

**CONSUMERS' PERCEPTION AND INTENTION TO CONSUME PLANT-
BASED MILK IN GULU CITY, UGANDA**

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**A DISSERTATION SUBMITTED TO THE DIRECTORATE OF
RESEARCH AND GRADUATE TRAINING AT GULU UNIVERSITY IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD
OF THE DEGREE OF MASTER OF SCIENCE IN FOOD SECURITY AND
COMMUNITY NUTRITION**

November, 2023

Declaration

I, Nekesa Rhodah (20/X/2135/MFN/PS), declare that the work presented in this dissertation is my own work and has not been submitted for academic award in any University.

Signature

A handwritten signature in black ink, appearing to be the initials 'NR' with a stylized flourish.

Date: 14th November, 2023

Approval

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Acknowledgement

I would like to thank God for the strength and good health throughout my study and in the development of this dissertation. I sincerely thank my supervisors Dr. Olum Solomon and Ms. Nassanga Prossy for their time and academic guidance. I acknowledge the Regional Universities Forum for Capacity Building in Agriculture for financial support which enabled me to have a smooth experience in my study and conducting this research. I also express my appreciation to my lectures and colleagues for their guidance, corrections and support. I thank my friends and siblings for always encouraging me through this journey. Lastly, I thank my father Mr. Stephen Onyango and my mother Mrs. Coletta Fabiano for their parental love and academic inspiration.

Dedication

I dedicate this work to my parents and siblings.

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List of acronyms

1. CVDs-cardiovascular diseases
2. NCDs-Non-communicable diseases
3. PBMS-Plant-Based Milk Substitutes
4. SBFP-Soya-Based Food Products
5. UBOS-Uganda Bureau of Statistics

ABSTRACT

Due to the rise in the concerns about non-communicable diseases (NCDs), environmental unsustainability and animal welfare, the market of animal milk has relatively declined. As a result, plant-based milk substitutes (PBMS) have been developed as ideal alternatives. However, the reception of these food products depends with the perception of consumers and the preference for the sensory attributes. While there is sufficient literature in developed countries to inform consumers' opinions about PBMS, there is a paucity of information in developing countries such as Uganda where the products are still new in the market. This study assessed the perception of consumers in Gulu city about PBMS, and factors that influence the intention to consume different flavors of the milk substitutes. A cross-sectional design entailing a consumer survey of 400 participants selected from Gulu University and supermarkets in Gulu city was conducted. A sensory evaluation experiment was done to assess the preference of different flavors of soymilk by 114 participants. The results indicated that consumers in Gulu city had an overall positive perception about PBMS. Consumers from the university were more positive than supermarket shoppers. On the factors that influence the intention to consume PBMS, price of PBMS, age, marital status and years spent in school were significant predictors ($p < 0.05$) among supermarket shoppers while price, knowledge on nutritional composition of PBMS, level of health consciousness and years spent in school were significant ($p < 0.05$) among consumers from the university. With regards to sensory evaluation of unflavored milk, chocolate, banana and vanilla flavors of soymilk, chocolate flavor was the most accepted by consumers. Specifically, its taste and aroma were significantly preferred to the unflavored milk. In summary, most consumers in Gulu city perceive PBMS positively and prefer added flavors to the unflavored soymilk. More modifications should be done to retain the white color of milk in added flavors and improve the mouthfeel so as to promote the rate of consumption of PBMS in Gulu city.

Keywords: Plant-based milk substitutes, animal milk, perception, intention to consume, added flavors, supermarket shoppers

CHAPTER ONE: INTRODUCTION

1.1 Background information

Milk from animals such as cows is a common food that has been consumed in many countries by different age groups without cultural restrictions as compared to other animal-sourced foods (Astolfi *et al.*, 2020). Nutritionally, cow milk is ranked second to breastmilk with a high density of nutrients ranging from whey proteins to bioactive compounds (Pietrzak-Fiecko & Kamelska-Sadowska, 2020). However, there is a reconsideration in the consumption of this food because of convincing data on its shortcomings. To mention just but a few, the issues include allergic reactions, high cholesterol level that predispose consumers to heart diseases, antibiotic resistance from the drugs used in treatment of the animals and hormonal changes from the residues of the growth promoters used to boost the production capacity of animals (Gardner & Janisch, 2015; Jeske *et al.*, 2017; Okechukwu *et al.*, 2020). In addition, overconsumption of animal milk predisposes consumers to cardiovascular diseases (CVDs) since they have 1-8% of naturally occurring trans-fatty acids.

