

Consumer Perceptions on Processed Fruit Peels as Dietary Additives

Eridiong O. Onyenweaku*

Food Evolution Research Laboratory, School of Tourism and Hospitality, College of Business and Economics, University of Johannesburg, South Africa, Email, eridiongo@uj.ac.za, <https://orcid.org/0000-0001-6691-8269>

Hema Kesa

Food Evolution Research Laboratory, School of Tourism and Hospitality, College of Business and Economics, University of Johannesburg, South Africa, Email, hemak@uj.ac.za <https://orcid.org.0000-0002-1258-9145>

Levi U. Akah

Department of Human Kinetics & Health Education, Faculty of Education, University of Calabar, Nigeria, Email, leviakah@gmail.com <https://orcid.org/0000-0002-4096-896X>

**Corresponding Author*

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Abstract

Plant foods reduces the risks of both chronic and infectious diseases in humans. Fruit peel is still frowned upon as part of a normal healthy diet. This study aims at ascertaining consumer fruit peel preferences, perceptions and acceptability to enable the production of processed fruit peel sprinkles that will be accepted by consumers as food additives. An online questionnaire was used for this cross-sectional survey and was circulated in South African provinces. Information gathered include sociodemographic data, overall perception/consumer choices of processed fruit peels and factors that influence choices of dietary products. Chi square test was used to check association between some sociodemographic variables and consumer preferences. ‘Sweetened’ was the most suggested flavour for the proposed product, followed by ‘Natural’ i.e. no flavor additives and ‘Chilli’ third most suggested. the participants were interested in processing of fruit peels for consumption. The responses showed general acceptability of the proposed fruit sprinkles, with citrus fruit peels (oranges, grapes and lemons) as most preferred. No association was observed between gender/income and certain consumer preferences for fruit peels. Educational level affected the priority factors of the respondents. Processing and consumption of fruit peels should be encouraged in order to strengthen the immune system especially during this pandemic. Increased consumption of fruit peels will also contribute to a reduction of food waste.

Keywords: Consumer; perception; fruit peels; dietary additives; food waste

Introduction

Over time, research has shown the critical importance of consuming healthy diets in order to prevent diseases and to promote well-being. The importance of plant foods in boosting the immune system by providing the essential micronutrients such as minerals and vitamins has been established (Kumar et al., 2021). Reports show that oxidative stress is a major cause of many chronic and degenerative diseases such as diabetes mellitus, cancer, cardiovascular diseases, ageing, immunosuppression and neurodegenerative diseases amongst other (Young & Woodside, 2001; Pizzino et al., 2017). Different parts of many plant species (leaves, stem, fruits, etc.) have been found to contain chemical compounds with potential antioxidant

properties (Rajendran et al., 2014). These compounds include vitamins, minerals, flavonoids, phenols and carotenoids.

Some reactive oxygen species (ROS) in humans are hydrogen peroxide, hydroxyl radical, peroxy radical, superoxide anion radical, nitric oxide radical, hypochlorous acid and singlet oxygen (Rajendran et al., 2014). Formation of ROS, such as superoxide anion radical and hydroxyl, is unavoidable during aerobic respiration, and ROS carry out important functions in the body, such as involvement in the signal transduction of inflammation to resist pathogen infection (Hancock et al., 2001; Pizzino et al., 2017). However, excess production of ROS may easily damage cells or tissues by lipid peroxidation and, denaturation of proteins or nucleic acid. This damage has severe consequences on overall metabolism (Schieber & Chandel, 2014), which may then cause a series of clinical symptoms, such as arteriosclerosis, arthritis, obesity, heart disease, and cancer.

