BINDURA UNIVERSITY OF SCIENCE EDUCATION

DEPARTMENT OF NATURAL RESOURCE

Exploring the Feasibility and Optimization of Jam Production using Baobab Fruit Powder as a Key Ingredient

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DECLARATION

I Enos Tinashe Kandemiyiri, do hereby, declare that the intellectual content of this dissertation is the results of my own work, except where otherwise acknowledged in the text

Student Reg: B191150B

Signature …… Date…30/05/2023……

Supervisor Dr A..Mureva

Signature…….. Date……

DEDICATION

I dedicate this dissertation to my mother, who has always been my greatest source of support, encouragement and inspiration. Her unwavering love and belief in me have propelled me forward on this academic journey and given me the strength to overcome any obstacles. This accomplishment is much as hers than as it is mine.

ACKNOWLEDGEMENT

I would like to express my heartfelt gratitude to my God, who has been my constant source of strength and guidance throughout this journey.

I would as well like to extend my sincere thanks to my supervisor Dr Mureva, for his invaluable support, insightful guidance, & constructive feedback. His belief in my abilities has been a great motivation for me.

I would also like to acknowledge Salome Chengahomwe, who provided me with immense support during the data collection process. Her contribution was instrumental in the success of this study.

Finally, I would like to express my gratitude to my family for their unwavering love, support, and encouragement. Their sacrifices and understanding during the entire period of my study are deeply appreciated.

Thank you all for your support and encouragement.

ABSTRACT

This study explores the feasibility and optimization of jam production using baobab powder as a key ingredient. The study reveals that baobab powder is a rich source of Vitamin C, antioxidants, and other essential nutrients. The use baobab powder in jam production is a relatively new concept, and its acceptance by consumers is yet to be determined. The baobab powder has been used in the food industry as an ingredient in various products, including drinks, snacks, and baked goods. However, there is limited research on its use in jam production hence the study aims to bridge this gap by exploring the use of baobab powder in jam production. The study suggests that the use of baobab powder in jam production has the potential to create a new market niche for health-conscious consumers. Sensory evaluation was conducted to determine the acceptability of baobab. Graphs and pie charts were used to present the data and the results showed a positive acceptance of baobab jam by a panel of 100 evaluators, providing evidence for the potential of baobab powder as a source in jam production. The findings have implications for the development of the baobab natural product industry and suggest potential for future research in this area.

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LIST OF ACRONYMS AND ABBREVIATIONS

CRD	Completely Randomized Design
SPSS	Statistical Package for Data Analysis
UNDP	United Nations Development Programs
%	Percent

CHAPTER 1: INTRODUCTION

1.1BACKGROUND

The global jam market size was valued at USD 8.47 billion in 2020, and it is expected to reach USD 10.78 billion by 2026, growing at a compound annual growth rate of 4.2% during 2021 to 2026 (Intelligence, 2021). The report attributes the growth of the jam market to the increasing demand for convenient and healthy food products, as well as the rising popularity of breakfast foods worldwide. Moreover, the report highlights the growing trend of consumers seeking more nutritious options in their food choices, which has led to the introduction of new types of jams with reduced sugar content and organic and natural ingredients (Intelligence, 2021). This trend is expected to drive the growth of the jam market further in the coming years.

According to Botsaris et al. (2018), the jam on market has several health problems; therefore, this has led to the exploration of alternative healthy ingredients and production methods. Most of the jam on the market is produced from exotic fruits-, which have some notable challenges due to their specific growing requirements. For example, in a review paper by Peña et al. (2018), the authors noted that cultivating of exotic fruits such as guava and passion fruit can be challenging due to their susceptibility to pests and diseases. Nath (2019), explained that the cultivation of exotic fruits such as pineapple and papaya can be formidable due to their specific soil and water requirements.

Baobab fruit powder is a potential alternative ingredient for jam production due to its high nutritional value. According to Debelo et al. (2020), baobab fruit powder is an excellent source of vitamin C, calcium, iron, and antioxidants. The powder is derived from the fruit of the Baobab tree, which is native to Africa. The tree is known for its ability to store water in its trunk, making it a valuable resource in arid regions. According to Helkar et al. (2019), using alternative ingredients in food production is becoming increasingly popular due to the growing demand for healthy and natural food products. Baobab fruit powder alternative ingredient that has been used in producing various food products, such as smoothies, energy bars, and baked goods. The nutritional value of Baobab fruit powder has been extensively studied. According to Rahu (2015), baobab fruit powder is rich in vitamin C, calcium, iron, and antioxidants. The powder has also been shown to have anti-inflammatory and prebiotic properties (Brubaker, 2019). The potential benefits of Baobab fruit powder in jam production have not been extensively studied, and this research aims to fill this gap.

Indigenous fruit opted over exotic fruits because of nutritional benefits. Indigenous fruit trees often have higher nutritional value than exotic trees; for example, the fruit of the baobab tree, indigenous to Africa, is a rich source of vitamin C, calcium, iron, and antioxidants (Sileshi et al., 2023). Using indigenous fruit trees in jam production can lead to the production of healthier and more nutritious products. In addition, Indigenous fruit trees are often better adapted to local climatic and soil conditions than exotic trees. In contrast, exotic trees may require specific growing requirements and may be more susceptible to pests and diseases. According to a study by Kiptot et al. (2014), using indigenous fruit trees in food production can lead to improved food security and resilience to climate change.

The present study will show the essential procedures for producing jam from the locally available baobab fruit powder, to add value to the fruit, increasing the variety of jams on the global market. The baobab powder can be used as a perfect potential alternative for pectin in jam production due to its high gelling capacity and incredible natural shelf life of up to 3 years hence, no preservatives or additives needed (Ängmo, 2022). Apart from the desirable gelling qualities of the Baobab powder, it also provides vitamin C ranging from 209 mg to 360 mg/100g and is also rich in carbohydrates, fibre, potassium, and calcium and has the highest antioxidant content of any whole fruit (Habte & Krawinkel, 2017). Therefore, the production of jam from baobab powder can attract a niche market locally, regionally and internationally in the long run.

1.2 PROBLEM STATEMENT

To determine the acceptability of jam made from baobab powder among consumers regarding taste, aroma, texture, and overall quality.

1.3JUSTIFICATION

It is essential to know the acceptability of baobab jam to assess the potential market of baobab fruit jam; the information will help to determine whether to proceed with the project, make some amendments or abandon it.

1.4 RESEARCH AIM

To explore the feasibility and optimization of jam production using Baobab fruit powder as an alternative ingredient.

1.5 RESEARCH OBJECTIVES

To determine the feasibility of producing jam using baobab fruit powder.

To assess the acceptability of baobab jam.

CHAPTER 2: LITERATURE REVIEW

2.1VALUE ADDITION OF *Adansonia digitata*

Baobab fruit can be processed into powder and used as an ingredient in various food products, including smoothies, baked goods, and energy bars. Tembo et al. (2017), study investigated baobab fruit powder's physicochemical and functional properties and found that it had high antioxidant activity and potential as an active food ingredient. In addition, Baobab fruit can be juiced to create a refreshing and nutritious beverage. Baobab fruit juice is high in vitamin C and antioxidants and is a popular drink in many African countries. A study by Maptouom et al. (2020), investigated baobab fruit juice's nutritional composition and antioxidant capacity and found high levels of vitamin C and antioxidants.

Baobab fruit has been used to produce cakes due to its high nutritional value and potential health benefits. The production of cakes from baobab fruit involves incorporating baobab fruit powder into the cake batter to create a healthy and nutritious dessert. Several studies have explored the feasibility of producing cakes from baobab fruit. Barakat (2021), evaluated the sensory and nutritional properties of sponge cake made with baobab fruit powder and found that it had good sensory attributes and was high in fibre, antioxidants, and vitamin C. The study also investigated the effect of baobab fruit powder on the physical sponge cake and found that it improved the nutritional value of the cake without affecting its sensory attributes. The study evaluated the nutritional value of cupcakes made with baobab fruit powder and found that they were high in fibre and antioxidants.

