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Consumer preferences and willingness to pay for dried traditional mangos from Kitui – A marketing analysis for Kenya and Germany

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The Kenyan mango value chain faces high post-harvest losses due to poor market access alongside a lack of storage technologies and processing facilities. Thus, using fruit processing methods, like solar drying, can enhance shelf life and help smallholder farmers access new markets, diversifying income and livelihoods. Nonetheless, the processing of both indigenous and grafted mango fruits is not a very common practice. This study was conducted to support product development targeting processing and marketing to link farmers to both local and export markets. Four independent consumer testing and sensory evaluation rounds on Kitui's dried mango flakes were conducted in Germany and Kenya. Data were collected via a group tasting by 31 randomly selected participants and an online questionnaire of 304 randomly selected participants. All participants were given samples of different varieties of dried mango flakes with and without additives. Results show that high-quality mango cultivars, like Ngowe, receive high hedonic scores without any additives (honey, sodium metabisulfite, or ascorbic acid). Some varieties positively respond to the treatments and achieve higher scores, e.g., Van Dyke or the indigenous variety Kikamba. The consumers testing in Germany show that extrinsic attributes, such as organic production, fair trade, cooperative, and sustainable labelled flakes open up new opportunities for farmers who aim for the export market. Against findings derived from German panellists, in Kenya, consumers do not show a higher willingness to pay despite having a positive attitude toward sustainability. Thus, the local market should focus on cost-reduction strategies rather than introducing standardisation.

KEYWORDS

smallholder farmers, post-harvest losses, market opportunities, consumer tasting panels, shelf life, processing facilities, solar dryers

1. Introduction

Mango (*Mangifera indica* L.) is a high-potential fruit that can be produced in many agro-ecological zones and, thus, across most of Kenya's territory. Due to its increasing demand in domestic, regional, and international markets, mango production has been deemed as a means to alleviate poverty in Kenyan households (Grant et al., 2015).

With a productive area of 49,098 ha and an annual raw mango production output ranging from 600,000 to 800,000 tons, Kenya is Africa's third largest mango producer (Grant et al., 2015). Since 2000, Kenya has witnessed an increase in mango production of almost 300% and exports of 400% (Fleming, 2020). In 2003, 14.4% of the total fruit export value was held by mango export alone. Yet, the export share of Kenya's mango production ranges between 1 and 4%, with most of the mango produced still consumed in the domestic market (FAO, 2004; Oseno, 2011; Grant et al., 2015).

While mango production used to be limited to coastal areas, as of 2023, mango cultivars produced for export and local markets are found in 7 out of 8 provinces. As of 2012, within the national production of 754,702 tonnes, the Coast and Eastern regions cover 79% of the total national acreage and produce 596,215 tonnes. The Lower Eastern region, which comprises the counties of Makeni, Kitui, and Machakos, contributes 52% of this production volume (Grant et al., 2015). Thus, these three counties contribute strongly to the supply of mango exports. The production is dominated by small-scale farms, with 62,150 households relying on mango production as a source of income (Muthini, 2015).

Despite having become the key source of revenue for many small-scale farms since 2000 (accounting for the 22% of farm household income in the Eastern region), the local mango sector is an insecure market with unreliable buyers and with a value chain dominated by intermediate buyers, due to mango producing households' inability to meet market requirements (Muthini, 2015).

These challenges are associated with the fruit's high perishability and seasonality, which often leads to inadequate year-round supply, oversupply during harvest seasons, and extreme price fluctuations (Saúco, 2013). Additionally, the lack of processing facilities, adequate transportation means, and other infrastructure necessary to access city markets results in high post-harvest losses of 30–40% (Mongi et al., 2013). Even when the infrastructure is present, the long distances between farms and marketplaces lead to product spoiling and high transportation costs, which can reach 77% of the product value (Nzioki, 2013; Muthini, 2015). Therefore, it is necessary to elaborate and assess available value-addition strategies that can address the low shelf life of the fruit and the lack of access to markets of choice (Kennedy, 2015; Tobin et al., 2016; Musyoka et al., 2020).

Drying is one of the most widely utilised methods of food preservation to address these constraints. In tropical and sub-tropical countries, drying is generally applied through solar energy, the cheapest and easiest method to implement (Akoy et al., 2008). This process is done to remove water to a level where microbial spoilage and deterioration reactions are greatly minimised (Akpınar and Bicer, 2004), resulting in longer shelf-life, reduced space needed for storage, and lighter weight to transport, which can facilitate and reduce the costs of exporting the product (Ertekin and Yaldiz, 2004; Naz, 2012; Mongi et al., 2013). Moreover, dried fruits are not subjected to the same strict market requirements that fresh fruits must respect since they can have various flavours, shapes, textures, and properties

depending on the processing (Wong et al., 2020). Processed dried mango is an added-value product that can be sold with a higher profit margin, improving the income and livelihoods of rural households (Grant et al., 2015; Wong et al., 2020).

In Kenya, where the retailing of fresh fruit is preferred to processed, dried mango is a novel product. Even for export, only 6% of local Kenyan farmers undertake this value-adding strategy, with, in total, only 2% of all mango grown in Kenya being processed (Musyoka et al., 2020). Thus, despite being Africa's largest mango producer, Kenya still plays a marginal role in the European dried mango import market. One main European consumer, Germany, sees its dried mango imports coming principally from Burkina Faso and South Africa [Centre for the Promotion of Imports from Developing Countries (CBI), Ministry of Foreign Affairs, 2021]. This can be seen as a missed opportunity for Kenya's smallholders, who rely more on subsistence production and farm gate purchases.

On the other hand, Germany is a fast-growing dried mango market, thus in 2020 surpassing European imports the UK as the main dried mango buyer. While retailing was traditionally relegated to specialised stores, now dried mango is found in most mainstream supermarkets [Centre for the Promotion of Imports from Developing Countries (CBI), Ministry of Foreign Affairs, 2021]. In 2020, 7,000 tons of dried mango were imported across Europe (with an increasing trend of import volume of 10–12% between 2018 and 2022). As the main export market of focus, the UK and Germany provide great opportunities, especially for fair trade and organic certified dried mango [Centre for the Promotion of Imports from Developing Countries (CBI), Ministry of Foreign Affairs, 2021]. The great success of fair trade and organic products can be attributed to the great relevance that these topics hold for European consumers. Ethical production, food safety, and marketing characteristics along the value chain, among others, play an essential role in consumer choice (Badar et al., 2015). These non-sensory attributes (defined as extrinsic attributes) are not part of the physical characteristics of the product (i.e., intrinsic attributes, such as taste, sweetness, aroma, consistency, etc.), yet they correspond to marketing-related attributes that consumers evaluate during the purchasing process (Badar et al., 2015; Rondoni et al., 2021). These are relevant to the consumer and their preferences.

The study was done in the frame of the EU (LEAP-Agri, 2017) project "STEP-UP." Export options for mango were assessed within a bundle of sustainable intensification (SI) and market linkage (ML) strategies to enable small farm enterprises (SFEs) to step up toward food and nutrition security, sustainable development, and income generation. The County Government of Kitui, in close collaboration with several key development partners, has identified value addition as one of the critical missing links necessary for sustainable mango farming in the county (CGoKTI, 2020). As such, 335 individuals were randomly selected in Germany and Kenya to evaluate the sensory attributes of Kitui's dried mango flakes. The overarching goal of the surveys is to provide an initial contribution to the market development of dried mango in Kenya (for local consumption) and Germany (for export). This will be done by answering three research questions:

1. How do Kenyan and German consumers differ in terms of intrinsic preferences toward different types of dried mango flakes produced in Kitui?

2. Do German and Kenyan consumers respond to the extrinsic attributes similarly? How do extrinsic attributes affect their willingness to pay?
3. Could varieties and processing methods be identified to meet the export or local market best?

More specific questions need to be formulated after further establishing the product in Kenya. Do more experienced German consumers assess the intrinsic attributes more critically and expect the product to have a fruity flavour, shiny colour, and sweet taste to receive higher hedonic scores than the new consumers in Kenya? Will we find extrinsic attributes with a similar impact on the WTP in both countries, even considering the high difference in wealth and age cohorts of the population?

