IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

ADANSONIA DIGITATA

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Abstract: The Kenya vision 2030 launched in the year 2008 is aimed at transforming the country into a middle income earning country, right from the current third world state, it is currently in. According to the Big 4 Agenda, Food security is one of the key agendas. So many parts of the country have been affected by drought which has led to drought being declared a National disaster. However, many of this drought-stricken areas can be utilized in the growth of Baobab plant scientifically known as Adansonia Digitata. This plant is able to strive in dry and arid areas. It sheds its leaves during dry seasons and is able to survive. This plant is able to produce succulent fruits and flour. Agriculture being one of the economic pillars of the country should focus on mass growth of plants that can survive even in dry and arid areas. The objective of this study was to fortify grain flour using baobab fruit pulp powder to improve the nutritional content of the flour. The specific objectives of the project were to improve the nutritional content of grain flour and increase the shelf life of grain flour. The parameters analyzed were the proximate analysis of some nutrients, monitoring shelf life and acceptability of baobab enriched grain flour. These parameters formed the basis of data collection. From the data, it was concluded that baobab improves the nutritional content of the flour. Baobab adds fiber value, although in minimal amounts. It was also established that there is an increasing trend of protein added to the flour as the quantity increases. As the amount of baobab pulp increases, the carbohydrate content also increases. Baobab also adds more vitamin C to the flour. Baobab is a preservative as there is a significant decrease in the number of E-Coli as the quantity of baobab pulp powder increases which proves that it increases the shelf life of the flour. The study recommends further analysis and tests on the fortified flour to prove if other nutrients which are not tested in this report are present. The study recommends investigation on the influence of temperature, time and PH on the final fortified flour.

Index Terms – Drought, Food Security, Kenya Vision 2030

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Drought has been one of the enemies of human beings from time immemorial. (Adolphe, Dahl, Whiting & Tyler, 2006). Governments opt to run to the World Bank for financial aid to alleviate this problem (Akner & Floistrup, 2003). However, many government advisors have not considered the option of coming up with a long-term solution. So many parts of the country have been affected by drought which has led to drought being declared a National disaster (Basu, 2006).

However, many of this drought-stricken areas can be utilized in the growth of Baobab plant scientifically known as Adansonia Digitata. This plant is able to strive in dry and arid areas. It sheds its leaves during dry seasons and is able to survive. This plant is able to produce succulent fruits and flour. Agriculture being one of the economic pillars of the country should focus on mass growth of plants that can survive even in dry and arid areas (FAO, 2006).

Fig 1.1 Adansonia digitata surviving in arid areas

In response, the government has introduced compulsory fortification on flour and cooking oil product in Kenya (Chapman, 2006). However, the use of fortification formula from chemical ingredients is difficult and poorly sustainable. Therefore, a food to food fortification could be an advantage (FAO, 2006). Many entrepreneurs have already come up with different ways of fortifying grain flour with different food to food ingredients which include Amaranth (mchicha), pumpkin seeds, and Moringa seeds among others. Children aged four to six years tend to have negative attitude towards porridge because of the fortification with many ingredients which produce a taste that children do not like (WHO, 2012).

The baobab (*Adansonia* *digitata*) belongs to the Bombacaceae family (Gibson, 2005). It produces large green or brownish fruits which are capsules and characteristically indehiscent. The capsule contain a soft whitish powdery pulp, kidney shaped seeds (Keller, 2004). 100g of baobab fruit pulp dry weight contains an average

1.1-10.4 mg of Iron, 390-700.9 mg of calcium, and up to 1.7 mg of Zinc (Miller, 2006). Baobab fruit pulp contains all the essential amino acids (WHO, 2012).

This ingredient can be important in fortifying porridge due to its acceptability among the children. The Baobab fruit pulp is commonly known as "Mabuyu" (Utiger, 1998). The baobab fruit has a very resistant capsule named epicarp and an internal portion, the fruit pulp, named endocarp (Miller, 2006). The ripe fruit pulp appears as naturally dehydrated powdery, whitish colored and with a slightly acidulous taste. It is split in small floury agglomerates that enclose multiple seeds. It contains filaments that subdivide the fruit in segments and its separation only needs a single mechanical process without any extraction, concentration or chemical treatment (WHO, 2012)..