The oxidative process is a major route for the production of free radicals in foods, drugs and even in living systems (Halliwell, 1994). Consequently, antioxidative defense mechanisms are the most effective pathways to eliminate and diminish the action of free radicals which cause the oxidative stress. Antioxidants are those substances which possess free radical chain reaction-breaking properties. In recent times there has been an upsurge of interest in the therapeutic potential of medicinal plants as antioxidants in reducing oxidative stress-induced tissue injury (Pourmorad et al., 2006; Kumar et al., 2015). Among the many naturally occurring antioxidants, carotenoids, ascorbic acid and phenolic compounds have proven to be most effective (Duh et al., 1999; Jacob et al., 2010). They are known to inhibit lipid peroxidation (by inactivating lipoxygenase), to scavenge free radicals and active oxygen species by propagating a reaction cycle and to chelate heavy metal ions (Sundararajan et al., 2006). Currently, there is a growing need to prevent disease and improve health, which is in line with one of the Sustainable Development Goals (SDGs) – sustainable health and wellbeing. The SDGs (17 of them) were adopted in 2015 by the United Nations as a global call to action to end poverty, protect the planet and ensure that by the end of 2030, people enjoy peace and prosperity (United Nations Development Programme - UNDP, 2022). SDG number 1 is ‘No poverty’, 2 is ‘Zero hunger’ and 3 is ‘Good health and well-being’ (UNDP, 2022). With the recent global economic crisis and increase in incidence/prevalence of diseases, it has become imperative to channel energy, time, resources (including research) to focus on achieving the first 3 SDGs. This research aimed at ascertaining consumer fruit peel preferences, perceptions and acceptability to enable the production of processed fruit peel sprinkles that will be accepted by consumers as food additives.

Literature review

During the current coronavirus (COVID-19) pandemic which affected the globe, it is reported that increased immunity via intake of vitamin C and zinc-rich foods, greatly protect the body against the virus infection and also reduce the severity of the disease if contacted (Robbins, 2020). Also, vitamin C has been reported to be one of the most potent antioxidants for fighting and preventing viral infections, including COVID-19 (Robbins, 2020). Vitamin C has been shown to reduce inflammatory response and may help prevent/shorten the duration of common cold. It also functions in regenerating other antioxidants in the body such as alpha-tocopherol, i.e. vitamin E (Jacob et al., 2010; Jacob & Sotoudeh, 2002). Excellent sources of vitamin C include citrus fruits such as grapes, lemons, oranges, kiwifruit, broccoli and strawberries.

Recent statistics have shown an increase in the incidence and prevalence of non-communicable diseases (NCDs) such as hypertension, stroke, cancer, diabetes and obesity (Onyenweaku et al., 2019). According to WHO (2015), NCDs are the leading cause of mortality in the world. Meanwhile, it is estimated that 80% of premature heart disease, stroke

and diabetes cases are preventable (Onyenweaku et al., 2022). Evaluation of the chemical composition of plant food materials is necessary to provide information on the potential uses of certain plants in the treatment and management of some health conditions.

Research has also shown that some chemical compounds which form part of plant defense mechanisms, also exhibit antioxidant properties (Amarowicz & Pegg, 2019; Jacob et al., 2010). Some of these compounds have been reported in higher concentrations in the peels of fruits (Jacob et al., 2010). On the other hand, scant information is available on the nutrient/phytochemical content of some of these fruit peels which are often not consumed and are wasted. These fruit peels could be dried and used as sprinkles (food additives) in foods, thereby enriching the diet reducing fruit wastes; this will also bring additional income to farmers and others involved in the processing of the fruit peels for commercial purposes. The processing of fruit peels will be covered by the 2nd phase of this research project.

In order to comprehend product preferences, various forces/factors, both internal (like prior experience) and external (like characteristics of the food products), that compete for consumers' attention must be taken into consideration in the context in which decisions are taken (Lindberg et al., 2018). Although the extent to which these influences ultimately affect consumers' buying behavior varies with individual personalities, analyzing them will certainly increase understanding of consumers' purchase decision processes with regard to food and, thus, facilitate proper planning for producers, manufacturers, and retailers in the food industry (Garber et al., 2003; Lindberg et al., 2018). Consequently, there is the need to maximize the nutritional and health benefits that can be obtained from consuming fruit peels. The possible concepts of the product quality classification that are of importance to the consumer when deciding to purchase a product are: satisfying the needs and requirements as well as any specific demands of customers at any time and immediately; also providing the customers with products and services that consistently surpass their expectations or at least satisfy them (Lindberg et al., 2018).

This preliminary study is focused on ascertaining consumers' fruit peel preferences and general acceptability of dried fruit peels as dietary sprinkles. This part of the study will serve as a guide in the further study and processing of the fruit peels to ensure consumer satisfaction and product quality, thereby reducing fruit wastes and promoting well-being. This phase 1 of this project on minimizing fruit wastes seeks to generate useful data such as product acceptability and preferred flavours in order to apply this data in Phase 2 of the work.