2. Methods

Through a series of workshops, STEP-UP co-designed the quality management and applied training on mango production and processing, as well as on marketing and market access of mango and mango value-added products, with a special focus on mango flakes. The STEP-UP Project with NETFUND and JKUAT, in close collaboration with the initiative at the County Government of Kitui, organised the trainings. From an initial two solar dryers in 2019, an additional 11 solar drying units were added step-by-step through 2021, which builds the basis for the sampling of the flakes for testing in the surveys (KVTT, GAPA, and KAPA). Between October 2019 and April 2021, product consumer testing and sensory evaluations were conducted after two seasons of mango drying activities, including processing through solar drying and commercialisation of locally produced mango flakes. The sampling methods were limited by the COVID-19 pandemic and related restrictions. Consequently, we could not approach randomised consumers at the site of markets or events to provide the mango flakes tasting samples. Nevertheless, 335 panellists in Germany and Kenya contributed to improving market strategies for export and local markets.

The Kenyan (KAPA) and German (GAPA) surveys use a methodology for developing marketing strategies that focus on the values of consumers comprising both particular interests for themes linked to the macro area of sustainability while also targeting a more pragmatic orientation (nutritional value, taste). The marketing strategy is then determined under the principle of compatibility (or fitting in with existing values, past experiences, and needs of potential adopters).

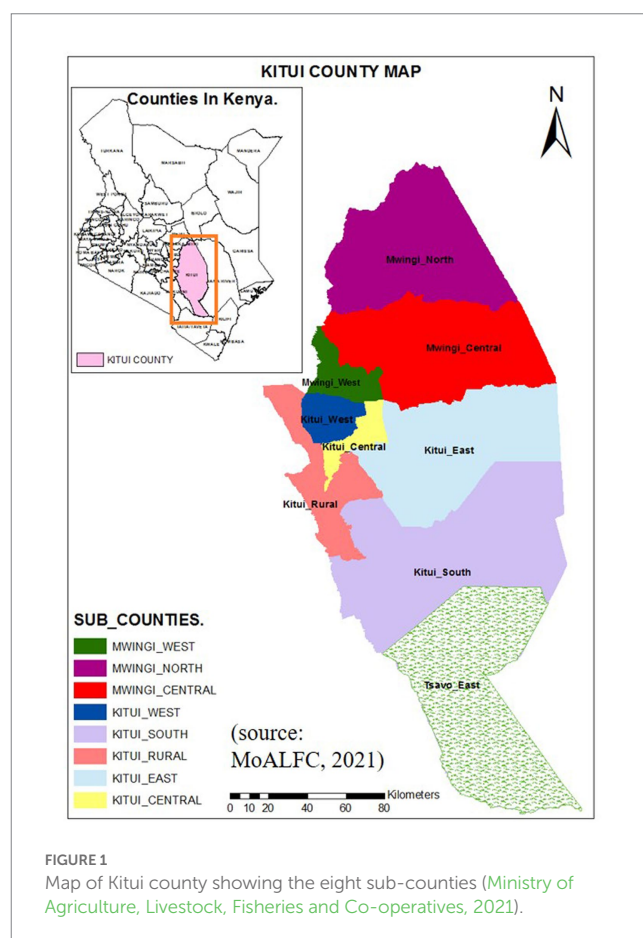
The survey on Kitui mango specifics (KVTT) carried out an analysis to establish the most appropriate treatment for each variety, enhancing the value-adding component. Each treatment has the property to enhance a specific intrinsic attribute and a specific treatment is not a panacea for all mango varieties.

2.1. Study area

The Kenyan surveys were conducted in the Kenyan counties of Nairobi, Kiambu, and Kitui, whereby the KVTT was conducted in the JKUAT, Juja/Nairobi only. Kitui County, one of 47 counties in Kenya, is situated 160 km east of Nairobi City. It lies between latitudes 0°10

South and 3°0 South and longitudes 37°50 East and 39°0 East. Based on its area cover, Kitui is the sixth-largest county in the country and covers an area of 30,429.5 km², which includes 6,302.7 km² occupied by Tsavo East National Park. The county has eight (8) sub-counties: Kitui Central, Kitui East, Kitui Rural, Kitui South, Kitui West, Mwingi Central, Mwingi North, and Mwingi West (Figure 1). According to the 2019 population census, Kitui has a population of 1,136,187 (Kenya National Bureau of Statistics, 2019). The main economic activity in Kitui County is agriculture, contributing to food security and generating 87% of rural household income. One of the main cash crops grown in the county is mango, with 81–100% of farmers engaged in the mango value chain (Ministry of Agriculture, Livestock, Fisheries and Co-operatives, 2021). Nairobi and Kiambu County were also selected for the study due to their huge markets. These two counties host a large working population of all ages with differing education levels, income levels, and eating habits (Ministry of Agriculture, Livestock, Fisheries and Co-operatives, 2021).

Together with the United Kingdom, Germany represents half of the European market for dried mango. Germany is a particularly attractive market for organic dried mango as the country is the largest European market for organic food. Further, sugar-free and preservative-free dried mango sales are increasing [Centre for the Promotion of Imports from Developing Countries (CBI), Ministry of Foreign Affairs, 2021]. In Europe, at least 80 percent of the dried fruits end up in breakfast cereals and the confectionery industry [Centre for the Promotion of Imports from Developing Countries (CBI), Ministry of Foreign Affairs of the Netherlands, 2014]. Hence, dried fruits sold



as a snack in Europe can generally be categorised as niche products. Tropical dried fruits, like mangoes, bananas, and pineapples, are among the rare dried fruits increasingly popular as healthy snacks [Centre for the Promotion of Imports from Developing Countries (CBI), Ministry of Foreign Affairs of the Netherlands, 2014].

2.2. The Kenyan varieties and treatment testing

The Kenyan varieties and treatment testing (KVTT) was conducted to determine the best-performing combination of mango variant and treatment from a mere intrinsic standpoint. It involved 31 students from the food and nutrition science department at the Jomo Kenyatta University of Agriculture and Technology (JKUAT) acting as semi-trained panellists, following an experimental research design with a 4×6 factorial arrangement. Provided with six varieties of dried mango flakes produced in Kitui Central and processed at the Sun Sweet solar drier of Ithiiani, participants were asked to evaluate the sensory attributes (i.e., colour, aroma, taste, chewiness, sweetness, and overall impression) of each variety through a questionnaire utilizing a 9 point hedonic scale ranging from the extreme like to extreme dislike. The meaning of each attribute was explained to the participants to avoid interpretation biases. No information regarding demographics (except the age and sex of participants) or consumer behaviour was collected. The testing aimed to address the range of intrinsic characteristics of Kitui's dried mango.

The tested mango varieties are Ngowe, Apple, Van Dyke, Boribo, Kent, and Kikamba. Each variety was presented to the panellists in 4 different samples (one control with no treatment, one sample treated with a solution of ascorbic acid, one treated with a solution of sodium metabisulfite, and one with a honey water solution). The participants received potable water for mouth rinsing between tests to avoid tasting disturbances.

The consumer testing results were analysed and compared between samples through an analysis of variance (ANOVA) at a significance level of $p \leq 0.05$ using the IBM statistical package SPSS 23.0. The means were compared using the Tukey's-*b* test whenever the treatment effects were significant.

2.3. The German acceptance and preference analysis

The German acceptance and preference analysis (GAPA) was developed in Berlin, the German capital. Due to the COVID-19 pandemic, conducting a physical consumer panel was impossible, so it was decided to design a home-use test that could be carried out remotely. The developed, easy-to-apply, research tool was distributed in Berlin and mailed to potential untrained consumers in Germany (Soika, 2022). The hand-out and mail contained three samples of mango flakes to evaluate intrinsic and extrinsic dried mango attributes. It sought to identify the correlation between demographic factors (age, sex, income, occupation), consuming behaviour related to dried mango (frequency of purchasing and consumption), label-certified products (organic, natural, fair

trade), values, and willingness to pay for Kenyan produced dried mango. GAPA was conducted in a two-stage survey of untrained panel settings. The participants of both panels were a convenience sample recruited through the network of the research team, which – due to Covid-19 – was the only feasible option to carry out research in person. Participants were mostly young people with academic backgrounds and not necessarily regular consumers of dried products. A remote home-use test for self-administration was designed and, for each round of testing, panellists received the samples and the evaluation form by mail. The sensory acceptance and preference test was devised following Lawless and Heymann (2010) and prepositioned to Nguyen and Wismer (2019). The acceptance test measures consumer attitudes toward a particular product nuanced by measurement of specific product attributes (Lawless and Heymann, 2010) and, in the present case, provides insights about the acceptance of the entirety of the mangos. For the WTP analysis, the method of “Price Sensitivity Meter” (PSM) was applied according to Van Westendorp (Chatterjee et al., 2015; Weinrich and Birgit Gassler, 2021) to determine the optimum price point of which consumers intend to buy the dried mango products.