Baobab fruit can be combined with other ingredients to create healthy snack bars. These bars are often made with nuts, seeds, and dried fruits providing a nutritious, energy-packed snack. Engelberger et al. (2013), investigated the sensory and nutritional properties of baobab fruit-nut bars and found that they had good sensory attributes and were high in fibre and antioxidants. The report also revealed that baobab fruit could be made into chewy candies high in fibre and antioxidants. Baobab fruit chews are a popular snack in many African countries.

Baobab fruit has been used to produce cooking oil due to its high nutritional value and potential health benefits. Cooking oil from baobab fruit involves extracting the oil from the seeds of the fruit and refining it to produce edible oil. Several studies have explored the feasibility of producing

cooking oil from baobab fruit; for instance, a survey by Msalilwa et al. (2020), investigated the physicochemical properties and fatty acid composition of baobab seed oil and found that it had a high content of unsaturated fatty acids, which are beneficial for human health. A study by El-Arab (2017), evaluated the quality and stability of baobab seed oil during storage. It found that it had good oxidative stability and could be a potential source of edible oil. A study by Ndiaye et al. (2022), investigated oil extraction from baobab seeds using different methods and found that the cold-pressing method produced oil with the highest yield and quality.

2.2 ACCEPTABILITY OF THE BAOBAB PRODUCTS

A Ghana study conducted by Kwamboka (2020), found that baobab-based snacks and drinks were highly acceptable among consumers. The study used sensory evaluation and focus group discussions to assess the acceptability of the products. Participants in the study reported that they enjoyed the taste and flavour of the products and perceived them as healthy and nutritious. Another survey by Kiprotich et al. (2019), in Ghana found that baobab-based cookies were well-liked by consumers, who appreciated the product's unique flavour and perceived health benefits. The study also found that consumers were generally willing to pay a premium for baobab-based products due to their perceived health benefits and natural sourcing.

In another study by Dietrich et al. (2015), in Malawi baobab fruit pulp was widely used in traditional culinary practices, and was perceived as healthy and nutritious. The study used surveys and focus group discussions to assess consumers' acceptability of baobab products. However, concerns were raised about the availability and affordability of baobab products, particularly in areas where the baobab tree is not native.

A study conducted by MacGonagle (2002), in Mozambique found that baobab powder was generally well-liked by consumers, who appreciated the natural and sustainable sourcing of the product and its nutritional properties. The study used sensory evaluation and focus group discussions to assess the acceptability of the product. However, concerns were raised about the taste and flavour of the product, with some participants finding it too tart or sour.

A study conducted by Sabbe et al. (2008), found that familiarity with baobab products was an important factor in consumer acceptance, with participants who were more familiar with baobab-based products reporting higher levels of acceptability. The study also found that perceived health benefits and natural sourcing were important factors in consumer acceptance. The study found that

taste and flavour influenced consumer acceptance of baobab products. The study used surveys and focus group discussions to assess the acceptability of the product. The study also found that familiarity with baobab products, perceived health benefits, and natural sourcing was essential to consumer acceptance.

A study conducted in Nyanyadzi and Gudyanga wards in Zimbabwe's Chimanimani district revealed that at least 70% of interviewees used baobab products (Kozanay et al., 2022). The utilization of the tree is centred on its fruit, seeds and fibrous bark. Like in other southern African communities, in Zimbabwe, the fruit pulp is dissolved in water or fresh milk to make a juice consumed frozen (Mugangavari, 2019). His study also found that seeds are roasted and ground into a powder used as a substitute for coffee. Craft items made from baobab fibre have been exported to South Africa from Zimbabwe since the early 1990s (Wynberg et al., 2012). This has contributed to livelihood security in the semi-arid areas of Zimbabwe.

Baobab products have been traditionally used in Zimbabwe for various reasons, for example, food, medicine and cultural rituals. Recently the acceptability of baobab products in Zimbabwe has increased owing to the growing awareness of their health benefits and unique taste (Leakey et al., 2019). Baobab powder, in particular, has gained popularity as a nutritional supplement due to its high vitamin C content, anti-inflammatory properties, and ability to boost the immune system, as evidenced (Caluwé et al., 2010). The baobab fruit is recently used as an ingredient in beverage and food products. According to a study by Puiggròs et al. (2017), on the acceptance of baobab products in Zimbabwe, the study revealed that baobab powder was highly accepted by consumers, mainly as an ingredient in beverages. In addition, another study by Moyo et al. (2019), focused on using baobab fruit as an ingredient in the traditional maize porridge in Zimbabwe. The study revealed that adding baobab fruit pulp increased the porridge's nutritional value, and consumers highly accepted it.

Baobab powder has a high gelling capacity, and research studies have shown that its potential has not been exploited yet (Ndabikunze et al., 2011). Due to its gelling ability, the research found that baobab powder can be a perfect potential alternative for commercial pectin in jam production.

CHAPTER 3: METHODOLOGY

3.1 OPTIMIZING OF FRUIT JAM FROM BAOBAB FRUIT POWDER

The ingredients for the sample 1 are water, baobab powder, sugar, and lemon juice**.** The first stage combines 1 cup of baobab powder, 1.5 cups of sugar, and 1 cup of water in a medium-sized pot. The next step involves stirring the mixture using a hand mixer for 10 minutes to mix the ingredients thoroughly. After that, the pot was placed on the stove over medium heat and brought the mixture to a boil, stirring with a spoon constantly. Once the mixture had reached the boiling point and became jelly-like, the heat was reduced to low and simmer for 10 minutes, stirring occasionally to avoid burning it. The pot was removed from heat, two tablespoons of lemon juice were added, and the mixture was stirred. Lastly, the jam was put in a clean, sterilized jar to allow it to cool before sealing.

Ingredients for sample two are baobab powder, sugar, and water. The first stage combines water and baobab powder in a pot with a ratio of 1:1. The second stage involves heating the mixture on a stove over medium heat until it thickens, stirring regularly to avoid burning it. Once the mixture thickened, 1 cup of sugar was added and stirred for ten minutes. The jam was then poured into a clean, sterilized jar to allow it to cool before sealing.

Ingredients for sample three are 1 cup of baobab powder, 1 cup of sugar, half a cup of milk cream, and 1 cup of water**.** The first step involves combining baobab powder, sugar and water. The second stage involved adding milk and stirring well until all the ingredients were mixed properly. The third step is heating the mixture for about 15-20 minutes, stirring more often until the mixture has thickened until all the sugar has dissolved. When the mixture became jelly-like, it was stirred to prevent it from scorching and sticking to the bottom of the pot. To test whether the jam is ready, dab a bit of the mixture in a tablespoon and then wait a minute. If the mixture thickens up, then it means the jam is ready. The pot was removed from heat, allowed to cool down slightly, and then poured the jam into sterilized jars, ready for consumption.

3.2 SENSORY EVALUATION

The three samples were subjected to sensory evaluation using a panel of 100 evaluators randomly selected from the Bindura University Of Science Education to assess consumers' preferences. The samples were evaluated for sensory attributes using a form shown in the appendix.

3.3 DATA ANALYSIS

The data was analyzed using SPSS whereby non parametric tests were done using Kendell W. The three jam recipes were evaluated based on five attributes which are appearance, taste, texture, aroma, and overall acceptability. For each attribute, the one with a lower rank indicated better performance. The mean rank was then calculated for each recipe in each attribute based on the rankings given by the evaluators. A table was used to present the mean ranks for each recipe in each attribute. Then also to determine if there were significant differences between the mean ranks of the jam recipes for each attribute, a statistical analysis was performed, which resulted in the key indicating the level of statistical significance. The letters "a" and "b" in the key denote the degree of significance, with "a" indicating a higher level of significance compared to "b". The key indicates that there is a significant difference between the mean ranks of the jam recipes for each attribute. The results were then presented in the form of bar graphs, tables and pie charts

CHAPTER 4: RESULTS

4.1 DATA PRESENTATION.

The study shows a total of 100 evaluators, 20 were below 20 years, 54 were between the age of 21-35 years, were 22 between 35-50 and 11 were above 50 years.