In the recent past, a high incidence of milk allergy and lactose intolerance has been registered in most of the developed countries such as United States, Canada, Switzerland and Australia (Flom & Sicherer, 2019). This has triggered restructuring of dietary patterns through rampant nutrition education and counselling of consumers because most of the numbers are recorded among children under five years which impacts their growth and health (Flom & Sicherer, 2019; Garipoglu *et al.*, 2021; Kaskous, 2021; Matsyura, 2021). Milk from animals has been associated with severe food-borne illnesses especially in areas where food storage and preparation methods are not upgraded i.e. using refrigerator and pasteurization (Ahmadi *et al.*, 2021; Artyukhova *et al.*, 2020; Asgari & Ahmadi, 2021; Movafagh, 2021). The diseases have been linked to the infectious and toxin-producing microorganisms such as *Listeria monocytogenes* and *Escherichia coli* O157:H7 that have resulted to death in the situations where they are not properly addressed (Kadhum & Khudor, 2021).

Recently, the concerns about environmental sustainability in rearing animals for food have caught the attention of the international stakeholders who champion climate smart agriculture, restoration of wetlands and food security (Beverland, 2014; Jaeger & Giacalone, 2021). It is encouraging that the discussions are being received positively at the national levels in different countries such as Uganda that now agree to protect the environment in ways such as reducing the stock level of animals per household (Namaalwa & Byakagaba, 2019). More emphasis is

being put on crop and plant cultivation for biosystem conservation. Additionally, many advocates on animal welfare have expressed discontent in the inhuman acts of harvesting food from animals and the poor care practices in rearing livestock (Golnaz Rezai, 2012; Walsh & Gunn, 2020). For this reason, they have discouraged a considerable number of consumers from consumption of animal-based food such as animal milk.

Similarly, the food nutritionists and dieticians have reinforced consumption of animal food alternatives by affirming to consumers that they deliver relatively enough nutrients required in the body alongside the numerous health benefits that are otherwise insufficient in the animal foods (Rensburg & Wiles, 2021). Consumption is applicable across all stages of life from pregnancy to old age (Han *et al.*, 2021a). This is recommended because of presence of nutrients such as fibers and polyphenolics that have anti-inflammatory effect in the body hence help to manage diseases that attack the immune system (Mccarthy *et al.*, 2017). The presence of minerals and vitamins in these foods are key for proper growth and development. However, unlike other plant-based foods such as fruits and vegetables, the specific recommended quantities for consumption of PBMS are yet to be provided which is a gap that needs to be addressed. This is because, consumers need to know of the quantities of foods they should averagely take for proper nutrition, health and well-being in this era of high risk of NCDs.

Overall, animals might not be a sustainable source of food to the current and future generations. To curb this, plant-based milk substitutes (PBMS) from different plants have been formulated to meet the demands of consumers (Mäkinen *et al.*, 2016a). These are milk-like fluids obtained from plant such as legumes, cereals and nuts (Aydar *et al.*, 2020). On the market, the commonly available PBMS include soy, coconut, cocoa, hemp, rice, and oat (Bridges, 2018; Yadav *et al.*, 2017) which are considered nutritionally adequate, safe and affordable by consumers (McClements *et al.*, 2019). Specifically, the presence of polysaturated fatty acids (PUFAs) and antioxidants has attracted the consumers who are aware about the food-health nexus and hence are alert about their nutritional and health outcomes (Aydar *et al.*, 2020a; Gardner & Janisch, 2015). Due to a high rise in the prevalence and risk of NCDs, foods such as PBMS could be a solution because of the several health and nutritional benefits engraved in them (McClements *et al.*, 2019). They have abundant antioxidants, that are otherwise missing in animal foods, which help in reducing inflammations. As a result, it helps in delaying the development and progression of NCDs. It is also worth noting that technology has been put in place to fortify PBMS such as soymilk with vitamin B complex, calcium, proteins and antioxidants (Mäkinen

et al., 2016a) to the levels that meet the Recommended Dietary Allowance (RDA) of consumers so as to avoid deficiencies.