Consumers' perceptions of food additives

Most previous studies have focused on people's perceptions of food additives in general (Kajanne & Pirttilä-Backman, 1996; Shim et al., 2011; Tarnavölgyi, 2003), but there are reasons to assume that consumers do not perceive all food additives in the same way. According to the FAO/WHO (2021:1) Codex Alimentarius, a food additive is defined as "any substance not normally consumed as a food by itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value, the intentional addition of which to food for a technological (including organoleptic) purpose in the manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food results, or may be reasonably expected to result, (directly or indirectly) in it or its by-products becoming a component of or otherwise affecting the characteristics of such foods".

Firstly, despite the fact that in science and regulation there is no strict differentiation between food additives of natural and artificial origin, previous literature suggests that consumers differentiate between them (Tarnavölgyi, 2003). In a study by Varela and Fiszman (2013), consumers were asked to indicate what they associated spontaneously with the term "food additives." The authors found that there was some confusion among consumer what

exactly denotes a food additive, as consumers mentioned salt, sugar or other spices. In terms of food additives, participants frequently mentioned colours, preservatives and sweeteners. Due to this salient distinction in consumers' minds, this study focuses solely on artificial food colours and artificial sweeteners.

Secondly, different food additive categories, such as preservatives, sweeteners or food colours might be perceived differently, as they serve various purposes and different people benefit from their use to differing degrees (Carocho et al., 2015; Eiser et al., 2002). Food colours and sweeteners are probably the most disputed and controversial food additives, as they are not necessities for food safety, such as preservatives. Food colours enhance the foods aesthetically, either by restoring colour, lost during processing or by imparting colour to food; as the name suggests, sweeteners are used to sweeten foods (Bimpizas-Pinis et al., 2022; Emerton & Choi, 2008). While sweeteners bring about a variety of benefits for the consumer (e.g., in terms of reduced caloric content or cariogenic properties of foods which are recommended for diabetics and obese individuals), food colours have no health benefits for the consumer (Emerton & Choi, 2008).

Also, in two large-scale Australian surveys about general food risk perceptions (Buchler et al., 2010; Williams et al., 2004), food additives were frequently mentioned as potential food hazards and respondents indicated to prefer foods that did not contain additives. In an English questionnaire study (Eiser et al., 2002), high school students were asked to compare foods with and without food additives. Participants mentioned concerns in terms of food additives' safety for health, but also stated to prefer foods with additives due to ease of preparation. The perception that food additives are unhealthy reduces acceptance, while conversely the perception of benefits encourages people to accept them. Consumers who are less informed about additives therefore think additives are harmful.

Methodology

The nine (9) South African provinces were covered by this online survey namely Gauteng, KwaZulu-Natal, Free state, Eastern cape, Western cape, Northern cape, Limpopo, North West and Mpumalanga. The choice of South Africa for this study was as a result of the 2 main researchers being resident in this country for data collection and the rich diversity of fruits present in the country. South Africa is also comprised of people from different races, nationals and continents; this helps in gathering views from people of different cultures, races and backgrounds (Kucich & Wicht, 2016).

The sample population for the online cross-sectional study consisted of 517 respondents from the nine South African provinces. In total, the following number of responses from the participating provinces were: Gauteng (222), KwaZulu-Natal (56), North West (110), Free State (23), Eastern Cape (26), Western Cape (26), Northern Cape (12), Limpopo (17) and Mpumalanga (25). The survey was distributed to people across different socio-economic groups and cultures.

Using the Leslie Kish formula below, a target sample size of 384 was calculated and the study was carried out online for a period of one month:

$n = Z \times Z_p(1-p) / e \times e$ to determine the sample size (Kish, 2017).

where: n = estimated sample size

Z = standard normal deviation usually set at 1.96 for 95% confidence

p = prevalence of any disease under study put at 50% where prevalence is not ascertained.

$1 - p = 0.5$

e = degree of accuracy desired, set at 0.05

After substituting the values,

n = 384

We hereby report findings on the first 517 replies to the online survey on ‘Consumer perceptions of processed fruit peels as dietary additives - a preliminary study on minimising fruit wastes’.

Random sampling, alongside the snowball sampling method, was used to select the respondents bringing the total sample size to 517 participants. The questionnaire was circulated via the online survey link sent across to respondents electronically since it was easier to gather data this way during this period due to the continued restrictions in movements and social distancing as a result of the third coronavirus wave.