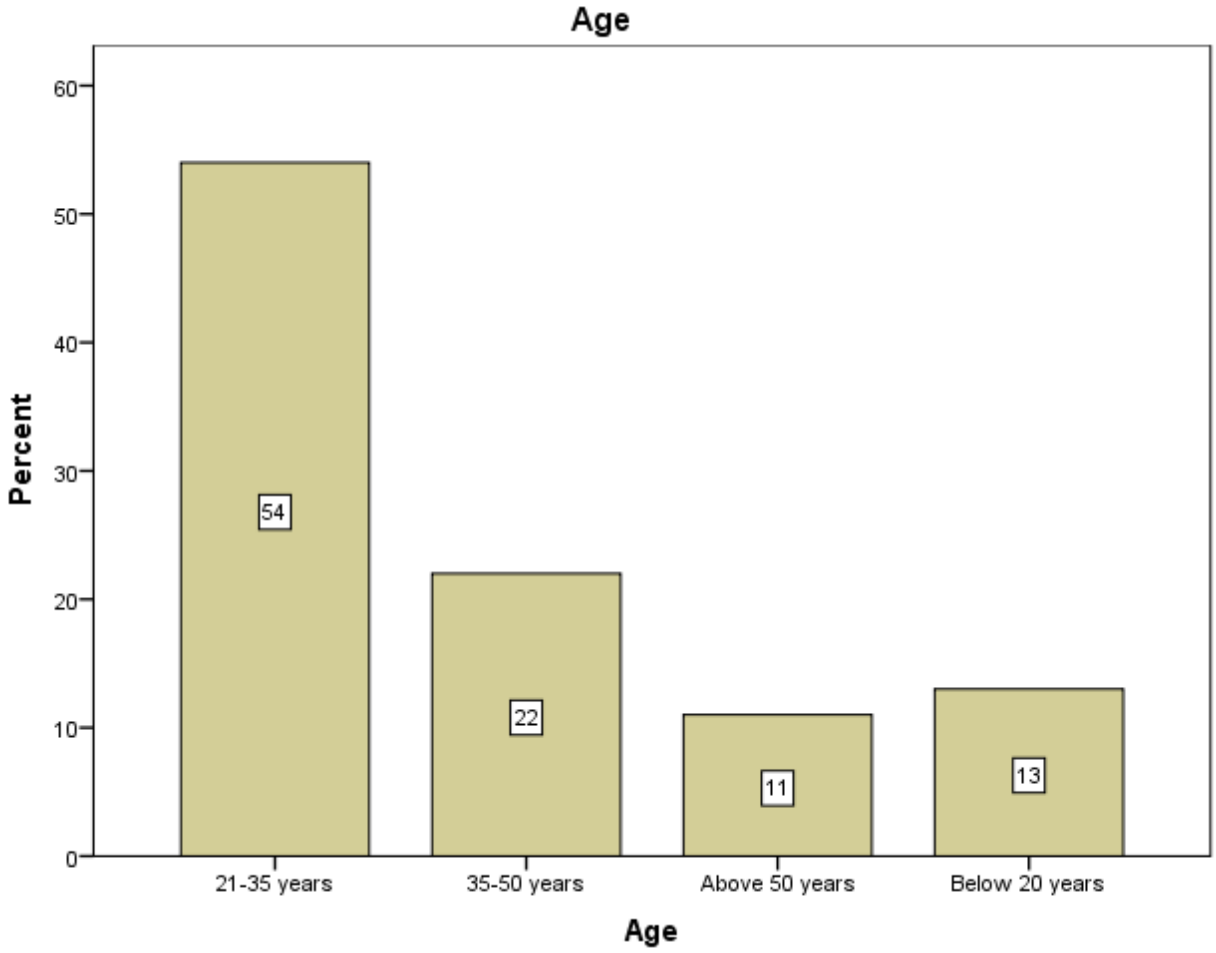


Fig 4. 1

The study shows more female evaluators. Out of the 100 evaluators who evaluated the three jam types, 59 were female and 41 were males

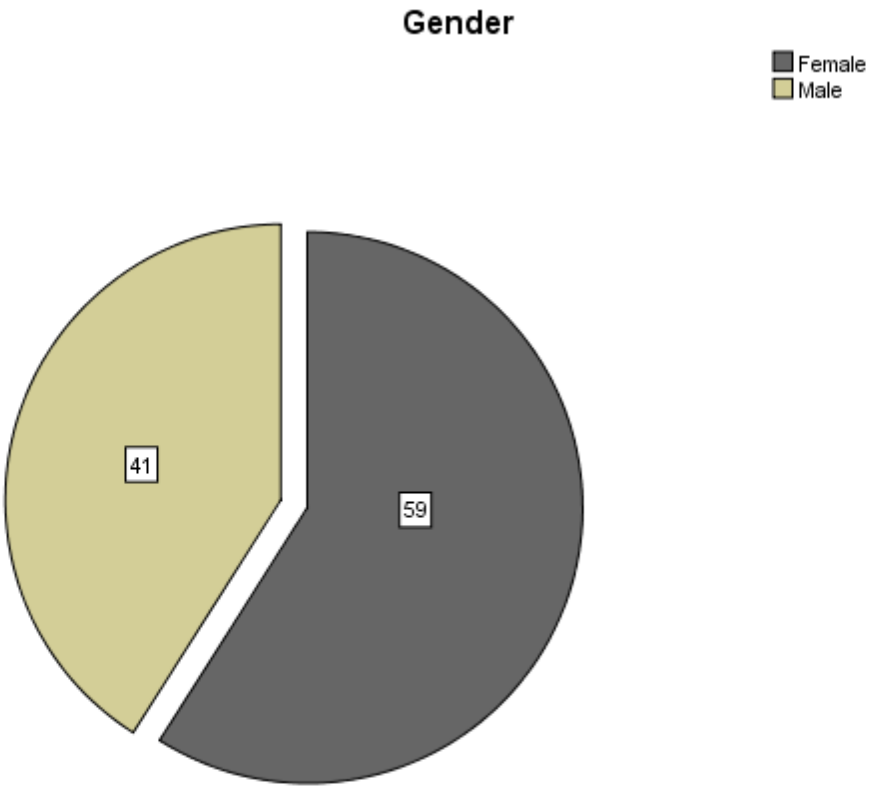
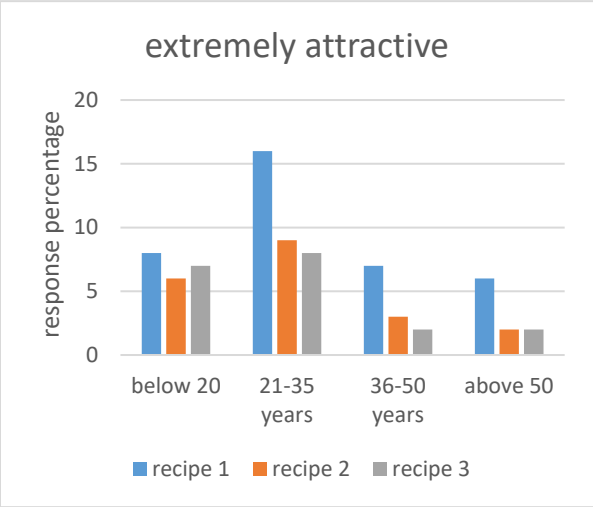
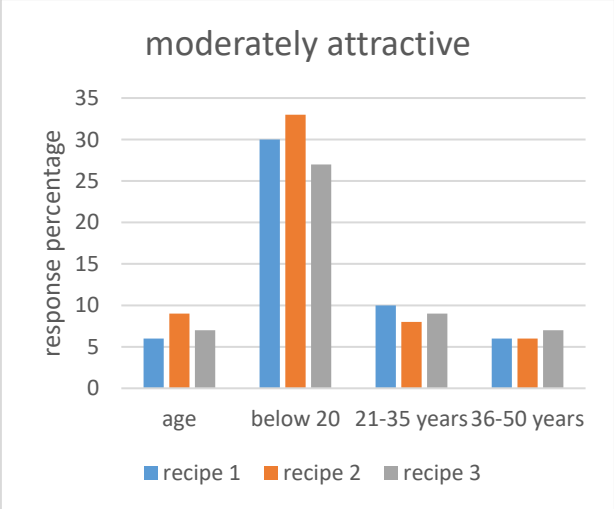