First, the Preparatory Consumer Testing (PCT), performed in January and February 2021, involved 113 untrained panellists who assessed the intrinsic attributes of 3 different dried mango samples: Kikamba half ripe, Kikamba full ripe (both produced in Kitui during the STEP-UP project during the harvest season 2019/2020 and without additives), and a brand widely offered in German supermarkets, hereafter referred to as *market reference* (which is treated with sodium bisulfite).

Second, the MCT (Major Consumer Testing) was conducted on 97 untrained panellists to investigate consumer preferences and willingness to pay, utilizing an untreated Apple mango (control) sample without additives, Kikamba Half Ripe mango fingers (produced in Kitui, also without additives), and again the same market reference treated with sodium bisulfite.

Each sample's intrinsic attribute (i.e., colour, aroma, taste, chewiness, sweetness, sourness, and overall impression) was evaluated by respondents using a 9-point hedonic scale ranging from the extreme like to extreme dislike.

Both surveys were conducted using the online tool Survey Monkey. The consumer acceptance and preferences analysis was done with IBM SPSS® Statistics version 27. Dummy variables for influential consumer liking variables were created to determine differences between consumer groups. These dummies include (a) Age (below and equal or above 35 years); (b) Ecological brand buying behaviour; (c) Sustainable store buyers; (d) Regular and non-regular consumers; (e) Regular and non-regular buyers; (f) Market reference buyers and non-buyers; and (g) Fair trade brand buyers and non-buyers. Further analyses on determinant factors like income, and clusters to build targeted communication strategies (Nandi et al., 2016) are not presented in this paper.

Each dummy related to consuming behaviours was created by dividing the population into two categories based on the frequency of consumption (where people answering the question “how often do you buy food that...” with “often” or “always” were assigned to the population adopting the consuming behaviour). Statistical significance was analysed through the ANOVA function at a significance level of $\alpha = 0.05$.

2.4. The Kenyan acceptance and preference analysis

Kenyan acceptance and preference analysis (KAPA) follows the same methodological design as GAPA to assess the possible degree of influence of Kenyan consumers' values, knowledge, and background on the intrinsic attributes, perception, and willingness to pay for dried mango. This part of the study serves mostly as a preliminary test to have an initial idea regarding the openness of Kenyan consumers to relatively cheap-to-produce varieties. It also served as a baseline to determine if the degree of influence of extrinsic factors is similar to the German case.

It employs a data set from a questionnaire administered online through Survey Monkey in three waves of surveys conducted in September and October 2021 of a 100-respondent sample. The stratified random population sample consists of members of NETFUND staff in Nairobi, JKUAT students in Kiambu, local mango producers in Kitui, and residents in Kitui. The respondents, who were not trained panellists, received dried mango samples and were asked to complete a questionnaire using Survey Monkey. Demographic information, such as age, gender, education, occupation, income, consumption and purchasing habits (concerning extrinsic attributes such as organic, fair trade, sustainable, and healthy products), was gathered and processed to conduct a regression analysis.

The solar-dried mango flake samples, consisting of full ripe Apple Mango and Kent Mango, were produced and purchased by a local mango processing facility small holder in Kitui Central without additives. Each sample's intrinsic attribute (i.e., colour, aroma, sweetness, taste, etc.) was evaluated by respondents using a 9-point hedonic scale ranging from the extreme like to extreme dislike. The testing round was conducted with the panellists not knowing about the dried mango's extrinsic attributes.

The data collected was treated and analysed using IBM SPSS® Statistics version 27. A set of dummy variables was created to divide the sample population into different sub-sets as independent variables, differentiating the degree of acceptance for various sample categories (and to find possible correlation links between consumer groups and appreciation of dried mango samples in light of extrinsic attributes). The dummy variables (all dichotomous or binary) were created to divide the population by (a) Age, differentiated in adults (>35) and youth (<=35); (b) Degree of ecological footprint awareness; (c) Dried mango

purchasing habits; (d) Degree of preferences for organic products; (e) Degree of preferences for fair trade products; (f) Degree of preferences for socially sustainable products; (g) Degree of preferences for healthy products; and (h) Budget constrained buyers and consumers without budget constraints.

Each dummy related to consuming behaviours was created by differentiating the population into two categories based on the frequency of consumption (where people answering the question "how often do you buy food that ..." with "often" or "always" being assigned to the population adopting the consuming behaviour). The statistical significance between variables ($p < 0.05$) was determined under the *T*-test and the Mann–Whitney *U* test through the one-way Analysis of Variance (ANOVA).

The COVID-19 pandemic affected the implementation of the study as gatherings were banned and major cities had lockdowns. These prevented researchers from moving from urban areas to rural areas.

2.5. Datasets used

2.5.1. Kenyan varieties and treatment testing

The Kenyan Varieties and Treatment Testing were conducted with a group of 31 semi-trained mango consumers, of which 18 were male and 13 female, all belonging to the age class of the youth (<35 years), with a mean age of 25 years. All participants were students of food and nutrition science at JKUAT. No other information regarding the sample population characteristics was collected.

2.5.2. German acceptance and preference analysis

2.5.2.1. Preparatory consumer testing

The Preparatory Consumer Testing (PCT) of the German Acceptance and Preference Analysis, conducted in January and February 2021, employed 113 untrained consumers, 67 of which were females (59.3%) and 46 males (40.7%), with a mean age of 32 years (with variability that ranges from 5 to 70 years), where the majority of panellists were in their mid-twenties and early thirties (Table 1). No information on education, occupation, and income was collected during the PCT.

TABLE 1 Gender and age of PCT and MCT participants in Germany (GAPA): percentage and N.

German surveys	PCT	PCT	MCT	MCT
Variable	Percentage (%)	Absolute frequency (N=)	Percentage (%)	Absolute frequency (N=)
Gender	100	113	98.9	93
Male	40.7	46	33	31
Female	59.3	67	64.9	61
Diverse	–	–	1.1	1
Age	100	113	100	94
35 or younger	74.3	84	85.1	80
36 or older	25.7	29	–	–
Between 36 and 57	–	–	8.5	8
Over 57	–	–	6.4	6

2.5.2.2. Main consumer testing

The Major Consumer Testing conducted 4 months after the PCT included 94 panellists (61 females, corresponding to 65% of the sample population, 31 males, equal to 33% of the sample, and one non-binary) (Table 1). Most panellists were in their mid-twenties and early thirties, with an average age of 32 years (similar to the PCT).

Most of the sample population had an academic degree, with 34% holding a Bachelor's degree, 30% a Master's degree, and 37% being enrolled in a university. Almost half of the sample population was employed, with the vast majority having an income range in the lower half of the spectrum (Table 2).

2.5.3. Kenyan acceptance and preference analysis

The rounds of testing in the Kenyan Acceptance and Preference Analysis included 100 respondents from Nairobi, Juja, and two sub-counties of Kitui County (Kitui Central and Mwingi West). The average age was 25 years (with a variability that ranges from 18 to 52 years), with the large majority being in their early to mid-20s, 40.8% being female, and 58.2 male (with one person describing themselves as non-binary). Adults (those older than 35) made up only 10% of the sample (Table 3).

Most of the sample had concluded their education in a tertiary institution (90%), 62% of the respondents were students, 23% were employed, 4% were unemployed, and 9% described themselves as self-employed (Table 4). These figures provide a first explanation regarding the income range of the sample, where 50% of the respondents collocated themselves at the lower end of the income spectrum, and only 24% earned more than 30,000 KES (KES = ISO code for Kenyan Shillings) per month.