In order to gather information from respondents, a well-structured questionnaire was designed and used in this survey. The questionnaire was structured to gather data on socio-demographics, fruit consumption pattern, fruit peel preferences and factors that influence consumers’ preferences. The Microsoft word document of the questionnaire was prepared and then converted into the online survey format using Google forms which ensured anonymity of the participants. The questionnaire was circulated electronically using the online survey link which was sent across to participants via WhatsApp and emails. The dietary-related knowledge, attitudes, perceptions and practices of the participants were also covered. A review of literature from research articles and journals was employed in designing the questionnaire. Participation in the study was voluntary. Appropriate ethical approval was obtained for this research from the School of Tourism and Hospitality Research and Ethics Committee, University of Johannesburg.

Respondents were asked to carefully read and understand the content summary first before proceeding to the questionnaire. The participants were assured all data would be used for research purposes only in the consent form. Participants’ answers were anonymous and confidential according to Google’s privacy policy (<https://policies.google.com/privacy?hl=en>). Neither the names nor contact details of participants were collected. In addition, participants were able to terminate their response and leave the questionnaire at any stage before the submission process; thus, their responses would not be saved. Responses were saved only by clicking on the provided “submit” button. By completing the survey, participants acknowledged their voluntary consent to participate in this anonymous study.

All statistical analyses were performed using the Statistical Package for Social Sciences software (SPSS, version 25.0). Descriptive statistics such as frequencies, percentages and charts, were used to define the proportion of responses for each question and the total distribution in the total score of each questionnaire. Pearson’s Chi square test was also used to check for association between selected variables and significance was accepted at $p < 0.05$. Phi values were also used to ascertain the strength of association (< 0.5 = Weak association, > 0.07 = Strong association).

Results and discussion

Socio-demographic characteristics of the surveyed population

Table 1 presents the socio-demographic characteristics of the surveyed population (517 people). The provinces were represented thus: Gauteng - 43%, North West - 21%, KwaZulu-Natal - 11%, Western Cape - 5%, Eastern Cape 5% and the other four provinces accounted for the remaining 15%. Females constituted 56.3% of this population and among them, 41% were aged between 18-29 years old while about 50% were aged between 30-49 years. Most of them had a tertiary education level (68%) and just few had secondary education level (23%) or less (9%). A higher percentage of them reported to be single (51%) while 33% were married. About 40% were living in a household of 1-2 persons, the others in either 3-5 person households (48.5%) or above (12.4%). They generally had a public (16.6%) or private job (19.7%), and others were self-employed (32.7%); 22.2% were unemployed.



Table 1. Socio-demographics characteristics of the surveyed population

Variable	Sub-variable	Frequency	Percentage
Province	Gauteng	222	42.9
	KwaZulu-Natal	56	10.8
	North West	110	21.3
	Western Cape	26	5.0
	Eastern Cape	26	5.0
	Limpopo	17	3.3
	Mpumalanga	25	4.8
	Free State	23	4.4
	Northern Cape	12	2.3
	Total	517	100.0
Sex	Female	198	38.3
	Male	291	56.3
	Prefer not to say	28	5.4
	Total	517	100.0
Age group	18 – 29 years	210	40.6
	30 – 39 years	156	30.2
	40 – 49 years	100	19.3
	50 – 59 years	39	7.5
	60 years & above	12	2.3
	Total	517	100.0
Marital status	Single	271	52.4
	Married	172	33.3
	Divorced	48	9.3
	Widowed	26	5.0
	Total	517	100.0
Education	No formal education	17	3.3
	Primary school	28	5.4
	Secondary (High) School	120	23.2
	Tertiary institution	352	68.1
	Total	517	100.0
Monthly income	R 0 – R 4,999	153	29.6
	R 5,000 – R 9,999	101	19.5
	R 10,000 – R 19,999	106	20.5
	R 20,000 – R 29,999	73	14.1
	Above R 30,000	84	16.2
	Total	517	100.0
Household size	Live alone	98	19.0
	2	104	20.1
	3 – 6	251	48.5
	More than 6	64	12.4
	Total	517	100.0
Employment sector	Public	86	16.6
	Private	102	19.7
	Informal	45	8.7
	Unemployed	115	22.2
	Self employed	109	32.7
	Total	517	100.0

Some of them reported a low monthly income of below R5,000 (29.6%), others earned between R5,000 - R20,000 (40%) while about 30.2% earned above R20,000 per month. Most of those who earned lower monthly incomes were students who were either self-employed or working part-time jobs while studying. In these days of advanced technology, younger people tend to respond more to online questionnaires than the older people (Fan & Yan, 2010); hence as can be seen by the results, 70% of this surveyed population were aged below 40 years.