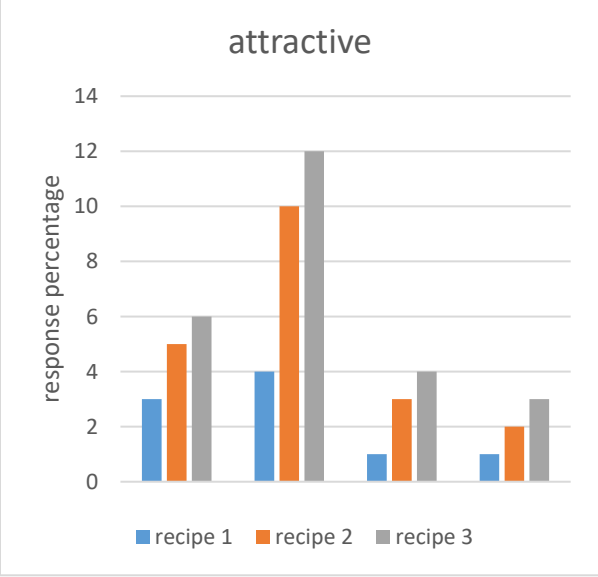
Fig 4. 2

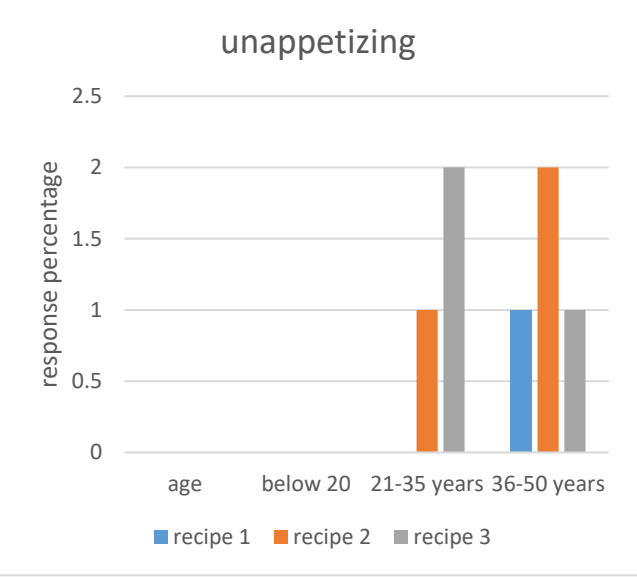
INFLUENCE OF AGE ON APPEARANCE

Fig 4.3 shows the effects of age on the appearance of the three jam types; the vertical axis shows the percent of the 100 evaluators. Based on the graphs, the appearance of all three jam types was acceptable mainly with the age group between 21-35 years and recipe two was ranked significantly higher than the others.









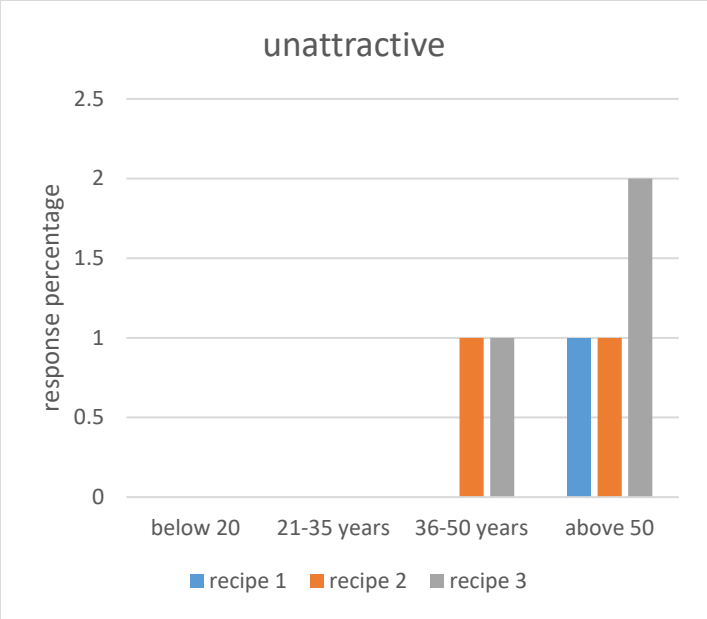
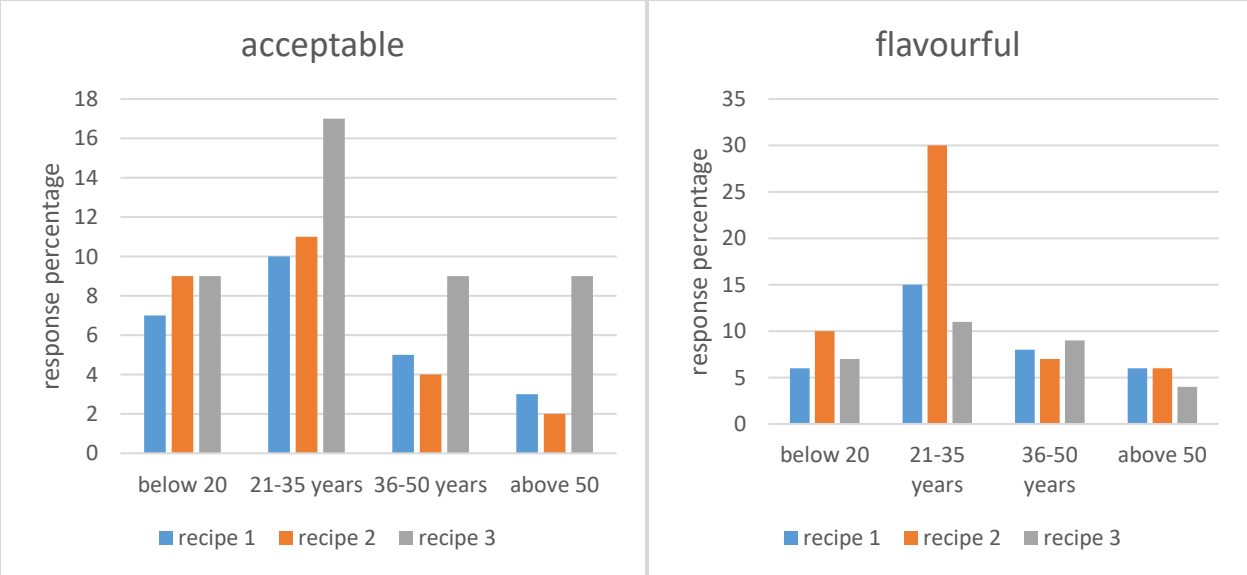
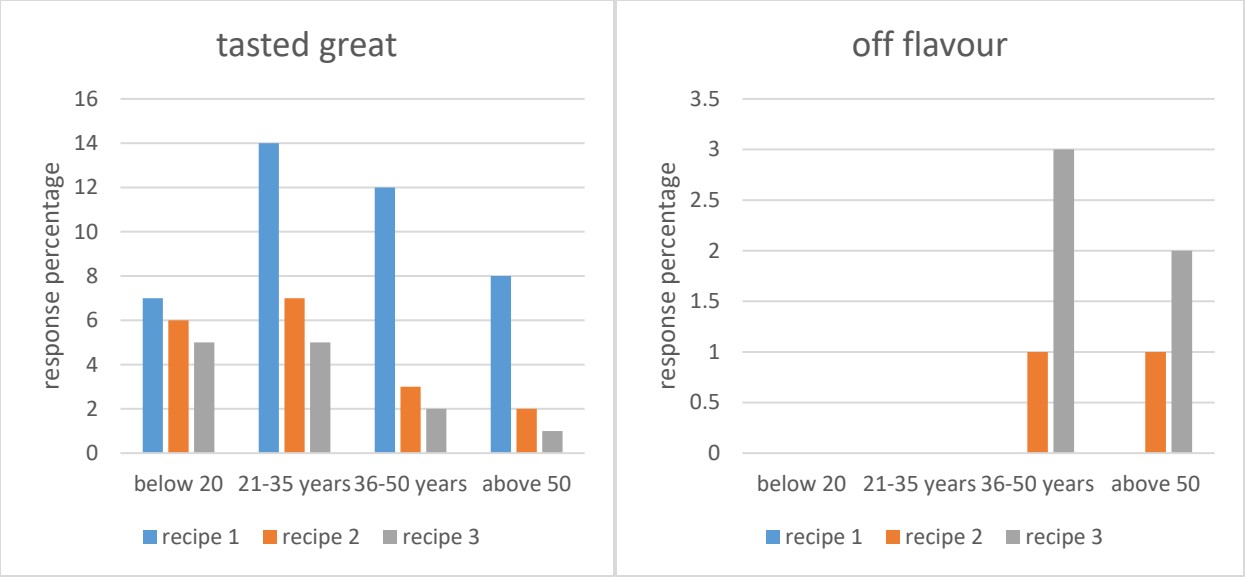