According to FAO (2006), the quantity of baobab per 100g of pulp is:

75.6 percent of total carbohydrates

32.3 percent of total proteins. 4 times of Flour

300mg ascorbic acid. Approximately 6 times that of orange

293 mg potassium. 4 times of bananas

118mg phosphorous

9.1 mg iron

It also contains more of energy, sodium, vitamin A, riboflavin, Thiamin, Niacin, magnesium and antioxidants.

1.2 Statement of Originality

We came up with this project after reading an article about the nutritional value of baobab.

We also got an inspiration from the drought that has affected the country until the president decided to go for aid in America.

1.3 Statement of the problem

According to the Big 4 Agenda, Food security is one of the key agendas. So many parts of the country have been affected by drought which has led to drought being declared a National disaster. However, many of this drought-stricken areas can be utilized in the growth of Baobab plant scientifically known as *Adansonia*

Digitata. This plant is able to strive in dry and arid areas. It sheds its leaves during dry seasons and is able to survive. This plant is able to produce succulent fruits and flour. (Basu, 2006). A growing number of children in Kenya are suffering from the effects of malnutrition due to poverty and food insecurity. The long term effects of malnutrition include poor growth, underweight and difficulties in learning. This affects the social and economic pillars of vision 2030.

1.4 Objectives of the study

1.4.1 General Objective of the study

To prepare and evaluate grain flour enriched with baobab pulp.

1.4.2 Specific Objectives of the study

i. To improve the nutritional content of grain flour.

ii. To improve the shelf life of grain flour.

1.5 Research Hypothesis

There is no much nutritional value in grain flour consumed.

1.6 Research question

Is there any much nutritional value in grain flour consumed?

1.7 Significance of the study

From this project, the outcomes are:

i. The nutritional quality of grain flour will be improved.

ii. The shelf life of grain flour is going to be increased.

iii. Value addition of grain flour products is of great importance due to the trend of consumption.

1.8 Organization of the study

The study is divided into five chapters. Chapter one brings out the introduction to this study. This chapter will include the background of the study, the statement of the problem, the research objectives, the hypothesis, the significance, the scope and the limitations of the study. Chapter two will entail the Literature review of the study Chapter three of the study will have the research methodology of this study. Chapter 4 will include the Data analysis and discussion while chapter 5 will entail the conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter is divided into three parts which include the introduction and the empirical literature review, in order for the research gaps to be unfolded, hence providing a knowledge gap for the current study.

2.2 Empirical Literature Review

WHO (2012) noted that while there is possibly 100,000 different edible plants in the world, so few are commercialized due to incomplete safety assessments, poor shelf life and the unavailability of the material for commercial production. Recently, a new botanical to the west seems to have found a reasonable solution to these problems with its use being imminent into the European Union and the USA market place.

Adolphe, Dahl, Whiting and Tyler (2006) noted that the baobab tree, *Adansonia digitata*, is a member of the Bombacaceae family which consists of around 20 genera and around 180 species. This deciduous tree was originally located in South Africa, Botswana, Namibia, Mozambique and Zimbabwe (Chapman, 2006), but it can be found in most countries within the African continent. Export by traders means the baobab tree is also common in America, India, Sri Lanka, Malaysia, China, Jamaica and Holland (Keller, 2004).

Chapman (2006) first highlighted the presence of organic acids in the baobab fruit pulp. These included citric acid, tartaric, malic, succinic and ascorbic acid. A later report from WHO (2012) confirmed the observations of Chapman (2006), when they showed that the pulp contained ascorbic acid, tartaric acid, mainly water soluble pectin and the elements of iron and calcium.

Gibson (2005) noted that the pulp of the baobab fruit had numerous uses by the indigenous people of Africa. The researcher noted that the fruit was eaten as a sweet and was also used to make ice cream. In Sudan, a refreshing drink called “gubdi” is made from the fruit pulp and cold water to preserve the vitamins.

