showed that the preferred quality attributes differed significantly at  $\alpha \leq 0.001$  between both customer segments, and the strength of the relationship between the preference and consumer segment variables was measured using Cramer's V (Table 3). While school pupils mainly preferred baobab juice products for their particular taste, adult consumers expressed a stronger preference for a variety of extrinsic product features, such as the availability of product information on a packaging label, the quality of the packaging material used, packaging size, and health claims made, as well as intrinsic product features such as added preservatives and nutritional properties of the baobab juice product. These preferences were strongly associated with the consumer segment variable as indicated by the Cramer's V values in Table 3.

**Table 3.** Quality attributes preferred by baobab juice consumers (% strong agreement).

| Quality Attributes   | School Pupils | Adults | Cramer's V |
|--|---------------|--------|------------|
| Product information on packaging label                         | 0.0           | 52.9   | 0.974      |
| Quality of packaging material                                  | 3.7           | 52.9   | 0.719      |
| Larger package size and volume                                 | 0.0           | 41.2   | 0.619      |
| High nutritional content                                       | 18.5          | 47.1   | 0.568      |
| No added preservatives   | 0.0           | 35.3   | 0.804      |
| High perceived health benefits                                 | 3.7           | 41.2   | 0.713      |
| Product quality conforming to Malawi Bureau of Standards (MBS) | 0.0           | 23.5   | 0.802      |
| Sweet taste  | 46.3          | 0.0    | 0.316      |

Pearson Chi-square values showed significance at 0.1% level.

### 3.4. Effect of Quality Attributes on Price of Baobab Products

On average, bottled baobab juice products were sold for a price of MWK 100 to 150 per 100 mL in the various retail outlets, and baobab fruit pulp powder was sold for a price of MKW 160 to 700 per 100 g in the different markets. In order to assess how the various attributes of a baobab food product contributed to its price, we used hedonic regression analysis. We compare the two product types most commonly available in formal and informal markets, baobab pulp powder and bottled baobab juice. Identifying those attributes that increase the value of the product to consumers can help food processing enterprises further improve the composition and marketing of their products, thereby increasing value-added and profitability (Table 4).

**Table 4.** Determinants of baobab food product quality attributes on price.

| Quality Attributes   | Model 1:<br>JuiceStandardized<br>Coefficients | Sig.     | Model 2:<br>PowderStandardized<br>Coefficients | Sig.     |
|--|---|----------|--|----------|
| (Constant)   |   | 0.002 ** |  | 0.636    |
| Product information on packaging label                         | 0.276   | 0.000 ** | 0.261  | 0.022 *  |
| Quality of packaging material                                  | 0.545   | 0.000 ** |  |          |
| Package size   |   |          | 0.744  | 0.000 ** |
| High nutritional content                                       | 0.250   | 0.015 *  |  |          |
| No added preservatives   |   |          | 0.460  | 0.000 ** |
| High perceived health benefits                                 | 0.297   | 0.027 *  |  |          |
| Product quality conforming to Malawi Bureau of Standards (MBS) | 0.356   | 0.004 ** |  |          |
| Adjusted R <sup>2</sup>  | 0.795   |          | 0.742  |          |

\*\*, \* indicate significance levels of 1% and 5%, respectively.

As indicated by the adjusted R<sup>2</sup> values, the regression models explained between 74%–80% of the variance in the data. All coefficients had positive signs indicating that the presence of the investigated intrinsic and extrinsic product attributes increased product price. It was found that a product label, the quality of packaging materials, high nutrient content, perceived health benefits, and conformity with Malawi Bureau of Standards (MBS) quality standards significantly influenced the price of bottled juice products. Packaging quality was the variable that had the largest impact on price; the model predicts that for every increase in quality of packaging material by 1 Standard Deviation (SD), there is a 0.545 unit SD increase in price. Availability of a product label, packaging size, as well as the absence of additives significantly increased the price of baobab fruit powder, with a 1 SD increase in volume or weight of the package causing a 0.744 unit SD increase in price.