Fig 4. 3

THE INFLUENCE OF AGE ON FLAVOUR

Based on Fig 4.4, it appears that there is some variation in the perceived taste and flavor of recipes based on the age of the person tasting them. All recipes received generally high scores across all age groups, with recipe 1 and recipe 2 performing slightly better than recipe 3.





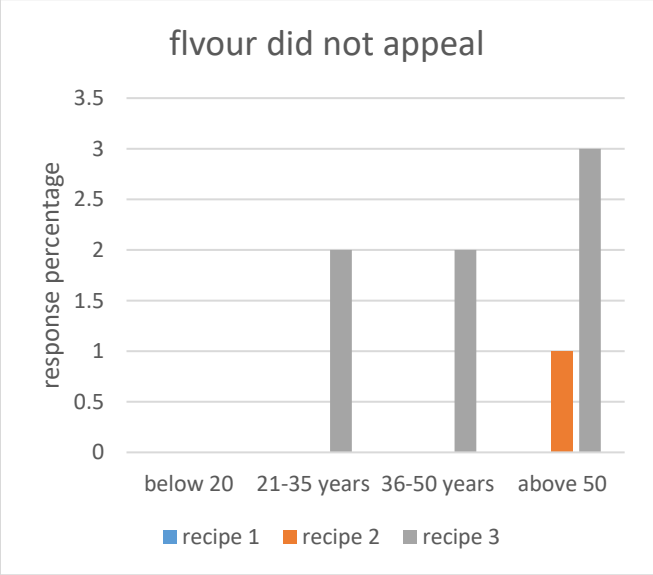


Fig 4. 4

INFLUENCE OF AGE ON TEXTURE

Based on fig 4.5, it appears that there is some variation in the perceived texture of recipes based on the age of the person tasting them.

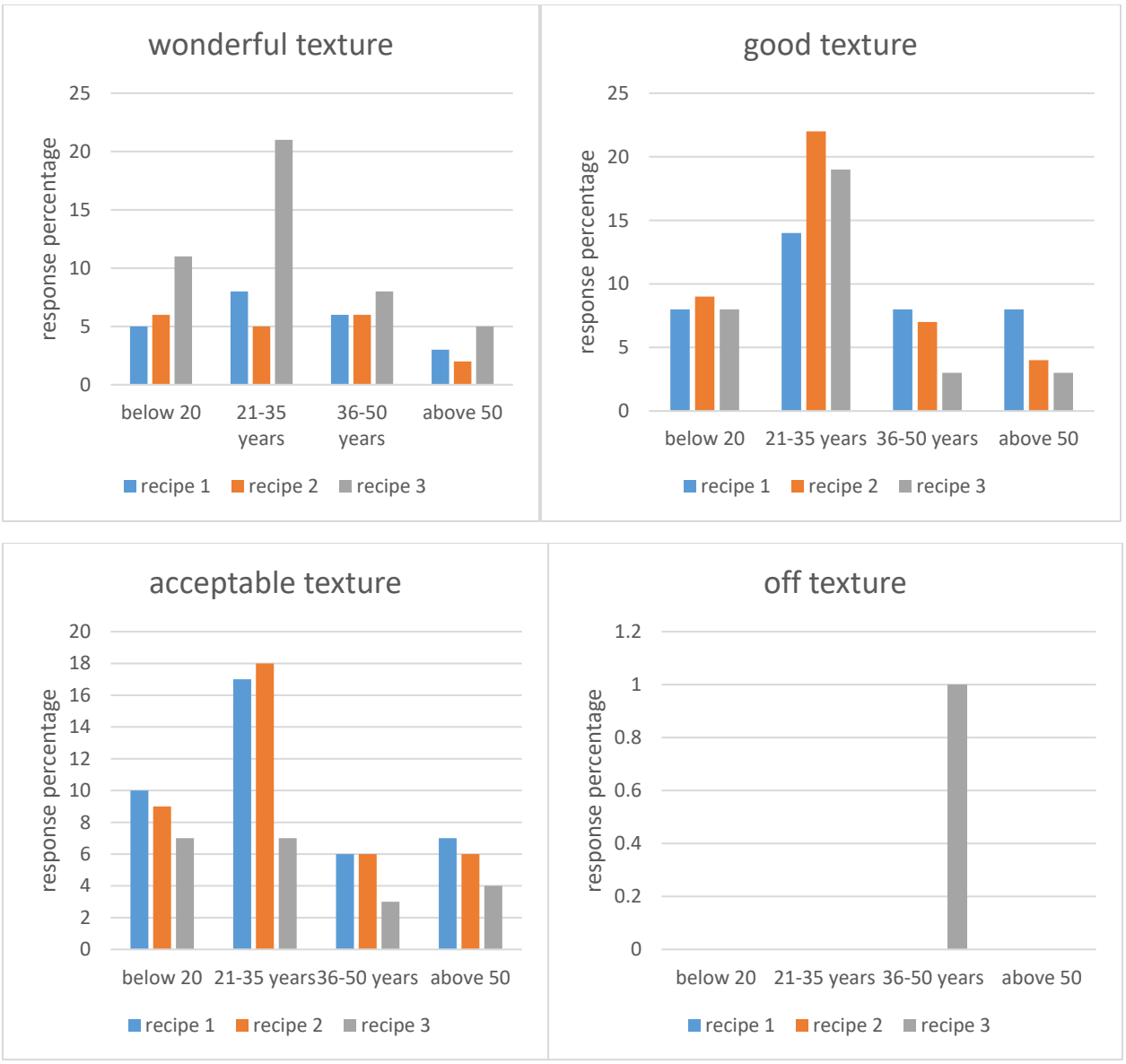
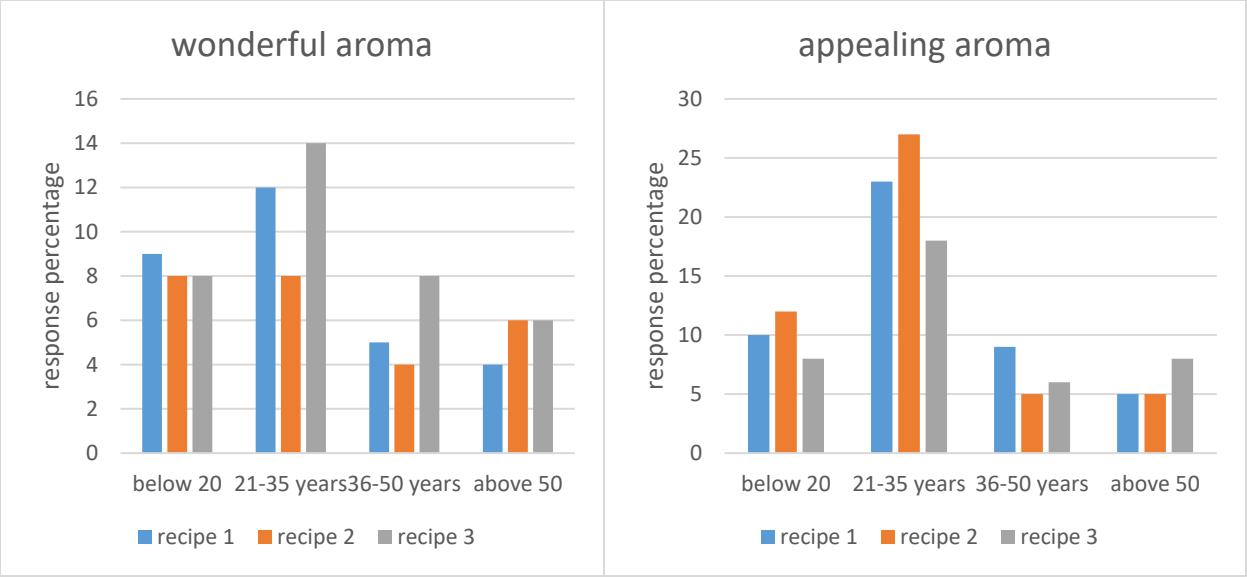