Participants' fruit consumption pattern

Over 70% of the respondents reported that they have consumed a fruit with its peel; among this category, the most popularly consumed fruit peels were apples, peaches and mangoes. With

regards to the frequency of fruit consumption, the respondents mostly consumed fruits 3-6 times a week (36.6%) and some others – less than 3 times a week (36.4%). It is worthy of note that 7.2% of the respondents said they do not consume fruits at all, while only 20% consumed fruits on a daily basis. Supermarkets (75.2%) and local markets (72.2%) were the most popular sources of fruits while ‘personal garden’ was the least (40%). The most commonly consumed fruits reported were citrus – oranges, grapefruits and lemons (78.3%) > bananas (76.3%) > mangoes (70.1%) > pawpaw (68.3%). The least consumed fruits were plums (40%) and pineapples (58%). The most common way of consuming fruits was reported to be as whole fruits (79.2%) followed by as salads (65.5%) then as juices (64.8%). In the COVID-19 context, up to 26.3% consumed certain fruits and supplements in order to prevent coronavirus infection; among these were citrus fruits – oranges, lemons, lime, followed by ginger and then vitamin C supplements.

A study in Ghana by Seidu et al. (2021) revealed that adolescents in senior high school were less likely to consume adequate fruits and vegetables compared to those in Junior high school. The study reported that gender, school grade, soft drink intake, fast food consumption and sedentary behavior were factors associated with adequate consumption of fruits and vegetables. An intervention study by Baranowski et al. (2000) reported an increase in the consumption of fruit, juice and vegetables (FJVs) among schoolchildren after the inclusion of nutrition education in the school curriculum and making the FJVs available. In a study by Ronda-Perez et al. (2020), it was reported that more enlightened workers had the highest fruit and vegetable consumption rates. This shows that proper awareness and good nutritional knowledge can yield positive results in terms of positive disposition towards consumption of healthy fresh foods/fruits. The low consumption rates for some fruits recorded in this study might be due to the seasonal nature of their availability. The most consumed fruits were of the citrus family and apples – these are available all year round. A different observation was made by Layade & Adeoye (2014) in their study of fruit consumption among University students in Nigeria; it was reported that the most preferred fruit by the students were banana (34%), followed by water melon (27%) then citrus i.e. sweet oranges (13%) and the least preferred were pawpaw (2%) and cashew (1%). The severity of the pandemic in South Africa caused increased awareness of the importance of plant foods in fighting infection. The role of ascorbic acid (found in good amounts in citrus fruits) in the prevention and treatment of COVID-19, may be partly responsible for the current relatively high of consumption of citrus fruits in South Africa. The respondents mostly got their fruits from supermarkets and these fruits are sometimes preserved with chemicals to increase their shelf life; hence proper caution should be applied in washing such fruits/vegetables well before consumption. Only few people got fruits from their own gardens, which is similar to the report of Kucich and Wicht (2016) which shows that home grown foods are no longer popular as a result of industrialisation. Home farms and natural production of crops should be encouraged where possible. This will increase access to, and availability of these fresh, natural foods instead of artificially modified products which are now found in shops (Galhena et al. (2013). When these fruits and vegetables are available/abundant, it will help to reduce their cost and improve affordability.

Table 2: Fruit consumption pattern of the respondents

Questions	Answers	Percentage responses (N=517)
How often do you eat fruits?	I do not consume	7.2%
	Less than 3 times a week	36.4%
	3 – 6 times a week	36.6%
	More than 6 times a week	19.9%
Where do you obtain the fruits you consume?	From nearby farmers	42.9%
	Supermarkets/Shops	75.2%

	Personal Gardens	39.9%
	Local market	72.2%
Do you sometimes replace a meal with just fruits?	No	35.8%
	Yes	64.2%
	As smoothies	55.4%
	As salads	65.5%
Most popular way of consuming fruits	As juices	64.8%
	As whole fruits	79.2%
	As dried fruits	45.0%
	Citrus – oranges, lemons, grapes	78.3%
	Bananas	76.3%
Top 5 most frequently consumed fruits	Mangoes	70.1%
	Pawpaw	68.3%
	Apples & English pear	68.2%
Did you start consuming any particular fruit/vegetable because of the COVID-19 pandemic?	No	67.1%
	Yes – still consuming	26.3%
	Yes – Previously	6.6%
	Healthy balanced meal	75.9%
On a general note, do you have access to the following:	Enough fruits	70.5%
	Enough vegetables	75.9%
	Healthy snacks	62.4%