## 4. Discussion

Our inventory of processed baobab products in Malawi has shown that a variety of products was available through various formal and informal retail outlets, including baobab drinks, fruit powder, sweets, chocolates, oils, and soaps. This corroborates earlier studies that have reported a diversity



of mostly traditional food uses of baobab in the region, e.g., [29,30]. The increasing importance of industrially processed baobab food products corresponds to the growing interest in baobab by the food processing industry, following the acceptance of baobab fruit pulp as a food ingredient by the European Union (2008/575/EC) and the US Food and Drug Administration (GRAS Notice No. GRN 000273). While the number and diversity of baobab food products currently available in Malawi demonstrates their importance for consumption and trade in line with the country's transformation into probably the largest market for baobab in Africa [31], it was lower than that reported from countries with a more developed food industry [32]. This illustrates the significant commercial opportunities in baobab products that are yet to be exploited by baobab producers and food processors in Malawi and elsewhere in Africa.

Our analysis has clearly revealed the presence of two distinct consumer segments for baobab juice products, which largely follow the formal–informal product divide currently existing in Malawi. While informal baobab juice and other informal food products like ice-lollies were largely consumed by low-income consumer groups such as school pupils, day labourers, or peasants visiting urban and peri-urban street markets, baobab juice manufactured by food processing companies in the formal sector were nearly exclusively consumed by higher-income urban consumers. In addition, evidence from interviews with shop owners and observation suggest that products such as baobab jam and chocolate sold in delicacy and specialty stores were mostly purchased by expatriates or international tourists, a consumer segment with preferences closely resembling those of consumers in developed western countries, and with purchasing power typically higher than the average Malawian urban resident. These findings conform with studies from elsewhere that found a stronger preference of better educated, higher income and well-established consumers for novel and healthy food products [33,34].

Our results also suggest that the preferences of the identified consumer segments with regard to baobab juice products differed at statistically significant levels. Our findings resemble results reported in other studies that indicated a strong association of the consumers' sociodemographic status and lifestyles with their preferences and willingness to pay for certain health-related food product attributes [35]. While low-income consumers mainly preferred baobab juice products with sweet taste, high-income consumers ranked quality attributes like product information on labels, packaging material, nutritional properties, long shelf life, health claims, and conformity with product quality standards more highly. Findings from Niger [36] also showed that the consumers' willingness to pay for baobab products correlated with their knowledge of global environmental concerns. The consumers' product preferences and choices with regard to health and food safety aspects, hence, are influenced by their distinct demographic characteristics such as education level and income [37]. This observed differentiation of baobab food products in terms of their attributes and marketing channels suggests the use of advanced product design and marketing techniques such as lifestyle marketing [38] by some of the formal baobab food product manufacturers, which address target audiences based on their particular lifestyle-related needs, interests, desires, and values.

The results of the hedonic regression analysis suggest that extrinsic product features had a strong positive association with product price for baobab fruit juice products, while the actual nutrient content was relatively less important. This was probably due to the fact that nutrient composition of various baobab juice products was relatively uniform across different brands, while extrinsic product attributes such as packaging quality, labelling, conformity with food standards, and perceived health benefits provided more distinct differentiation potential. For example, while the type and quality of packaging was partially determined by distribution channel requirements, it was also associated with the consumers' perceptions of product aesthetics [39], as well as shelf life and food safety [40]. In addition, product manufacturers may generally find it easier to differentiate their products based on extrinsic rather than intrinsic product attributes, which are generally more difficult to change. Examples show that product differentiation based on extrinsic attributes can substantially increase product value by 100% and more [35]. However, the intrinsic attributes of baobab food products also provide ample opportunities for product differentiation. For example, as noted by Cisse et al. [41], the quality of

traditionally prepared baobab fruit nectars quickly deteriorates without special precautions. While the shelf life of most informal baobab juice products is therefore typically very limited, the choice of a particular technological option, such as use of artificial or natural preservatives, pasteurization, or cold stabilization using crossflow microfiltration provides the opportunity for juice processing enterprises in the formal sector to target the respective preferences held by particular consumer segments.