According to Miller (2006), Baobab pulp has been determine to be generally recognized as safe (GKAS), consistent with section 201 (5) of the Federal Food, Drug and Cosmetic Act. This determination is based on scientific procedures as described in the following sections under the conditions of its intended use in food. Therefore, the use of baobab fruit pulp in food, as described below is exempt from the requirement of premarket approval. In the year 2008, the EU authorized the use of baobab dried fruit pulp as a safe ingredient in food products and in 2009, it was granted GRAS status in the United States.

CHAPTER THREE

METHODOLOGY

3.1 Materials and Ingredients

- Baobab pulp powder
- Grain flour
- Mixing spoon
- Basin
- Seaver
- Pestle and mortar

3.2 Procedure

3.2.1 To prepare Baobab Pulp Powder

- Using a hacksaw, cut the baobab fruit and split it into two.
- Remove the pulp and separate the red fibres.
- Put the pulp in a pestle and grind using the mortar to separate the pulp powder from the seeds.
- Seave to collect fine powder

Fig 3.1 Baobab fruits and powder

3.2.2 Procedure for Grain Flour fortification

Mix the pulp powder and the flour at a ratio of 1: 2 respectively.

Pack the resultant mixture in a tight container or enclosed packet.

3.3 Limitations and Constraints

The limitation is that baobab trees are only found in a few parts of the country. To grow baobab trees for production of the fruit pulp, it will take 20 to 30 years. Baobab is not a fast maturing plant. Urgent impact or fortification using baobab fruit pulp powder rely on the existing plants available.

3.4 Merits

- Baobab is a preservative therefore increasing the shelf life of the fortified grain flour.
- Baobab is an antioxidant to improve the body immune system.
- Baobab is one of the nutritive plants identified by scientists. This improves the nutritional value of the grain flour.
- Baobab is available in the ASAL (Arid and Semi-arid lands) where malnutrition is common due to food insecurity.

3.5 Applications

The grain flour is used to prepare porridge, ugali flour for ugali meal and wheat flour which is used for various pastries.

3.6 Observation

It is observed that the children who take "Mabuyu", baobab pulp that are flavored are always very healthy, energetic and intelligent.

The acidity of the baobab makes the resultant flour acidic. When food test is done, it shows that ascorbic acid and proteins are present.

3.7 Precautions

- Store the flour in a cool dry place away from direct sunlight.
- Mix the ingredients in the correct ratio.

3.8 Demerits

Because of the acid composition, the flour cannot be used for weaning small babies.

3.9 Effect of change on Parameters

Baobab pulp can also be used to fortify drinks and milk. When it is used in milk, it causes coagulation because of the citric acid.

In the preparation of the flour, if the pulp powder used is more, the resultant flour becomes very weak (if mixed with water, it becomes too dilute).

CHAPTER FOUR

DATA COLLECTION, ANALYSIS AND DISCUSSION

4.1 Data collection

This chapter discusses the methods used in data collection.

Data was collected by carrying out nutritional tests and shelf life experiments on the fortified grain flour and unfortified one (control experiment). Grain flour was fortified with baobab fruit pulp powder obtained from Voi, Taita Taveta County.

The baobab pulp was mixed with the grain flour in the ratio of 1: 2 respectively at 0%, 10 %, 20%, 30% and 40 % as stipulated in Table 1.

Table 4.1: Formulation of enriched Flour with baobab pulp.

Sample	Grain Flour (%)	Baobab pulp (%)
A	100	0
B	90	10
C	80	20
D	70	30
E	60	40

The following experiments were carried out:

4.1.1 Foaming test

Two grams of baobab powder were dissolved in 100 ml of distilled water and blended at high speed for 1 minute. The volume was measured and foaming capacity was calculated.