3. Results

3.1. Sensory evaluation under different treatments and intrinsic attributes assessment (KVTT)

The sensory evaluation of each mango flake variety under no treatment shows that Ngowe is the mango with the highest quality, according to the trained panellists, followed by Van Dyke and Boribo. In contrast, Kikamba is rated as the lowest quality variety (yet not rejected by the panellists), followed by Kent and Apple (Table 5).

Observing the hedonic scores given by 32 panellists to 6 mango flakes varieties treated with sodium metabisulfite, ascorbic acid, and honey, it emerges that these treatments do not significantly increase the overall acceptance of Ngowe (where the treatment negatively affects the hedonic score), Apple, Van Dyke, or Kent. On the other hand, sodium metabisulfite enhances the degree of liking of Boribo. In contrast, honey significantly affects the degree of enjoyment of varieties like Kikamba and Boribo (but to a lower extent compared to sodium metabisulfite for Boribo). Additionally, the variation in hedonic score between control Van Dyke and Van Dyke treated with honey suggests that honey increases the degree of enjoyment of the variety. Still, this difference is insignificant ($p > 0.05$), similar to Kent treated with ascorbic acid. Honey-treated dried mango flakes had the highest score on overall acceptability, followed by sodium metabisulfite, control, and ascorbic acid. The study also shows that the use of additives has no significant effect on the taste, sweetness,

TABLE 2 Socio-demographics of MCT (GAPA): percentage and N of education, occupation and income.

Variable	Percentage (%)	Absolute Frequency (N=)
<i>Education</i>	98.9	93
Secondary School	3.2	3
College, no degree	11.7	11
University, no degree	16	15
Bachelors' graduate	34	32
Masters' graduate	29.8	28
Promotion	4.3	4
<i>Occupation</i>	97.9	92
Student	4.3	4
University Student	37.2	35
Employed	44.7	42
Freelancer	11.7	11
<i>Income (per month)</i>	97.9	92
Less than 1,000 €	29.8	28
1,000–1,499 €	24.5	23
1,500–1999 €	10.6	10
2000–2,999 €	20.2	19
3,000–4,999 €	8.5	8
5,000 € and more	4.3	4

TABLE 3 Kenyan sample population (KAPA), N and percentages for gender, age and education classes.

Variable	Percentage (%)	Absolute frequency (n=)
<i>Gender</i>	100	98
Male	58.2	57
Female	40.8	40
Non-Binary	1	1
<i>Age</i>	100	100
34 or younger	91	91
35 or older	9	9
<i>Education</i>	100	98
Secondary	8.2	8
Tertiary*	91.8	90

*Formal post-secondary education, including public and private universities, colleges, technical training institutes, and vocational schools.

and chewiness (or mouthfeel) of four mango varieties: Ngowe, Apple, Van Dyke, and Kent (Table 5).

3.2. Germany's acceptance and preference analysis

3.2.1. Preparatory consumer testing

Figure 2 gives an overview of the last time of purchase of the two German surveys: In PCT 52 respondents (46%) never purchased dried

TABLE 4 Kenyan sample population (KAPA) divided in occupation classes and related gross monthly income in KES.

Occupation	Gross Monthly Income				Total N
	Less than KES 10,000	Between 10,000 – 30,000	Between 30,000- 50,000	Above 50,000	
Pupil	1	0	0	0	1
Student	45	14	2	0	61
Self employed	3	4	2	0	9
Employee	0	6	5	12	23
Unemployed	1	2	1	0	4
Total N	50	26	10	12	98

KES, ISO code for Kenyan Shillings.

TABLE 5 Kenyan hedonic test scores* of dried mango flakes' overall acceptance as affected by the variety and treatment (KVTT); means with different superscripts^(j) within a column and with different subscript_(i) within a row are significantly different (LSD, P<0.05), and values are presented as mean±SD.

Variety	Treatment				Sig. level row
	Control	Sodium metabisulfite	Ascorbic acid	Honey	
Ngowe	7.23 ± 1.56 ^b _b	6.39 ± 1.75 ^{ab} _{ab}	6.13 ± 1.78 ^{bc} _a	6.77 ± 1.15 ^{abc} _{ab}	*
Apple	5.90 ± 1.94 ^{ab} _a	6.03 ± 1.80 ^a _a	5.48 ± 2.01 ^{ab} _a	5.84 ± 1.66 ^a _a	ns
Van Dyke	6.65 ± 2.09 ^{ab} _a	7.35 ± 1.38 ^b _a	7.00 ± 1.77 ^c _a	7.42 ± 1.26 ^c _a	ns
Boribo	6.65 ± 1.84 ^{ab} _{ab}	7.27 ± 1.60 ^b _b	5.74 ± 2.28 ^{abc} _a	7.06 ± 1.91 ^{bc} _b	*
Kent	5.81 ± 1.94 ^{ab} _a	6.58 ± 1.18 ^{ab} _a	5.61 ± 1.76 ^{abc} _a	6.16 ± 1.66 ^{ab} _a	ns
Kikamba	5.00 ± 2.22 ^a _{ab}	5.55 ± 2.05 ^a _{ab}	4.68 ± 2.18 ^a _a	6.13 ± 1.74 ^{ab} _b	*
Sig. level col.	*	*	*	*	

N=31, * = Significant at 5% level and ns, non-significant (p > 0.05). *Hedonic scale from 1 to 9, 1 = I dislike extremely, 2 = I dislike very much, 3 = I dislike moderately, 4 = I dislike slightly, 5 = Neither like nor dislike, 6 = I like slightly, 7 = I like moderately, 8 = I like very much, 9 = I like extremely (Lerantilei, 2022).

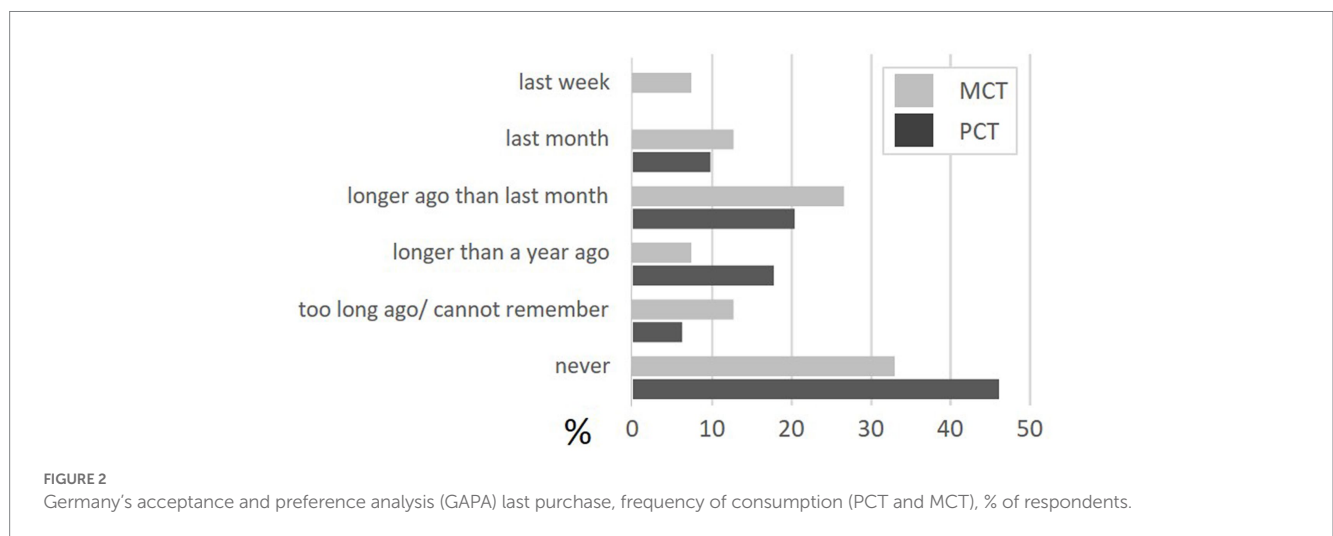
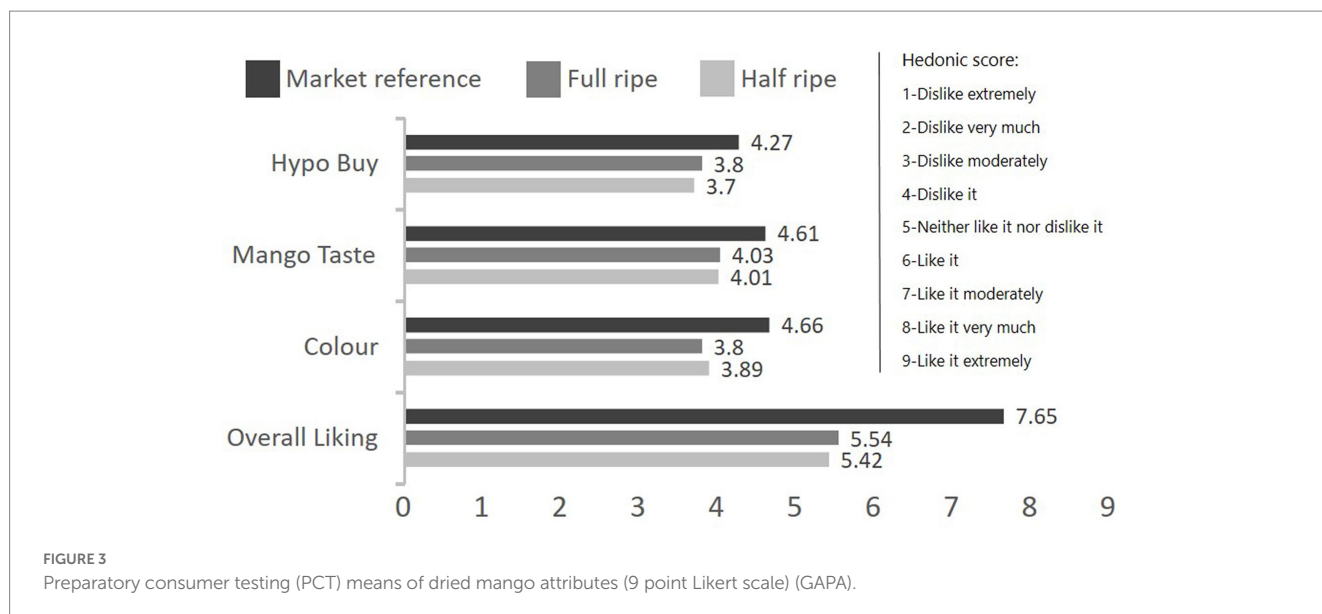