Consumers' choices/preferences with respect to fruit peels

The analysis of the responses from the surveyed population with respect to their preferences is summarized in Table 3 and 4. It reveals that only 16.2% said no to adding processed fruit peels to their food, the others showed interest in trying out the new concept of food sprinkles made from fruit peels. Out of this small proportion, almost half of them (43%) believed that fruit peels may be harmful to health. Majority agreed that they could either purchase the fruit peels or make them at home depending on which was more convenient for them. Among the listed flavours for the fruit sprinkles, 'sweetened' was the most preferred (35.6%) followed by natural taste i.e. no flavourings added (24.4%) then chilli (11.4%). With respect to the most suggested fruit peels to be processed as dietary additives, the citrus group (oranges, lemons, grapefruits, etc) was the most popular choice (42.6%) followed by apples (35.6%) then mangoes (30.0%). Respondents were also required to prioritise the factors that affect their choice of new products and the results are seen in Table 4. Majority of the respondents indicated that quality of the product (22.9%), good knowledge of the product (25.2%) and the price of the product (22.9%) were of high priority for them while on the other hand, 24.5% said the good knowledge of the product and its price were low priority. Up to 23% agreed that the nutritional/health benefit of the product was of topmost priority (essential). Over 40% did not see packaging/appearance as a priority in their choice of a food product. Appealing taste, flavour and aroma was of low priority to 27.6% but 24.3% said it was of high priority.

Table 3: Consumer preferences with regards processed fruit peels

Questions	Answers	Frequency	Percentage
Would you like to add processed fruit peels to your food?	No	84	16.2
	Yes	238	46.0
	Maybe – it depends	195	37.3
	Total	517	100.0
If 'no' to the above, give the reasons (multiple):	I don't like fruits	40	20.8
	Peels are not palatable	65	33.7
	Peels are not nutritious	69	35.8
	Peels may be harmful	80	42.8
	Total	254	100.0
Which would you prefer in processing fruit peels?	Prepare by myself	119	23.0
	Buy already processed	79	15.3
	Any of the above	214	41.4
	Not sure	105	20.3
	Total	517	100.0
Preferred flavours for the proposed fruit peel sprinkles	Salty	18	3.5



	Spicy	31	6.0
	Sweetened	184	35.6
	Chili	59	11.4
	Bland/Tasteless	42	8.1
	Natural – no additives	126	24.4
	None of the above	57	11.0
	Total	517	100.0
	Citrus – oranges, lemons	220	42.6
Most preferred fruit peels to be processed into sprinkles: (Suggestions)	Apples	184	35.6
	Mangoes	155	30.0
	Pawpaw	140	27.1
	Pineapples	126	24.4

People naturally prefer foods/food products that taste sweet, hence the preference of the sweetened flavour for the sprinkles. Nevertheless, this may affect the general taste of the food to which the fruit peel sprinkles are added and may alter its original flavour, because some foods are meant to taste salty/sour and may have an unacceptable taste if they are made to taste sweet instead. Consequently, it may be necessary to produce the fruit sprinkles in different flavours so that consumers can use them differently based on the foods they are adding them to. An alternative would be to use the ‘bland’ flavour, which is tasteless, so as not to tamper with the actual taste of the food. In a similar study Wunderlich and Gatto (2016), participants reported that the nutritious qualities, sensory qualities, and overall health effects of food were very important in their dietary choices which is similar to the findings of this study.