The formula used for calculation is:

$$\text{Foaming capacity} = \frac{V2 - V1}{V1} \times 100$$

Where V1=initial volume

V2=Final volume

4.1.2 Determination of moisture content

Two grams of the powder were weighed and put in a moisture extraction oven. The difference in weight was calculated as a percentage of the original sample (Agac, 2003).

$$\text{Percentage moisture} = \frac{X2-X1}{X1} \times 100$$

Where X1= Weight of the sample before drying

X2= Weight of the sample after drying

4.1.3 Determination of protein content

Proteins in the samples were determined by Kjeldahl method. 1 g of samples was introduced in digestion flask. 10 ml of concentrated H_2SO_4 and 8g of digestion mixture of K_2SO_4: $CuSO_4$ (8:1) was added.

The mixture was transferred to 100 ml volumetric flask and volume topped up using distilled water.

The percentage of protein was calculated using the formulae (Agac, 2003).

$$\text{Nitrogen} = (V1-V2) \times N \times D \times 0.014 \times \frac{100}{V} \times \frac{100}{S}$$

Where V1= Titer for the sample (m1)

V1= Titer for the sample (m1)

S=weight of sample taken (g)

F= Factor of standard HCl solution

N= Normality of HCl solution (0.002)

D=Dilution of sample after digestion

V=Volume of diluted digest taken for distillation (10 ml)

0.014= mill equivalent weight of Nitrogen

Protein %= Nitrogen X protein factor

4.1.4 Determination of fiber content

Two grams samples were put into 200ml of 1.25 % of H_2SO_4 and boiled for 30 minutes. The solution and content were then poured into Buchner funnel equipped with muslin cloth and secured with elastic band. This was allowed to filter and residue was then put into 200ml boiled NaOH and boiled for 30 minutes. It was filtered and residue obtained. The fiber content was calculated after weighing the residue.

$$= W1 = \frac{W2}{W3} \times 100$$

Where:

W1= weight of sample before

W2= weight of sample after

W3= weight of original sample

4.1.5 Determination of carbohydrate content

The content of total carbohydrates was calculated by subtracting the sum of moisture, protein, fat and fiber from 100 (Agac, 2003).

4.1.6 Determination of Vitamin C content

Vitamin C determination was done according to the method described by Vikram, Bamesh and Prapulla (2005). 1g of the sample was mixed with 30 ml of metaphosphate acid and centrifuged at 10,000 revolutions per minute for 10 minutes at 4^0C in a refrigerated centrifuge. Filtration was done and the filtrate was divided with 1 ml of 0.8% metaphosphoric acid and filtered. The concentration was calculated from the standard graph in mg/100g.

In the second type of experiment, all the samples were left in a dark place for 3 weeks and the number of E-coli confirmed. Serial dilutions in the ratio of 1: 10 were prepared using peptone water. The dilution was shaken by rotation and tilting. Small drops of each sample was put in a sterilized violet bile agar plates for E-coli test. The plates were incubated at 37^0C for 24 hours then examined for colonies appearing on the medium, which were then counted.