FIGURE 2 Germany's acceptance and preference analysis (GAPA) last purchase, frequency of consumption (PCT and MCT), % of respondents.

mangos, 11 respondents (9.7%) bought mangos within the last month 23 panellists (20.4%) purchased them over a month ago, 20 respondents (17.7%) over a year ago, and 7 (6.2%) indicated that they could not remember the last time of purchase or that it was too long ago. In the sample evaluation, there were no statistically significant differences between frequent consumers of dried mango and those who do not buy or consume it, in overall liking and mango taste scores on the provided mango samples.

The market reference scored the highest means in every category. The largest discrepancy is displayed for overall liking, where the market reference has a mean (M) of M = 7.65 (Supplementary Table A.2 and Figure 3). The means of the Kenyan varieties for overall liking, mango taste, colour, and hypothetical purchase frequency are quite close for both full-ripe and half-ripe (Figure 3).

The results of the first consumer panel (without extrinsic attributes mentioned to the panellists) show that younger and female



consumers are those who purchase and consume dried mangos most often (Supplementary Table A.2). The greatest difference in sensory evaluation between the Kikamba varieties and the market reference can be found in the attributes of colour and mango taste (where the market reference displays higher liking). The mango taste of the Kikamba varieties was evaluated slightly better by ecological brand buyers than by regular brand buyers, yet not by a significant margin. Furthermore, ecological brand buyers evaluated the mango taste of the treated market reference as slightly inferior. In total, 88 panellists preferred the market reference, 11 liked the half ripe Kikamba most, and 11 the full-ripe Kikamba (Supplementary Table A.2).

3.2.2. Major consumer testing

Figure 2 also gives an overview of the last time of purchase for the 94 MCT respondents: 33% never bought dried mango, 26.6% stated that the last time they purchased was over a month ago; further 7.4% purchased dried mango last week, 12.8% last month, 7.4% purchased it over a year ago, and 12.8% cannot remember or the purchase was too long ago to remember. The results show no difference in acceptance of the mango samples between the frequent and non-frequent purchasers of dried mango. Therefore, the respondents are treated equally.

The market reference shows the highest score for overall liking with a mean (M) of $M=7.24$ on the 9-point hedonic scale compared to the Kenyan variants with a mean score of $M=6.85$ (Apple) and $M=5.81$ (Kikamba) (Figure 4).

Please find results of statistical analyses displayed in Supplementary Tables A.3, A.4:

No statistical significance was found between the groups of younger and older consumers. The Kikamba variant has the lowest means, followed by the Apple variant. The market reference shows the highest values and is slightly preferred by younger consumers, while older respondents prefer the Kikamba mango and market reference.

Ecological brand buyers do not significantly differ in overall liking compared to regular brand buyers. No significant difference was detected between the groups of infrequent and frequent buyers,

market reference and various brand buyers, or between consumers and non-consumers of dried mango.

Consumers with either high or low scores for ecological awareness both prefer the market reference. However, consumers with a high score on ecological awareness rank the Apple mango second ($M=6.9$) and Kikamba last ($M=5.7$), whereas consumers with a low score rank the Kikamba mango second ($M=6.0$) and Apple last ($M=5.0$).

Consumers with a high awareness of fair-trade show overall higher means for liking mangos across all variants. The group with high awareness shows the highest mean of all 68 groups for the Apple mango ($M=7.37$), which is only 0.36 points lower than the mean of the market reference ($M=7.73$). The group' means differ only statistically for the market reference; it is close to significant for the Apple variant ($p=0.56$).

The Apple mango has the highest mean for mango taste, with a value of $M=5.54$, followed by the market reference, with a mean of $M=5.47$. Kikamba mango has the lowest value for this attribute, with a value of $M=4.86$. Yet, Kikamba mango shows the lowest means followed by the market reference and Apple mango with higher means.

The reference mango has the highest mean, with $M=6.27$ for the attribute colour, closely followed by Apple mango with $M=5.94$. The brown Kikamba mango has the lowest value, with $M=3.85$. Consumers with a high awareness of fair food production have a higher overall liking for the colour of all variants. The hypothetical purchasing frequency is the highest for the market reference, with a mean of $M=4.46$. The mean for Apple is slightly lower at $M=4.11$, followed by Kikamba at $M=3.57$. No relevant significance for hypothetical purchasing frequency is found for all other consumer groups.

Following the tasting, respondents were asked to state which sample they preferred without any further information: 50% of the respondents chose the market reference, 29.8% picked the Apple mango, and 20.2% the Kikamba mango (Figure 5). After assessing the intrinsic attributes, the panellists were informed about the extrinsic attributes of the samples: the Kenyan mangos