Table 4: Priority factors which affect consumer’s choice of new products

	Not a Priority	Low Priority	Medium Priority	High Priority	Essential	Total
The quality of the product	13.30%	22.70%	22.00%	22.90%	19.00%	100%
Good knowledge of the product	12.10%	24.60%	18.90%	25.20%	19.10%	100%
The price of the product	12.50%	24.50%	20.60%	25.30%	17.20%	100%
Review/recommendation in a magazine or website	16.70%	29.10%	23.00%	18.90%	12.40%	100%
The nutritional and health benefit of the product	9.90%	26.60%	17.50%	22.90%	23.10%	100%
Packaging and appearance	13.50%	28.20%	22.40%	21.60%	14.30%	100%
A recommendation by a family member or friend	17.10%	27.60%	24.70%	18.30%	12.30%	100%
Appealing taste, flavour and aroma	10.70%	27.60%	17.50%	24.30%	19.80%	100%

*Highlighted values are worthy of note

Association of consumer preferences with some sociodemographic variables

Figure 1 shows the association between Gender and flavour preferences while the association between gender and preferences in means acquiring the fruit peels, is seen in Figure 2. Most females preferred sweetened flavour for the proposed fruit peel sprinkles and same was observed with males (70). Natural taste (no flavour additives) was the next most preferred flavour for both males (48) and females (74). Pearson’s chi square test revealed that there was no association between gender and flavour preferences (P value = 0.08). In the case of gender and mode of acquiring the fruit peels additives, most males and most females too, chose the option of any convenient means (i.e. buying and also processing by themselves). Similarly, no association was observed between gender and method of acquiring the fruit peel sprinkles (P value = 0.44).

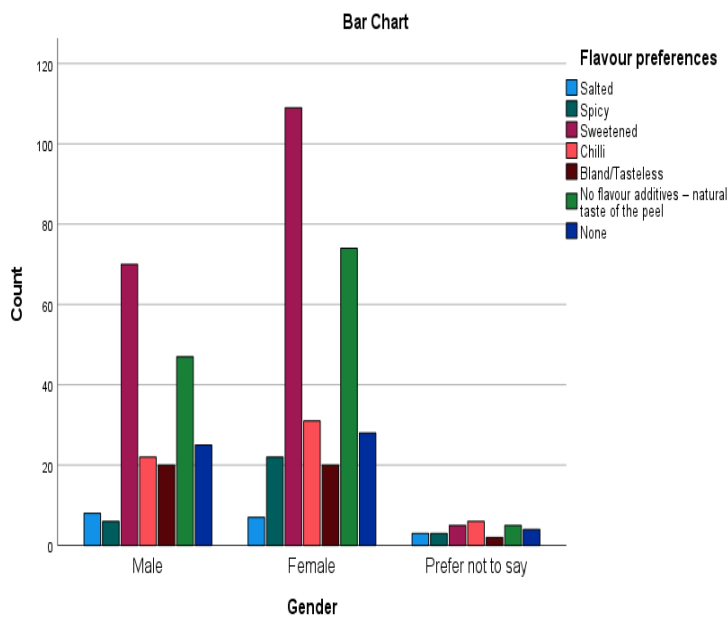


Figure 1: Association between Gender and flavour preferences

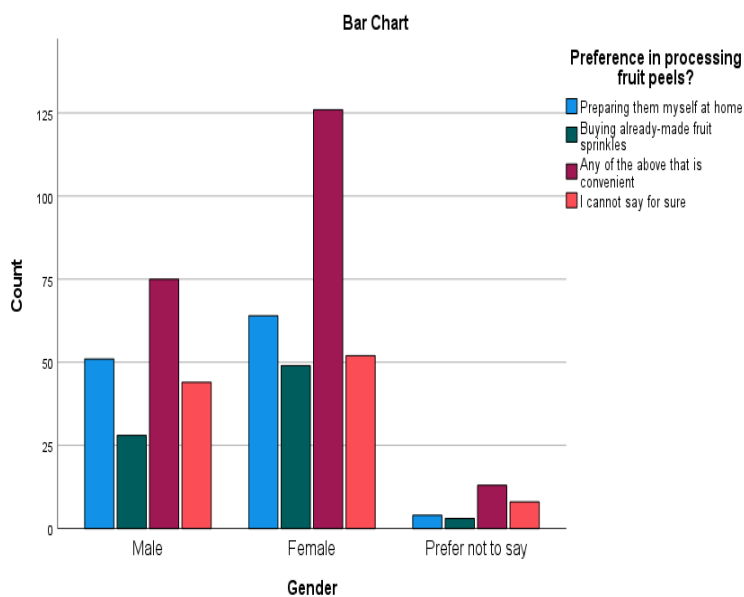


Figure 2: Association between Gender and processing preferences

Table 5 shows the association between education and income versus priority scale for consumer choices. The chi square values reveal that level of education affected the choice of quality, price and nutritional/health benefit of a product and recommendation by a family/friends, as determining factors for their purchase of a new product. Conversely, income level was not found to be associated with most of the priority factors ($p > 0.05$) except for nutritional/health benefit of the product and recommendation by family/friends.