4.2 Data Analysis and Presentation

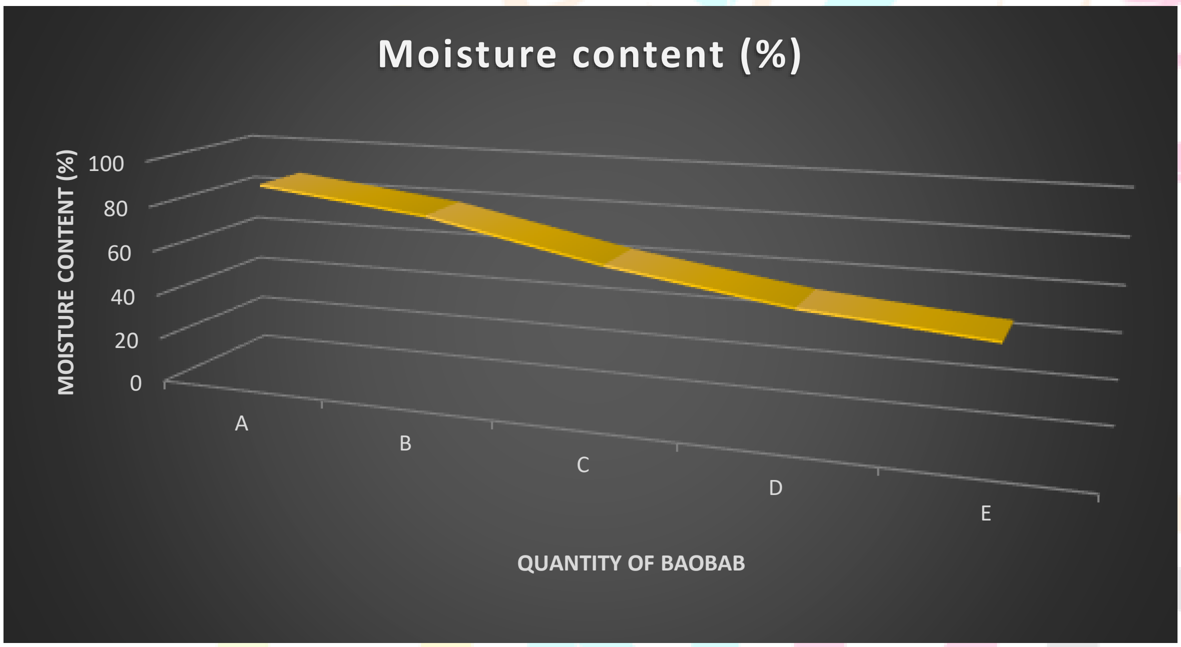
This chapter presents the findings of the experiments and analyze them:

4.2.1 Moisture content

Table 4.2 Moisture content in the samples

Sample	Moisture content (%)
A	87.82
B	79.43
C	64.31
D	53.28
E	47.13

Fig 4.1 Line graph showing the effects of baobab pulp powder on the moisture content of Grain flour

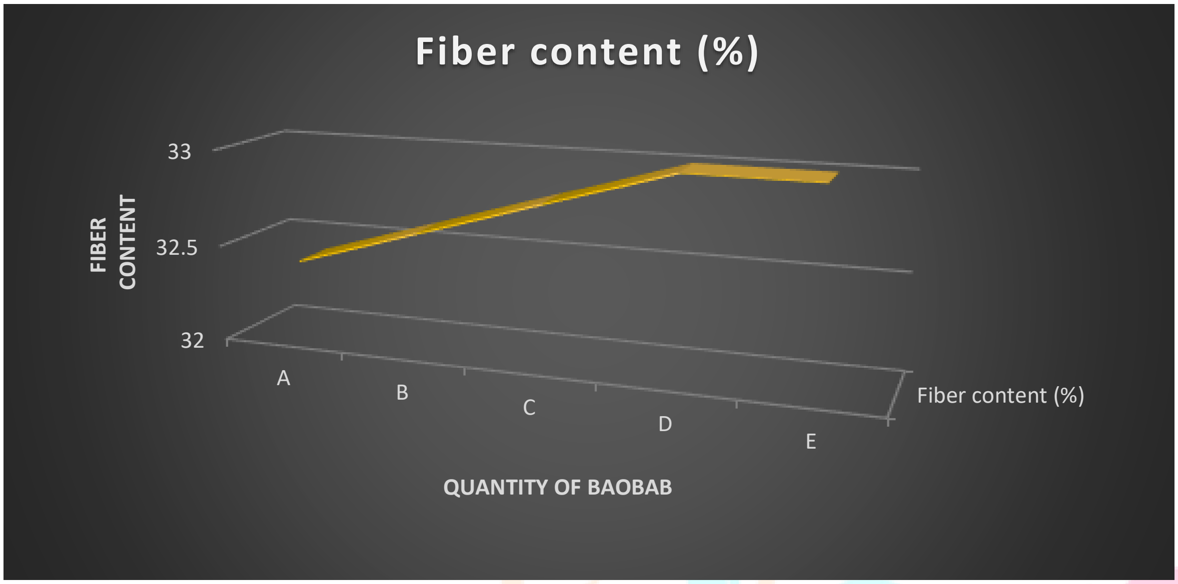


4.2.2 Fiber content

Table 4.3 Fiber content in the samples

Sample	Fiber content (%)
A	32.4
B	32.6
C	32.8
D	33.0
E	33.0

Fig 4.2 Line graph showing the effects of baobab pulp powder on the Fiber content of Grain flour