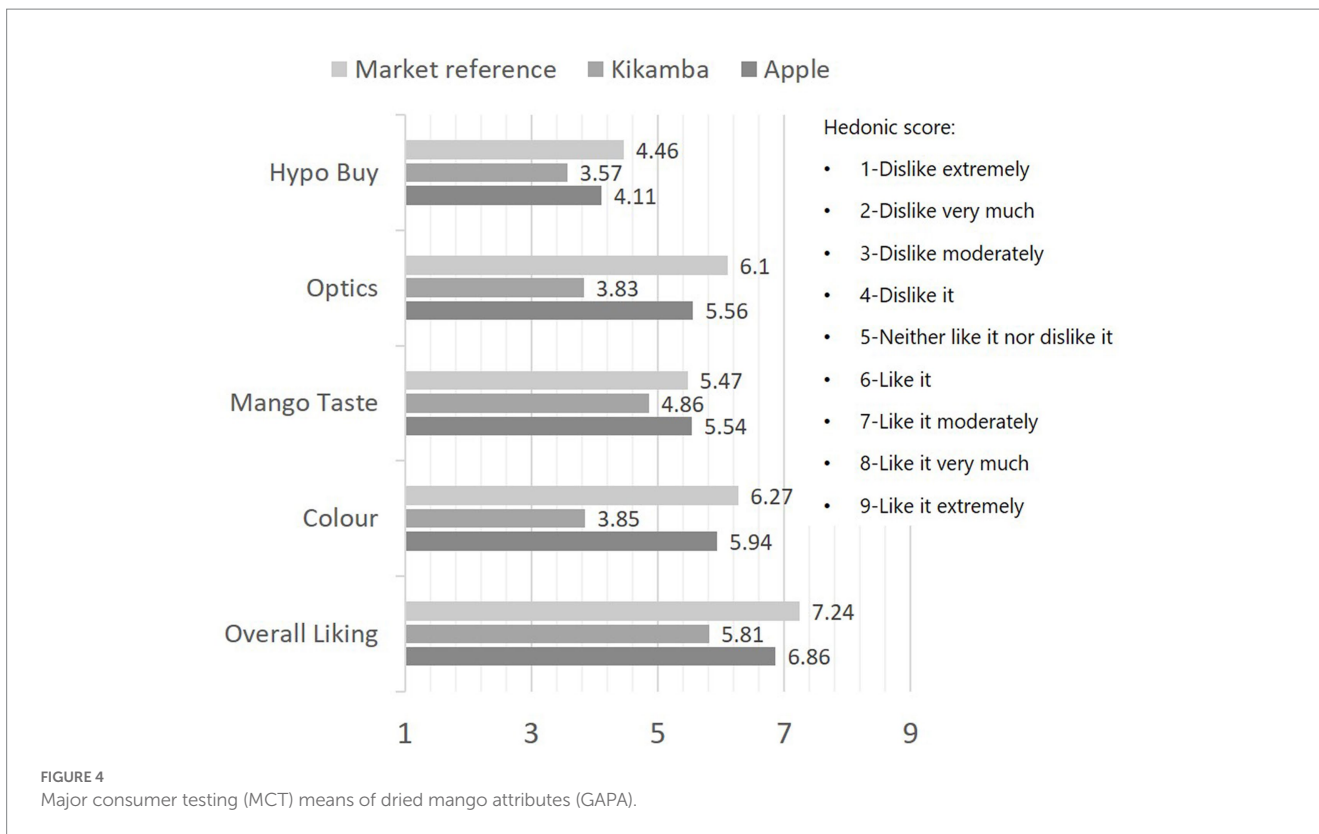


FIGURE 4 Major consumer testing (MCT) means of dried mango attributes (GAPA).

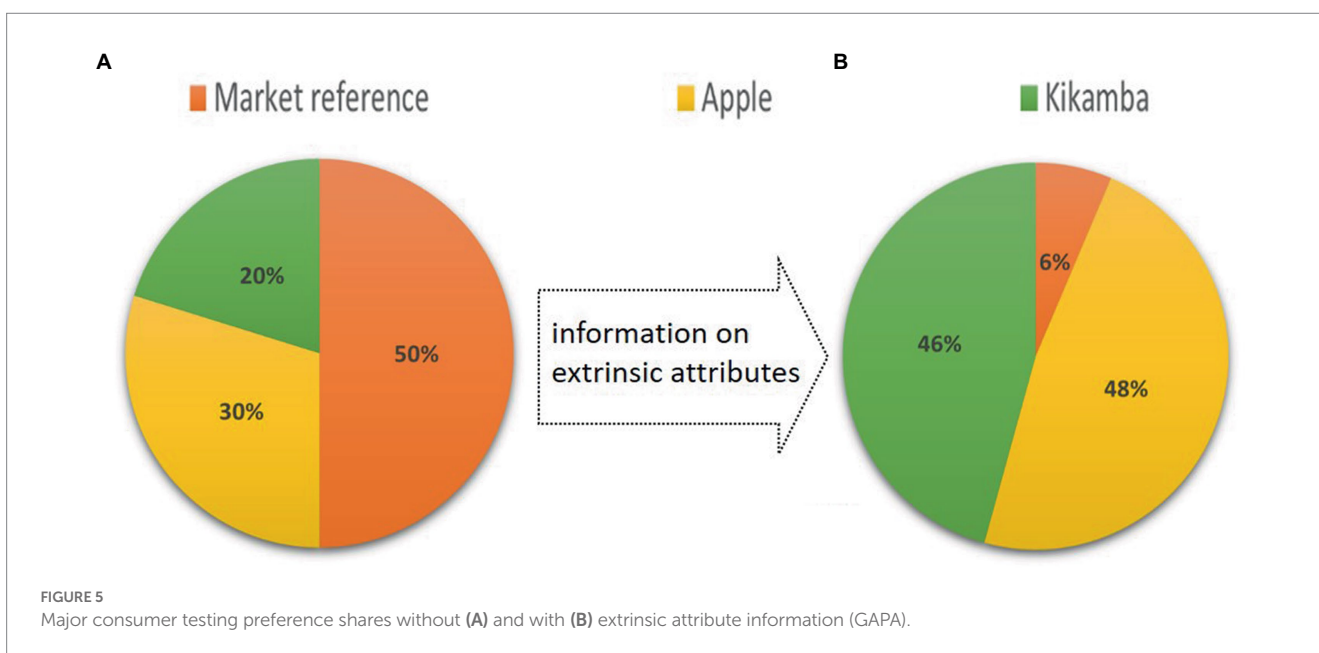


FIGURE 5 Major consumer testing preference shares without (A) and with (B) extrinsic attribute information (GAPA).

were characterised by no additional treatments, ecological production, and fair-trade certification, while there was a sodium bisulfite treatment and no such certification for the market reference. With that information given, 43.6% of the former respondents who previously preferred the market reference mango changed to the Kenyan variants, resulting in 47.9% of the panellists preferring the Apple mango and 45.7% the Kikamba mango (Figure 5).

3.3. Sensory evaluation results from Kenya (KAPA)

Among the untrained panellists participating in the KAPA consumer testing, only a small fraction, $n=9$ (13%), had bought dried mango within the last month. The majority of the sample had never bought dried mango before (59.4%), while the rest had bought it a long time ago (17.4%) or within the last year (10.1%). Among the

reasons why respondents do not buy dried mango products regularly, the most chosen response was “unavailability,” followed by the “preference for fresh produce.”

All respondents liked the samples (from “slightly” to “extremely”) with few exceptions. Kent received more negative scores than the Apple variety, with greater minimum scores for all the liking factors. In terms of overall appreciation, Apple is slightly more preferred. The Apple variant is particularly appreciated for taste and aroma (sweet taste), and the Kent variety for the colour (appearance or look) (Supplementary Table A.5).

Analogous to the investigations of extrinsic attributes of dried mangos sold in Germany, the influence of motivation or attitude on the evaluation of the dried mango flakes was tested in the survey in Kenya. For this purpose, the respondents were divided into two groups based on their answers – which were used as a dummy variant to work out differences. Both adults and youth have a slight preference for the Apple variant. The sample population younger than 35 gave higher average scores to both variants than the adults: 1.73 and 0.45 average points, respectively. Statistical significance was found for different Kent attributes, showing a higher predisposition of the youth for the Kent variety (Supplementary Tables A.7, A.8).

When analysing the results with respect to gender, no statistically significant difference between males and females emerged. Yet, the results show that females tend to give higher scores for all the liking factors and, thus, the overall impression of both variety samples (Supplementary Tables A.7, A.8). Males, on the other hand, gave more negative scores (even from “moderate” to “extreme”) to the Kent variant and a few slightly negative scores to the Apple variant. Statistically significant differences were found between the groups of regular and non-regular mango flakes buyers concerning Kent variety overall impression ($p=0.016$), aroma ($p=0.020$), chewiness (0.043), and sweetness (0.025), with regular buyers providing significantly greater average scores. Additionally, regular buyers provide higher scores for every sensorial category for Kent and Apple varieties (Supplementary Table A.6).

Against results from the GAPA we checked the possible impact of extrinsic attributes by looking at the correlation between the degree of overall liking and participants buying habits. We found among created consumer groups that only within those who were oriented toward natural products showing significant differences ($p<0.05$). For groupings regarding ecological footprint (eco-friendly) or fair-trade awareness, consumer behaviours seeking for organic, and local (KO) products, any statistically significant differences ($p<0.05$) were revealed (Supplementary Tables A.7, A.8).