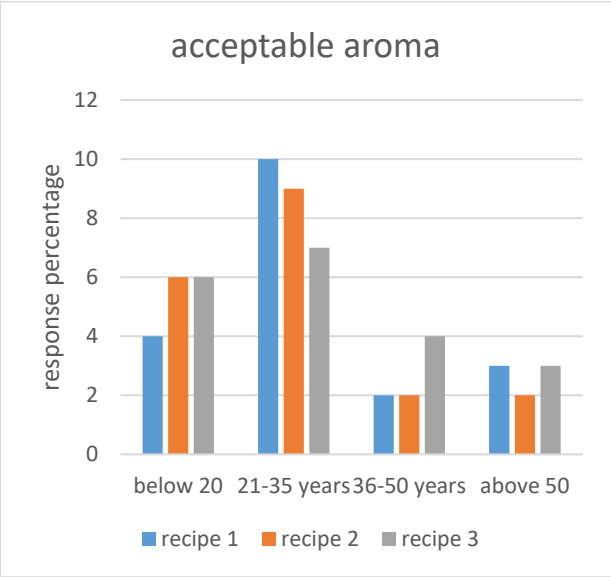
Fig 4. 5

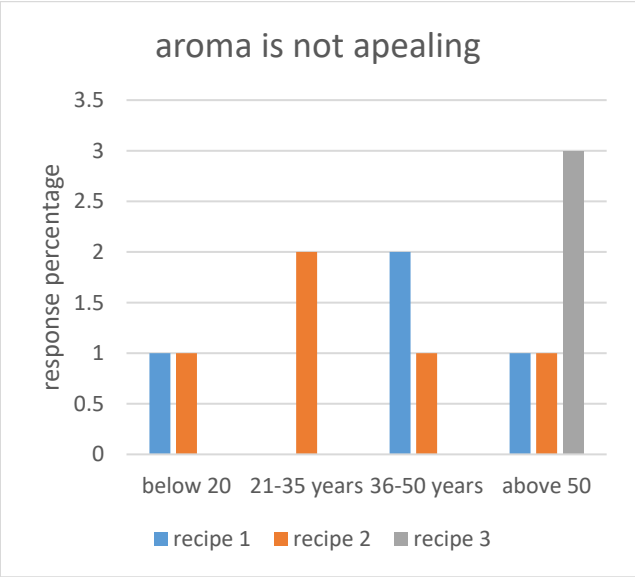
INFLUENCE OF AGE ON AROMA

Based on fig 4.6 it appears that there is some variation in the perceived aroma of recipes based on the age of the person smelling them with the young age ranking the aroma higher than the old age.


wonderful aroma
response percentage
16
14
12
10
8
6
4
2
0
below 20
21-35 years
36-50 years
above 50
recipe 1
recipe 2
recipe 3

appealing aroma
response percentage
30
25
20
15
10
5
0
below 20
21-35 years
36-50 years
above 50
recipe 1
recipe 2
recipe 3


acceptable aroma
response percentage
12
10
8
6
4
2
0
below 20
21-35 years
36-50 years
above 50
recipe 1
recipe 2
recipe 3


aroma is not apealing
response percentage
3.5
3
2.5
2
1.5
1
0.5
0
below 20
21-35 years
36-50 years
above 50
recipe 1
recipe 2
recipe 3

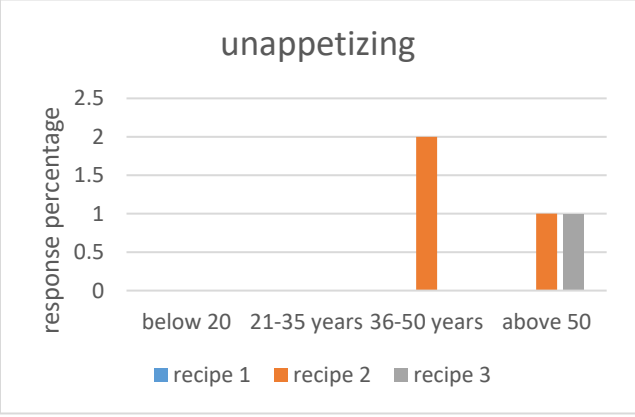

unappetizing
response percentage
2.5
2
1.5
1
0.5
0
below 20
21-35 years
36-50 years
above 50
recipe 1
recipe 2
recipe 3

Fig 4. 6

INFLUENCE OF AGE ON OVERALL ACCEPTABILITY

Basing on fig 4.7, **For recipe 1:**

The age group below 20: The percentage of extremely acceptable ratings is highest in this age group at 60%, followed by moderately acceptable ratings at 27.27%, and acceptable ratings at 20%. The percentage of moderately unacceptable and unacceptable ratings is 0%. This suggests that jam recipe 1 is highly acceptable among younger people. 21-35 years: The percentage of extremely acceptable ratings decreases to 31.58% in this age group, with moderately acceptable ratings at 12.73% and acceptable ratings at 13.33%. Again, the percentage of moderately unacceptable and unacceptable ratings is 0%. This suggests that jam recipe 1 is still fairly well-accepted among people in their 20s and 30s. 36-50 years: The percentage of extremely acceptable ratings decreases further to 11.54% in this age group, with moderately acceptable ratings at 5.45% and acceptable ratings at 6.67%. The percentage of moderately unacceptable ratings is 0%, but there were 0.83% unacceptable ratings. This suggests that jam recipe 1 is less well-accepted among people in their late 30s to 50s. Above 50: The percentage of extremely acceptable ratings is lowest in this age group at 7.69%, followed by moderately acceptable ratings at 1.82% and acceptable ratings at 3.33%. The percentage of moderately unacceptable ratings is 0%, but there were 0.83% unacceptable ratings. This suggests that jam recipe 1 is least accepted among older people.

For recipe 2:

Below 20: The percentage of extremely acceptable ratings is 0% in this age group, with moderately acceptable ratings at 18.18% and acceptable ratings at 16.67%. The percentage of moderately unacceptable and unacceptable ratings is 0%. This suggests that jam recipe 2 is still fairly well-accepted among younger people.21-35 years: The percentage of extremely acceptable ratings is still 0% in this age group, with moderately acceptable ratings at 23.64% and acceptable ratings at 18.33%. The percentage of moderately unacceptable and unacceptable ratings is 0%. This suggests that jam recipe 2 is still fairly well-accepted among people in their 20s and 30s. 36-50 years: The percentage of extremely acceptable ratings is still 0% in this age group, with moderately acceptable ratings at 10.91% and acceptable ratings at 8.33%. The percentage of moderately unacceptable and unacceptable ratings is 0%. This suggests that jam recipe 2 is less well-accepted among people in their late 30s to 50s. Above 50: The percentage of extremely acceptable ratings is still 0% in this age group, with moderately acceptable ratings at 3.64% and acceptable ratings at 6.67%. The

percentage of moderately unacceptable and unacceptable ratings is 0%. This suggests that jam recipe 2 is least accepted among older people.