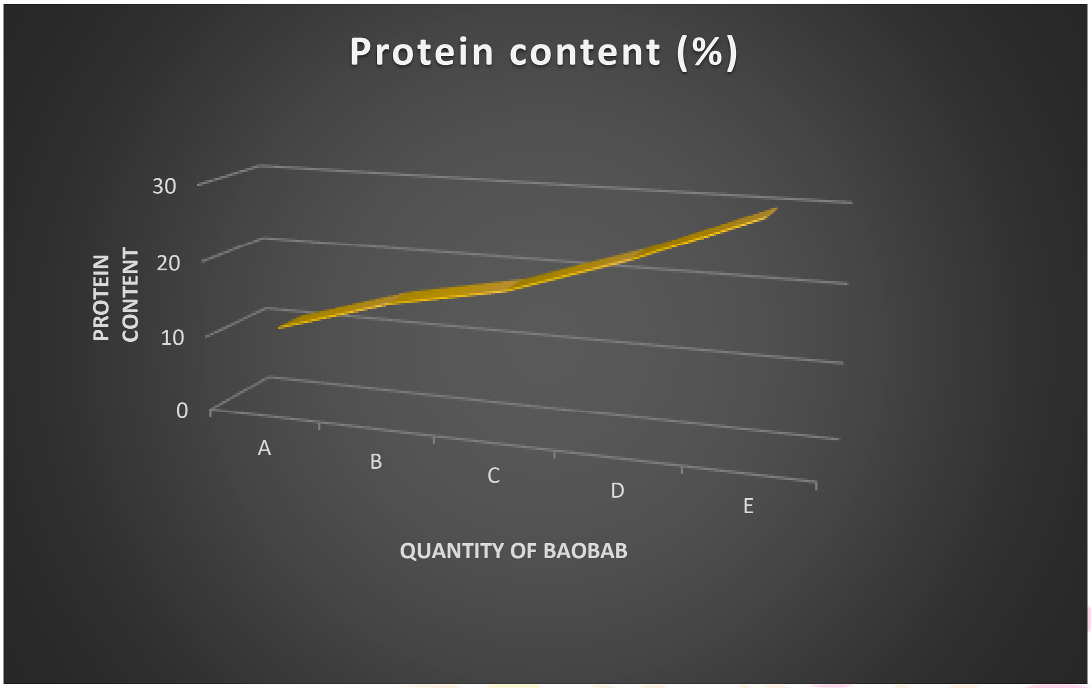


4.2.3 Protein content

Table 4.4 Protein content in the samples

Sample	Protein content (%)
A	10.7
B	15.3
C	18.3
D	23.5
E	29.7

Fig 4.3 Line graph showing the effects of baobab pulp powder on the Protein content of Grain flour