The sense of taste is a more of a psychological phenomenon than a physiological one (Samarrai, 2015), hence the choices/preferences did not vary significantly based on gender. Similarly, a study by Adengan and Adeoye (2011), income/finances affected the frequency of



fruit consumption but not the choice/types of fruits consumed, same thing was observed with gender as is seen in the results from this study.

Table 5: Consumer preferences with some sociodemographic variables

		Pearson Chi-Square		Asymptotic Significance (2-sided)	Strength of association (Phi value)
		Value	df		
Education	Quality of the product	34.80 ^a	12	0.00	0.26
	Good knowledge of the product	19.74 ^a	12	0.07	0.20
	Price of the product	31.02 ^a	12	0.00	0.24
	Review/recommendation in magazine or website	21.93 ^a	12	0.04	0.21
	Nutritional/health benefit of the product	47.21 ^a	12	0.00	0.30
	Packaging and appearance	21.10 ^a	12	0.05	0.02
	Recommendation by family/friend	28.81 ^a	12	0.00	0.23
	Appealing taste, flavour and aroma	23.18 ^a	12	0.03	0.21
	Quality of the product	26.05 ^a	16	0.05	0.22
	Good knowledge of the product	16.53 ^a	16	0.42	0.12
	Price of the product	14.42 ^a	16	0.57	0.17
	Review/recommendation in magazine or website	25.39 ^a	16	0.06	0.22
Income	Nutritional/health benefit of the product	29.42 ^a	16	0.02	0.24
	Packaging and appearance	24.75 ^a	16	0.07	0.22
	Recommendation by family/friend	30.67 ^a	16	0.02	0.24
	Good taste, flavour & aroma	11.78 ^a	16	0.76	0.15

Significance accepted at $p < 0.05$, Phi values < 0.05 indicate weak association

Conclusion and recommendations

The results of this study showed that most of the people in the surveyed population were open to trying the new proposed fruit peel products. This confirmed high level product acceptability and some were even willing to try preparing the sprinkles by themselves at home – if shown how to. The most preferred peels suggested for processing were those from the citrus family such as oranges, lemons and grapes. In terms of flavor for the products, people preferred ‘sweetened’ and ‘natural taste’ (i.e. no flavor additives) more and some others choose the ‘chili’ option. A good proportion of the respondents considered the nutritional/health benefits of a product of upmost important in their dietary choices; others also reported that the quality, price and knowledge of the product was of high priority when making choices of food products to purchase. This showed good nutritional knowledge among the respondents. Generally, gender and income level did not seem to affect the consumer preferences much but level of educational attainment did. Summarily, citrus family peels and ‘sweetened’ flavor were the most preferred and the product acceptability was remarkable.

Nevertheless, results from the fruit consumption pattern show that the frequency of consuming fruits was a bit low for some people; there is need for enlightenment/advocacy on the importance of plant-based diets in making daily dietary choices. Particular attention should be paid to consumption of fresh fruits as well as vegetables which help in preventing diseases and improving health. In addition, purchase of fresh fruits/vegetables from local farmers should also be promoted as this will go a long way to encourage their organic cultivation. These observations have potential implications that could assist in the development of recommendations to maintain good health and eating habits especially during this COVID-19 pandemic and beyond with the aim of boosting immunity, promoting wellbeing and longevity. Governments should regulate policies to promote nutrition education awareness, encourage farmers and ensure the availability of safe and healthy fresh foods (fruits and vegetables).

People should also be encouraged to minimize fruit wastes by consuming fruits along with their peels where possible, while pending the production of the processed fruit peels which will be used as food additives to enrich meals.

This study was limited to an online survey by the COVID-19 restrictions which did not allow the researchers to move to freely across the Provinces. The researchers were not allowed to physically collect data, hence the online surveys but due to the snowball method the surveys were circulated randomly and the issue of affordability of network data/internet connection in the lower socio-economic areas was a problem. Despite this, the study still tried to cover people of different socio-economic class who were largely educated and about 50% of them earned above R10,000 per month. Kindly note that the study was focused mostly on common, non-seasonal fruits which are easily found in most parts of Africa and other continents. The validity of answers is also a general problem of online surveys which may be difficult to ascertain.

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