When comparing natural product buyers and non-natural product buyers, statistically significant differences are found between the two groups concerning Apple variety overall impression ($p=0.022$), where natural buyers give a significantly higher average score (8.19 vs. 7.68) (Supplementary Tables A.7, A.8). According to the average scores for each variety, Kent colour is the only characteristic deemed better than Apple by both groups.

Looking at the sample population portion who always or often buys healthy products, compared to those who do not or do it seldomly, there is a statistically significant difference ($p=0.021$) concerning the degree of appreciation of Kent mango colour, with non-healthy buyers ($M=8.56$) giving a significantly higher mean score (against an $M=7.86$ from healthy buyers). This population also gave higher scores to the aroma, sweetness, sourness, chewiness, and

overall impression. Kent’s worst attribute, according to non-healthy buyers, was taste, while for healthy buyers, it was the aroma (Supplementary Tables A.7, A.8).

3.4. Willingness to pay comparison between Germany and Kenya

In Germany, the Kikamba and Apple mango purchased at around 3 euros would be considered a good offer (with 5.50 euros considered too expensive and 1.76 euros too cheap, whereas the right price for the market reference is 2.27, with 4.52 too expensive and 1.38 too cheap), with the max expenditure set at around 4.20 euros for both varieties. Consumers with a higher awareness of fair-trade exhibit a higher mean for the expensive price point at which they would still buy the dried mangos compared to those with a middle to low awareness. On the other hand, figures from the Kenya survey show that the willingness to pay is much lower, even after knowing the extrinsic attributes, with no statistical significance in the willingness to pay among the dummy variables created. The willingness to pay was then evaluated based on the income classes to out rule the lack of finances as the main motivation.

More than half of the respondents of all income classes would pay between 40 and 80 cents for 100 g of dried mango, 25% between 80 cents and 1.20 euros, 14% between 1.20 and 1.65 euros, and only 7.9% would pay the price ranging between 1.65 and 2.05 euros. The portion of the population at the lower end of the income spectrum gave the highest average scores for the overall impression of both mango varieties. However, this did not have a noticeable positive effect on their willingness to pay.

Notably, the willingness to pay does not increase significantly for higher income classes, even though more people within the class between 30,000 and 50,000 KES per month report a willingness to pay a slightly higher price, although this difference is not statistically significant, with $p>0.05$.

4. Discussion

4.1. Comparing the Kenyan and German consumer groups (KAPA and GAPA)

According to overall impression rates, it is possible to establish that the Kenyan population does not have a strong preference for one specific variant, even though the Apple variety shows higher means, especially for the sweetness, taste, and overall impression. On the other hand, according to the PCT results from Germany, the market reference surpasses the scoring of both Kenyan varieties. In Germany, the mango flakes market is already established and consolidated; hence almost half of the panellists in the PCT have consumed or purchased dried mango in the recent past or within the month before the assessment (unlike Kenya, where this sub-group shrinks to 13%). In the MCT, 15% of the respondents frequently purchase dried mango (once or more than once per month). The market reference (which is already popular in German grocery stores) is deemed as the best under unknown extrinsic attributes when compared with the new Kenyan varieties (namely Apple and Kikamba, the latter of which, as the KVTT showed, is at the lower end of the quality spectrum).

On the other hand, in the KAPA, Kent and Apple receive very high scores for their overall impression, surpassing the acceptance of the market reference in Germany and the scores of the same varieties evaluated in the KVT. The Apple variant is particularly appreciated for taste, sweetness, and aroma, while the Kent receives very high scores for its colour. Such attributes are essential for product acceptance (Leng et al., 2017) since they are the primary concerns of the consumers (Khandelwal et al., 2017).

It is impossible to assess whether these higher scores translate into a greater predisposition by Kenyans to enjoy local mango varieties or if the high score is again due to a lack of access to dried mango and, hence, they do not have a baseline for assessing the sample characteristics as in Germany. The latter would seem more likely, considering that the semi-trained panellists from the KVT were much more moderate in expressing their liking: knowing the bunch of Kitui mango varieties with their range of qualities and flavours provided a baseline to judge the other samples accordingly. On the other hand, some KAPA participants have experienced mango flakes before, yet they still provided very high ratings, especially for the Kent variety. Hence, from an intrinsic standpoint, the variants produced during the STEP-UP project can be competitive in the local Kenyan market.

What could also be easily assumed is that the German market reference is a higher-quality mango variety. Yet, it must be highlighted that the main gap could be due to the processing carried out for the first time for Kikamba before additional training of the processing staff. The issue with sun drying is that the product can degrade if not done properly or in ventilated facilities. The first quality to be judged by a consumer when buying is generally the product's colour, which influences consumer acceptability. Hence, abnormal colour causes the product to be rejected by the consumer (Avila and Silva, 1999; Akoy et al., 2008). To maintain the dry mango's original colour without discolouration or darkening, a temperature of 80° is essential (being the optimal drying temperature). Still, the drying time also significantly affects the final output (Akoy et al., 2008). The gap between the colour (orange and shiny) of the German market reference and the Kenyan varieties might have affected the degree of enjoyment of other attributes (especially for the brown Kikamba). However, this is only speculation, especially considering that, although Kent was deemed as the variety with the best-looking colour by Kenyans, it was judged worse than Apple in terms of overall appreciation (yet slightly and not significantly). It must be noted that mango drying in Kenya is new. With ongoing practice of this value-addition strategy, the product's visual quality will likely increase with experience. Therefore, capacity building in training farmers and exporters remains imperative (even after the STEP-UP project) to meet the quality standards of the European Union (Ouedraogo and Chrysostome, 2019).

Considering the results from the MCT and related WTP analysis (where consumers shifted their preference choices in light of the explicated extrinsic attributes), the findings confirm the classical frameworks of consumer behaviour, which propose that food choices are the results of consideration of intrinsic (i.e., colour, texture, taste, etc.) and extrinsic factors (i.e., price, brand name, origin, packaging, organic and fair trade production), with the influence of the latter moderated by consumer demographic and socio-economic characteristics (Alphonse et al., 2015). Findings reveal differences in willingness to pay according to the respondents' profile and geography.

In Germany, consumers with a higher awareness of fair-trade exhibit a higher mean for the expensive price point at which they would still buy the dried mangos compared to those with a middle to low awareness. In Kenya, the willingness to pay is much lower, even after knowing the extrinsic attributes, and the lack of finances is the main motivation underlying the willingness to pay. As consumers in Europe and other developed countries are becoming more critical in their food choices, the use of third-party certification has become very popular for credence attributes related to health, environmental benefits, fair trade, and animal welfare (Harper, 2001; Didier and Lucie, 2008; Rijswijk et al., 2008).

In this sense, the results suggest that, on the one hand, the organic and fair-trade labels are a good marketing strategy to apply for Germany. It should be considered, on the other hand, that most panellists were young and with a superior education. Highly educated consumers are more aware of health, show environmental concern, and benefit from greater purchasing power (Baiardi et al., 2012). Educated consumers seem to care more for organic products than the less educated (Smith et al., 2009). While educated European consumers are more prone to pay extra for organic products, most of the population pays more attention to locally produced products, even though they are produced with conventional methods. At the same time, they tend to discount imported products from developing countries even more than those from developed nations (this process is also known as a domestic bias for organic food) (Schjøll, 2014).

The country of origin indeed seems to be more important than the organic aspect of the product, with foreign origin (especially from developing countries) negatively affecting the willingness to pay (this also applies to developing countries importing foreign products) (Alphonse et al., 2015). This refers to labels such as organic, green, ecological, natural, and environmentally sustainable (where consumers often are unable to distinguish between these, associating all these terms to something that can be described as naturalness or greenness, which offer a counter for what conventional production is associated with: food poisoning, pesticides, antibiotics, hormones, etc.) (Aarset et al., 2004; Yiridoe et al., 2005; Olesen et al., 2010). This can also be due to the fact that some consumers do not see any added value from organic production or might associate some sanitary risk with it (Guilbert and Wood, 2012). On the other hand, while the country of origin can work as a depreciation factor for Europeans (especially within the elderly population), most case studies show that a certified fair trade label increases the willingness to pay a price premium (European Commission DGVI, 1997; De Pelsmacker et al., 2005; Didier and Lucie, 2008; Mahé, 2010; Cailleba and Casteran, 2011; Rotaris and Danielis, 2011). For example, in a 1997 Eurobarometer survey conducted in the European Union, 70 percent of the consumers were willing to pay at least a 10 percent premium for products with a fair-trade label (Alphonse et al., 2015). Indeed GAPA consumers with a high awareness of social fairness show overall higher means (especially for Apple, with 6.9 average scores point at the 9-point hedonic scale). This validates the hypothesis that the extrinsic attribute "fair trade" enhances the intrinsic attribute experience. This is not the case for Kenyans, though, where even people with a high awareness of fair trade and social working conditions did not display significantly higher means.