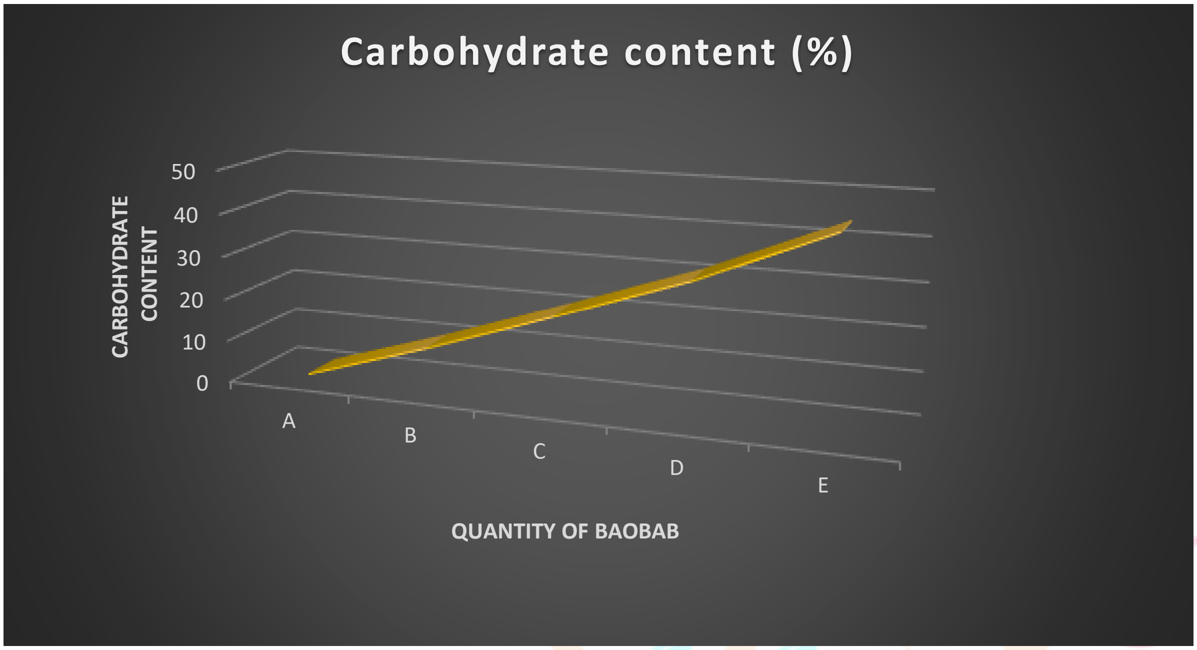


4.2.4 Carbohydrate content

Table 4.5 Carbohydrate content in the samples

Sample	Carbohydrate content (%)
A	0.8
B	10.3
C	20.7
D	31.3
E	44.1

Fig 4.4 Line graph showing the effects of baobab pulp powder on the Carbohydrate content of Grain flour