For recipe 3:

Below 20: The percentage of extremely acceptable ratings is 0% in this age group, with moderately acceptable ratings at 0% and acceptable ratings at 26.67%. The percentage of moderately unacceptable and unacceptable ratings is 0%. This suggests that jam recipe 3 is still fairly well-accepted among younger people.21-35 years: The percentage of extremely acceptable ratings is still 0% in this age group, with moderately acceptable ratings at 0% and acceptable ratings at 28.33%. The percentage of moderately unacceptable and unacceptable ratings is 0%. This suggests that jam recipe 3 is still fairly well-accepted among people in their 20s and 30s.36-50 years: The percentage of extremely acceptable ratings is still 0% in this age group, with moderately acceptable ratings at 0% and acceptable ratings at 20%. The percentage of moderately unacceptable and unacceptable ratings is 0%. This suggests that jam recipe 3 is less well-accepted among people in their late 30s to 50s. Above 50: The percentage of extremely acceptable ratings is still 0% in this age group, with moderately acceptable ratings at 0% and acceptable ratings at 16.67%. The percentage of moderately unacceptable ratings is 0%, but there were 0.83% unacceptable ratings. This suggests that jam recipe 3 is least accepted among older people.

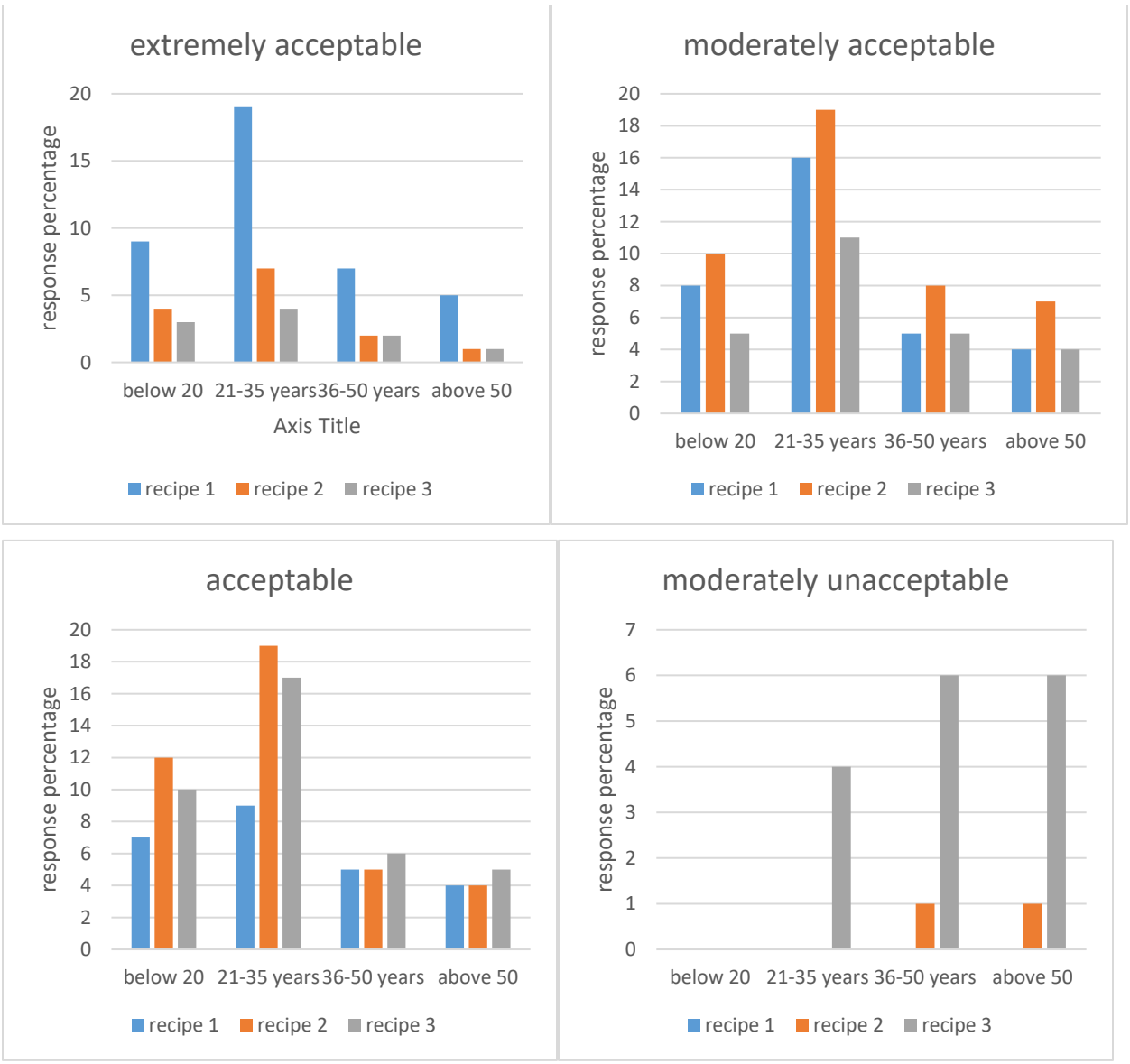

extremely acceptable
response percentage
20
15
10
5
0
below 20
21-35 years
36-50 years
above 50
Axis Title
recipe 1
recipe 2
recipe 3
moderately acceptable
response percentage
20
18
16
14
12
10
8
6
4
2
0
below 20
21-35 years
36-50 years
above 50
recipe 1
recipe 2
recipe 3
acceptable
response percentage
20
18
16
14
12
10
8
6
4
2
0
below 20
21-35 years
36-50 years
above 50
recipe 1
recipe 2
recipe 3
moderately unacceptable
response percentage
7
6
5
4
3
2
1
0
below 20
21-35 years
36-50 years
above 50
recipe 1
recipe 2
recipe 3

Fig 4. 7

INFLUENCE OF GENDER ON OVERALL ACCEPTABILITY OF ALL THE RECIPES

Based on fig 4.8, gender has an effect on the texture, appearance, aroma, flavor and overall acceptability of the jam. The graphs show that the jam is mostly liked by the female gender.

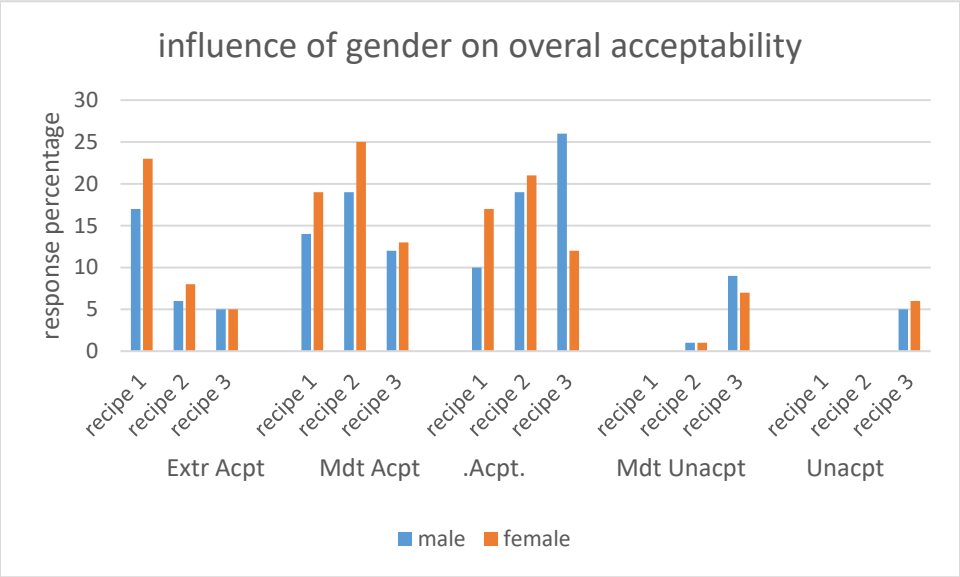


Fig 4. 8

extr acpt its extremely acceptable, mdt acpt = moderately acceptable, acpt = acceptable, Mdt Uacpt= moderately unacceptable, Unacpt= unacceptable

4.2 KENDELL W ANALYSIS

Fig 4.9 shows the mean ranks of three different jam recipes based on five attributes which include appearance, taste, texture, aroma, and overall acceptability. The mean ranks represent the average ranking of each recipe in each attribute, with a lower rank indicating better performance. Recipe 1 has the lowest mean rank for appearance and overall acceptability, indicating that it performed the best in these two attributes. Recipe 2 has the lowest mean rank for texture, while Recipe 3 has the lowest mean rank for taste and aroma.