Past studies have shown that consumers and retailers equally place high value on food labelling [42]. Food labelling has been shown to have a positive association with price for health-conscious consumers, females, and highly educated individuals [43,44]. Studies also show that health and nutrition-related attributes had a statistically significant influence on price [33,43]; and that compliance with advanced food standards such as organic often also attracted additional price premiums in the developed world [45,46]. In contrast, baobab fruit pulp powder generally seemed to benefit less from these differentiation opportunities, giving it more the character of a commodity product. The only determinants of product price, in addition to packaging size, were product labelling and the absence of preservatives. Again, this illustrates the significant opportunities that still exist for product differentiation and additional value creation through, for example, more advanced packaging and product certification of baobab fruit pulp products in Malawi.

Notwithstanding the obvious opportunities related to the increased commercialization of baobab in Malawi, the implications of its intensified utilization on the well-being of particularly vulnerable rural populations that traditionally depended on these resources deserve further careful analysis and consideration. Circumstantial evidence suggests that increasing commercialization leads to baobab fruits being more rapidly collected right after—and sometimes even before—they mature, given that collectors compete with each other in conditions when harvesting is unregulated and property rights in baobab trees are ill-defined or poorly enforced. This might reduce the availability of these fruits for consumption by poor and vulnerable population strata; a point that has also been highlighted critically in western Africa [47]. Likewise, the higher value and price of processed baobab food products might make them less affordable and reduce the quantities consumed by poor population strata [8]. Equally important are studies that investigate the effect of increasing fruit harvesting on the structure and natural regeneration of baobab populations and wildlife.

## 5. Conclusions

While the overall contribution of baobab trees to the livelihoods of rural populations in large parts of sub-Saharan Africa can hardly be overestimated, our results clearly suggest that the notion of baobab serving as an emergency food for poor rural populations is a too narrow depiction of the present realities in Malawi. Along with the awakening international interest in and growing demand for baobab pulp as a nutritious natural ingredient for a variety of lifestyle food products in Europe, the US, and a number of other developed markets, and building on a long tradition of baobab use by local populations, a vivid baobab-processing sector has emerged in Malawi that supplies a diversity of food and non-food products to local consumers. While entrepreneurs running small-scale and often informal enterprises can play an important role in driving the development of an industry, innovating products, services, and business models [48], the majority of informal baobab processing enterprises in Malawi currently only offer food products of minimum quality and low price that are customized to the tastes and purchasing power of low-income population strata. This is in line with the general description of informal enterprises often being survivalist, heavily resource constrained, and of low productivity [49] and their food products being related to higher food safety and health risks [50,51]. Notwithstanding this, and given the ubiquity of informal baobab food products in Malawi during the baobab harvesting season, such products can make a certain contribution to the diversification of diets and the energy and micronutrient supply of consumers, at least during some parts of the year. However, an exact account of the contribution of these products to nutrition and food security was beyond the scope of our study.

In addition to the numerous informal baobab businesses targeting low-income consumers, growing numbers of formal enterprises have started to exploit the market opportunities emerging from the increasing differentiation and fragmentation of consumer segments and their preferences that are connected to economic development, urbanization, and the westernization of African lifestyles and societies. This empirical result somewhat expands the currently prevailing food-for-the-poor narrative for baobab fruits. Given their better access to managerial and technical know-how, financial capital, business networks, and other resources, formal companies can oftentimes more easily comply with legal or formal supply chain requirements and fulfil more advanced customer expectations in terms of the intrinsic quality or extrinsic attributes of their products. Targeting the higher-value market segments and pursuing a consequent product differentiation strategy can thus be a rational strategic choice for such enterprises. In light of contesting views in the literature [52–54], an interesting question left to future research is whether a business model targeting the bottom-of-the-pyramid consumers could be equally or even more profitable (and at the same time socially and ethically justifiable) than a model pursuing premium pricing based on product differentiation.

Although the formal baobab processing companies mostly meet the product standards required by Malawian regulators and consumers, there is room to further improve their products given a variety of anticipated yet unmet customer needs. Further investment in market research, product development and formulations, quality management, and marketing may therefore be recommended for local food processing companies to continuously develop and grow their businesses. If successful, such investments can even lead to the building of an internationally competitive baobab-processing sector in Malawi that supplies high-value processed products to international markets, an opportunity which—in light of the growing popularity of baobab products in developed markets—does not perhaps seem too far-fetched.

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