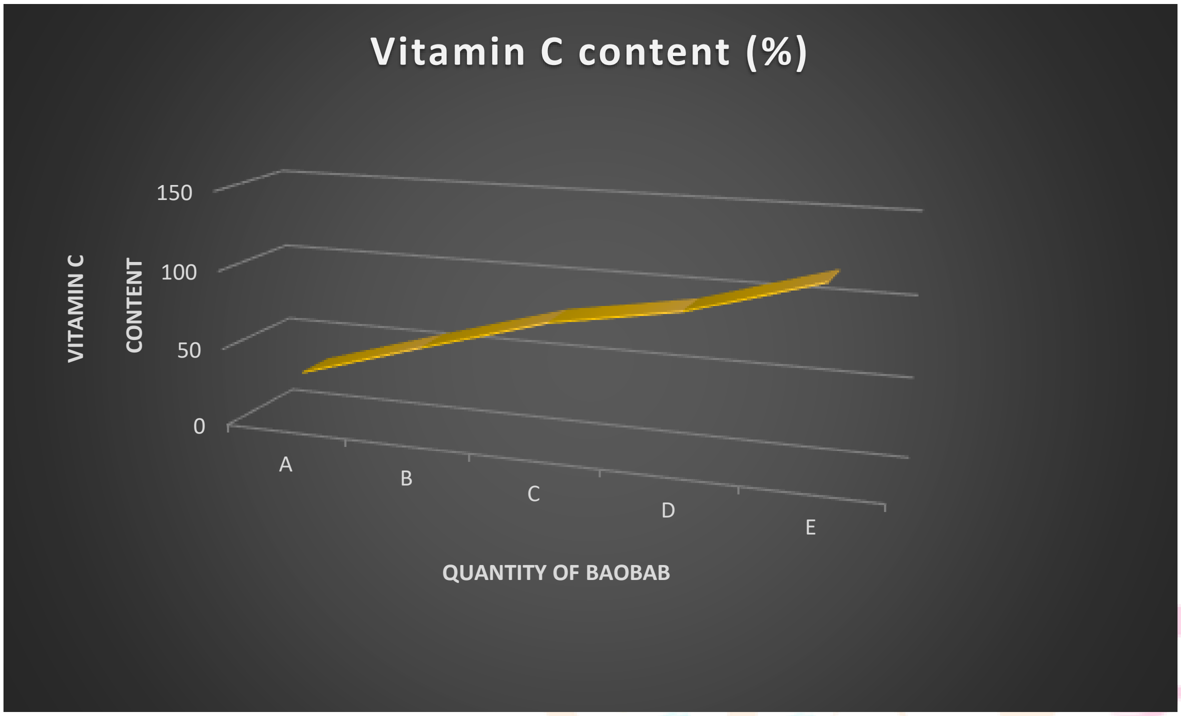


4.2.5 Vitamin C content

Table 4.6 Vitamin C content in the samples

Sample	Vitamin C content (%)
A	32
B	56
C	79
D	93
E	117

Fig 4.5 Line graph showing the effects of baobab pulp powder on the Vitamin C content of Grain flour



4.2.6 Number of E-Coli

Table 4.7 Number of E-Coli in the Samples after 3 weeks

Sample	Number of E-Coli
A	314
B	20
C	3
D	0
E	0

4.3 Variables

According to Creswell (2003), a variable is a measurable characteristic that could change and affect the end result in a study. Study variables are commonly independent and independent.

4.3.1 Independent Variables

According to Creswell (2003), an independent variable is a variable whose effect the researcher would like to establish in a study. They are therefore the variables the variables the researcher has control over.

In this project, the independent variable is the quantity of baobab fruit pulp powder used in fortification.

4.3.2 Dependent Variables

Dependent variables are those variables researchers measure in order to establish change of effect created on them. A dependent variable experience the effect created on it by independent variable.

In this project, the dependent variable are moisture content, protein content, fiber content, carbohydrate content, vitamin C content and number of E-coli which is determined by the quantity of baobab fruit pulp used.

4.4 Data Discussion

The first test was a forming test which determines how baobab powder can form in the flour without creating sediments.

The results in Table 4.2 or Fig 4.1 shows how the moisture content of the flour decreases with the addition of more powder. This shows that baobab contains gluten which causes the flour to thicken.

Baobab adds fiber value, although in minimal amounts as shown in Table 4.3 or Fig 4.2. Fig 4.3 represents data analyzed in table 4.4. It is established that there is an increasing trend of protein added to the flour as the quantity increases. Baobab contains carbohydrate which is important for energy. As the amount of baobab pulp increases, the carbohydrate content also increases as shown in Table 4.5 or Fig 4.4. Baobab also adds more vitamin C to the flour as shown in Table 4.6 or Fig 4.5

Baobab is a preservative from the result in Table 4.7, there is a significant decrease in the number of E-Coli as the quantity of baobab pulp powder increases from sample A to E which proves that it increases the shelf life of the flour.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

From the data, it was concluded that baobab improves the nutritional content of the flour. Baobab adds fiber value, although in minimal amounts. It was also established that there is an increasing trend of protein added to the flour as the quantity increases. As the amount of baobab pulp increases, the carbohydrate content also increases. Baobab also adds more vitamin C to the flour. Baobab is a preservative as there is a significant decrease in the number of E-Coli as the quantity of baobab pulp powder increases which proves that it increases the shelf life of the flour. With this data, the hypothesis has been proved and all the specific objectives have been achieved.

5.2 Recommendation

The study recommends further analysis and tests on the fortified flour to prove if other nutrients which are not tested in this report are present. The study recommends investigation on the influence of temperature, time and PH on the final fortified flour.

5.3 Future Adjustment

In future, we look to carry out more tests and experiments to prove the presence of other nutrients.

We also look to conduct a study on the side effects of baobab.

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APPENDICES

APPENDIX I: LETTER TO THE RESPONDENT

Dear Respondent,

I am currently a teacher at St Angela Sengera Girls' High School, Kenya. My Science club students are currently carrying out a research study on a project whose topic is:

"ADANSONIA DIGITATA".

I therefore request for your information and cooperation in this exercise. All information will be treated with confidentiality.

Yours with regard

DR. DENNIS OSORO MARANGA

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