The key indicates the level of statistical significance among the jam recipes, with the letters "a" and "b" denoting the degree of significance. The key indicates that there is a significant difference between the mean ranks of the jam recipes for each attribute. Specifically, Recipe 1 performed significantly better in appearance and overall acceptability compared to Recipes 2 and 3.

Jam samples	Mean ranks				
	Appearance	Taste	Texture	Aroma	Overall Acceptability
Recipe 1	1.37^{a}	1.58^{a}	1.65^{a}	1.50^{a}	1.37^{a}
Recipe 2	1.48^{b}	1.56^{b}	1.50^{b}	1.53^{b}	1.64^{b}
Recipe 3	1.52^{b}	1.44^{b}	1.35^{b}	1.48^{b}	1.76^{b}

Fig 4.9 Key $^{a}{}_{b}$ indicates the significance among the jam recipes

CHAPTER 5: DISCUSSION

5.1 ACCEPTANCE OF BAOBAB JAM

The acceptance of baobab jam was assessed through a survey conducted at Bindura University Of Science Education. 90% of the respondents were aware of baobab fruit, and were willing to try baobab jam. The primary reasons for the willingness to try baobab jam were its health benefits, unique taste, and the desire to support local products. However, some respondents were unwilling to try baobab jam, primarily due to a lack of familiarity with the product and its taste.

Of the three jam types, recipe 1 was the most acceptable in terms of overall acceptability, followed by recipe two and, lastly, recipe 3. Recipe 1 was the most liked by the evaluators, primarily because of the lemon juice, which provided a sweet scent and an extremely excellent taste. The recipe with lemon was mainly appreciated by the age group between 21-35, followed by the age between 36-50 years and the jam was especially liked again by the female gender. This might mean that the jam might have a good chance of survival on the market since evaluators who rated the jam's overall acceptability primarily as extremely acceptable are the economically active age. Another reason recipe one jam might survive competition on the market is that it was mostly accepted by the female gender, which usually does most of the household shopping.

Recipe 2 was reasonably acceptable; the recipe had no extra ingredients and had the real taste of baobab fruit. This sample was liked mainly by the age group between 36-50, followed by those above 50. This recipe had an equal number of males and females who rated the overall acceptability of the jam as extremely acceptable. The aroma of recipe 2 was the least rated of the three recipes since it had no extra ingredients. Based on the overall acceptability rating of the jam shown in Fig 4.7, the jam has a moderate chance of surviving on the market since it is moderately acceptable.

Recipe 3 with milk was the least rated or liked by evaluators, this is because it had a lot of milk and sugar; hence it was delightful. Additionally, recipe three tasted like ice Lolos because of the milk, reducing its overall acceptability. The third sample was rated mainly by the age group below 20; its overall acceptability was considered extremely primarily acceptable by the male gender. Out of the three recipes, recipe 3 was the only one whose overall acceptability was rated

unacceptable by more than ten evaluators. The findings showed that the acceptability of the third recipe was relatively low; several amendments are required before putting the jam on the market.

Based on the sensory evaluation, all three baobab jam types were acceptable, with recipe one ranked significantly high among the 3. The results of the study showed that the majority of the respondents had a positive perception of baobab jam. Most respondents indicated they would buy baobab jam if it were available. These findings suggest that there is a potential market for baobab jam and that the product has the potential to be successful in the market

5.2 BENEFITS OF BAOBAB JAM

Baobab fruit is a rich vitamin C, calcium, and potassium source. Consumption of baobab jam helps improve the nutritional status of individuals with limited access to a diverse range of foods (Musyoki et al.,2022). The study found that the production and consumption of baobab jam can reduce malnutrition and related illnesses (Mounjouenpou et al., 2018). Including baobab jam in the diet will also provide energy and essential nutrients for individuals who engage in physically demanding activities. These findings are consistent with previous studies that have shown that consuming baobab fruit can contribute to the improvement of the diet of individuals (Venter & Witkowski, 2013).

The jam produced from baobab powder can also aid weight loss by promoting feelings of fullness. According to research done by Clegg et al. (2021), adding baobab powder is beneficial in reducing body weight. It can help stop or mitigate cravings, promoting feelings of fullness; hence eating less leads to weight loss. Additionally, the powder helps to balance blood sugar levels; thus, it is healthy. Antioxidant and polyphenol content may reduce Inflammation. Baobab contains many antioxidants and polyphenols; the compounds are important as they protect body cells from oxidative damage, reducing Inflammation (Otong & Musa, 2021). Lastly, high fibre content in baobab may promote digestive health.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

Based on the results of this study, it can be concluded that baobab jam is a viable and acceptable product in Zimbabwe. The study revealed that the production of jam from baobab powder is very much possible and can be a vital source of income for small-scale farmers and large-scale farmers with access to baobab trees. The sensory evaluation proved that the panellists accepted the baobab jam well, with its unique taste, appearance, aroma and flavour profile being a crucial factor in its overall acceptance. Ultimately, the study demonstrates that the production of baobab jam has the potential to be a profitable and sustainable enterprise that can benefit small-scale farmers and contribute to the conservation of baobab trees. Further studies can be conducted to explore other potential applications of baobab powder in food production.

6.2 RECOMMENDATIONS

1. Further research on the formulation of baobab jam should be conducted to improve its sensory attributes and overall quality, thus increasing its acceptance among consumers.

2. The production process should be optimized to enhance the yield and quality of baobab jam, making it more profitable for producers.

3. The nutritional value of baobab jam should be assessed, and its potential health benefits should be communicated to consumers, as it may increase the demand for this product.

4. Marketing strategies should be developed to promote baobab jam. This could include creating a brand image that emphasizes the product's nutritional value and unique taste, developing promotional materials, and establishing partnerships with retailers and restaurants to increase its availability.

5. Finally, further studies on accepting baobab jam should be conducted in different regions to determine whether it has the potential for global market penetration.

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APPENDICES

SENSORY EVALUATION FORM FOR BAOBAB JAM

Person's name …….

M ☐ **Gender: F** ☐

Age. below 20 years ☐ 21-35. years ☐ 36-50 years ☐

above 50 years. ☐

Recipe 1: category: jam

Instructions: Tick one rating boxes for one of the following; appearance, taste/flavor, texture Aroma and overall acceptability

Appearance.	Extremely attractive	Moderately attractive.	Attractive	unappetizing	Unattractive.
Taste/flavour.	Tasted great	Flavourful.	acceptable	Off flavour	Flavour did not appeal to me.
Texture.	Wonderful texture	Good texture.	Acceptable texture	Off texture	Inappropriate texture.
Aroma.	Wonderful aroma	Appealing aroma.	Acceptable aroma	Aroma is not appealing	Unappetizing.
Overall acceptability.	Extremely acceptable	Moderately accepted.	acceptable	Moderately unacceptable	Unacceptable.

Recipe 2:

Appearance.	Extremely attractive	Moderately attractive.	attractive	unappetizing	Unattractive.
Taste/flavour.	Tasted great	Flavourful.	acceptable	Off flavour	Flavour did not appeal to me.
Texture.	Wonderful texture	Good texture.	Acceptable texture	Off texture	Inappropriate texture.
Aroma.	Wonderful aroma	Appealing aroma.	Acceptable aroma	Aroma is not appealing	Unappetizing.
Overall acceptability.	Extremely acceptable	Moderately.accepted	acceptable	Moderately unacceptable	Unacceptable.

Recipe 3:

Appearance.	Extremely attractive	Moderately attractive.	Attractive	unappetizing	Unattractive.
Taste/flavour.	Tasted great	Flavourful.	acceptable	Off flavour	Flavour did not appeal to me.
Texture.	Wonderful texture	Good texture.	Acceptable texture	Off texture	Inappropriate texture.
Aroma.	Wonderful aroma	Appealing aroma.	Acceptable aroma	Aroma is not appealing	Unappetizing.
Overall acceptability.	Extremely acceptable	Moderately accepted.	acceptable	Moderately unacceptable	Unacceptable.