According to the study by Alphonse et al. (2015) on "European consumer preference for African dried fruits," 70% of consumers within the study sample prefer naturally produced products (i.e.,

dried fruits with no additives, sugar, or other preservatives) to products with more stable tastes. This corroborates the results of this study, which would suggest that an untreated Ngowe mango would be the best option for export, according to the KVTT results. The fact that it is free of additives must also be stressed and made as explicit as possible on the packaging. However, Lusk and Briggeman (2009) indicate that taste is a very important factor for consumer acceptance and cannot be neglected. In general, sensorial preferences for dried fruit are mainly driven by strong fruit aroma, sweetness, or acidic intensity (this explains why the Apple variant is the most appreciated among the Kenyan mango flakes in KAPA and GAPA) (Alphonse et al., 2015). The KVTT verifies this precondition. Contrarily, the lack of aroma, extreme hardness, and low sweetness combined with high acidity are sensory properties that consumers reject the most (Alphonse et al., 2015). Yet, people who prefer sweet flavours differ from those preferring strong, acidic, or sweet and sour flavours.

For this reason, according to KVTT results, Van Dyke with sodium metabisulfite, honey, or ascorbic acid treatments, together with Boribo treated with sodium metabisulfite or honey, are also strong candidates for export; a label with descriptive sensory attributes should be placed accordingly. This should go together with the fair-trade and organic labels, which are important because assessments of dried mango flakes in Germany show that meeting sustainability preferences through packaging and labelling could increase the willingness to pay by consumers with specific values and consumption behaviours.

According to KAPA results, while participants are highly open to the Kenyan mango samples from an intrinsic standpoint, the extrinsic attributes did not produce any effect on their degree of enjoyment or WTP with respect to Kenyan responders. The only statistically significant correlation in terms of consumption choices was between healthy and non-healthy product buyers regarding Kent colour and between natural product buyers and regular buyers concerning the overall impression of Kent. The willingness of Kenyan consumers to pay is significantly lower than that of German consumers. While this could be attributed to the higher cost of living and salaries in Germany, the willingness to pay is not correlated with the income of the respondents. The initial findings of our study are consistent with those of Mujuka et al. (2021), which indicate a low consumer awareness of the processed product. Additionally, Kenyan consumers here indicate a very low willingness to pay for dried mangoes between USD 0.7–0.9 per 100 g (Mujuka et al., 2021).

According to Ronteltap et al. (2007), in addition to the sensory attributes, consumer acceptance is determined by the costs and benefits. These include not just personal benefits, like usage and health-related benefits, but also societal benefits (in the case of dried mango, this would include local farmers' improved livelihood, reduced waste, and sustainable food production). Yet, the perceived benefit is not always equal to the actual benefit derived from innovation. Still, the personal considerations of such a cost/benefit analysis determine consumer acceptance from a traditional economic point of view. Thus, while the degree of acceptance related to the sensorial experience is high, the degree of acceptance from the traditional economic perspective is low (as a cost/benefit analysis, where a trade-off is made between societal benefits and economic costs associated with a certain technology or activity)

(Ronteltap et al., 2007). This is because the average willingness to pay is set at less than 1 euro for a portion of dried mango, which is hardly sufficient to cover the marginal cost of production of high-quality mango flake varieties.

Thus, using non-endemic grafted varieties (comparatively more demanding regarding agricultural inputs) to process and produce mango flakes for the local market is less recommended due to its higher production costs. On the other hand, the people of Kitui have a long history of building food resilience through practices that make the most out of local agriculture and wild biodiversity. Kikamba mango fruit trees make an important contribution to fruit consumption, especially in drier areas where most fruit trees cannot survive during water stress, making mangos the most reliable source of fruits from December through April (Morimoto et al., 2010). Yet, a comparison with a countrywide database on traditional foods shows that less than 10% of traditional food species consumed by rural Kenyans go to Nairobi markets (Adeka et al., 2009). Considering the low initial costs and production costs of making Kikamba dried flakes and taking into account that most of these fruits spoil before reaching the market or being consumed, a large portion of the Kikamba harvest should be used to produce mango flakes (both for increasing shelf life and for guaranteeing easier access to local markets). Kikamba is a mango variety with a low water footprint and requires low inputs; thus, the dried mango produced from this variety has considerably lower production costs and will provide revenues that would be untapped if the fruit was purchased fresh (especially considering the high production losses that come from its production and delivery in fresh form).

While Kikamba is the least performing variety in terms of overall appreciation when untreated, when treated with honey, it produces higher degrees of appreciation than Apple and Kent (untreated) according to the KVTT. Considering the high degree of enjoyment generated by the two varieties and displayed in the KAPA results (even among people buying dried mango more frequently, suggesting that these varieties can be competitive in the local market), it is easy to predict that the Kikamba flakes treated with honey will represent a non-negligible source of revenue for local smallholder farmers.

To conclude, on the one hand, the valorisation of Kikamba, the local mango variety, is crucial. Still, on the other hand, an increase in the number of mango trees and varieties is required to guarantee a diversified and high-quality production (Ronner et al., 2019). This will resolve the high fruit perishability and transportability dilemma, potentially creating new businesses and a number of new mango products available to sell, thus opening many opportunities in the European market and providing a poverty alleviation strategy (Ronner et al., 2019).

This is a preliminary study collecting information of a general nature regarding the predisposition of Kenyan and German populations to dried mango from Kitui County. The research provides some inputs for a general interpretation of dried mango consumers' current values, habits, and predispositions. It is designed to establish a foundation upon which further and more in-depth research on markets and marketing strategies can be based. Extrinsic attributes impact the willingness to pay of both populations (since the sample is mostly young university students), yet the Kenyan population was affected to a lower degree. The Kenyan population shows a slightly higher predisposition for

natural products, while the German sample population did for fair-trade and organic (labelled) products. Accordingly, willingness to pay might be increased with fair-trade, organic, and sustainable labels for both populations. However, the degree of increment is uncertain due to the limited sample size and challenging settings of the taste testing. Further research and collaboration between academia and agricultural institutions are needed to identify the most appropriate and preferred mango varieties for producing mango flakes for export and local markets.

4.2. Study limitations

The first limitation of this study is that the sample is not representative of either Germany's or Kenya's populations. Although this research provides new insights for creating marketing strategies and processing optimisation to meet consumer preferences, the findings cannot be generalised at scale. Secondly, the factors determining consumer preferences should be explored in more detail using a variety of factors, including respondents' profiles, demographics, health status, personality, knowledge, exposure, and mood, as all of these can play a role in consumers' perception and evaluation of a particular product. Another study limitation relates to social desirability bias. Respondents may be concerned that researchers will judge their answers, thus misreporting their opinion. To avoid this issue, the study objectives and survey items were clearly explained to the respondents. Finally, the lack of experience with dried mangos among Kenyans respondents makes it difficult to assess whether high scores can be translated into a greater predisposition by Kenyans to enjoy local mango varieties or if other factors affect their preferences. Thus, as previously indicated, more research is needed to explore the determinants of mango consumers' preferences in Kenya.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

GU, JS, SL, MM, DM, and AC contributed to conception and design of the study. GU, JS, and SL organised the database and together with AC performed the statistical analysis. GU and AC wrote the first draft of the manuscript. GU, JS, SL, MM, and AC wrote sections of the manuscript. CM, LT, TM, DM, SS, and ER

supported interpretation of data and together with all authors contributed to manuscript revision, read, and approved the submitted. All authors listed have made a substantial, direct and intellectual contribution to the work, and all approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2023.1113930/full#supplementary-material>

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