Moreover, extra efforts have been tailored towards improving bioavailability of minerals in these food products by removing antinutrients such as phytates to promote utilization of the nutrients in the body (Han *et al.*, 2021a; Theodoropoulos *et al.*, 2018; Zhu *et al.*, 2020, Calvo & Whiting, 2013). Awareness of the above-mentioned benefits has resulted to a consistent rise in the rate of consumption of PBMS which in turn has collapsed the market of animal milk by 36.5% in developed countries (Haas *et al.*, 2019b). A similar observation has been made among 15% of European consumers who no longer take dairy milk because of the availability of healthy and nutritious ‘plant milk’. In the context of developing world, the effect of urbanization, localization of information through different media platforms and international trade has enabled consumers in countries such as Senegal and Nigeria to quickly adopt new foods inclusive of PBMS (Damaria *et al.*, 2018). Even though consumption of plant foods has been associated with poverty and low socioeconomic status in the past, the current trend of consumption of the accessible PBMS has been grounded on informed consumer choices based on the health implications of different foods available to them (Dusabe *et al.*, 2022).

In Uganda, plant-based food products are not new. Examples of these include the sorghum/millet fermented ‘bushera’ and ‘kwete’ (Yadav *et al.*, 2017). On PBMS, efforts have been tailored towards local extraction of soymilk among the households that grow soybeans for own consumption (Khojely *et al.*, 2018). However, the commercially available PBMS are still few in this country just like in any other developing country especially in Sub-Saharan Africa. Moreover, the few available PBMS are sold mostly in the mega supermarkets in main cities and big towns which may not be majorly accessed by the general public (Wanyama *et al.*, 2019). In Gulu city, the products have been spotted in only two supermarkets, Cynibel and Don, where the latter is also accessed by travellers who might not be the residents of Gulu City (researcher observation). Considering that the rate of bovine milk production in Uganda especially among the major producers in the South-West region (i.e., Mbarara) is declining due to the limitation in natural resources (Ekou, 2014; Gray & Sundal, 2017), consumers deserve to be alerted about the available milk alternatives around them. Most importantly, there is a need to assess their acceptance and perception about these products because they influence consumption of new foods such as PBMS (Alcorta *et al.*, 2021; Ergönül, 2013). This will also help to coin better strategies that will encourage consumption of these food products for health and nutritional gain.

With regard to food preference, most of the sensory attributes of PBMS have not been well received by consumers. Specific reference is to the unpleasant taste, nutty/beany mouthfeel and off flavors (McClements & Grossmann, 2021) which come about as a result of the preparation and processing methods used in the industry. To solve this, food technologists have added different flavors such as vanilla, chocolate, strawberry with a presumption that they will mimic animal milk and hence improve the rate of consumption. Whereas this strategy has greatly improved consumption of PBMS in the developed countries, it is necessary to note that food preference and patterns are unique to consumers from different geographical locations and cultural backgrounds such as Uganda due to exposure (Blas *et al.*, 2019). Therefore, it is key to assess the influence of added flavors on consumption of PBMS besides the perception and factors that influence the intention to consume these new food products in Gulu city in Northern Uganda.

1.2 Statement of the problem

The emergence of new challenges about production and consumption of animal milk has triggered exploration of plant sources to provide alternatives to consumers. Globally, NCDs have proven to be a threat to the social, economic and political sectors of different nations as they account for 70% mortality rate especially among the productive populations (Salti, 2020). This is majorly as a result of consumption of foods with high cholesterol level and chemical contaminants such as animal milk (Wagner & Brath, 2012). From a nutritional perspective, the reduction of this burden has been proposed to be achieved by shifting to PBMS that have PUFAs, antioxidants and bioactive compounds in commendable quantities.

With the current need for food diversification, it is notable that the introduction of PBMS in the market could also improve diversification in the ready-to-eat plant food products that are available to consumers for consumption. For instance, consumers are able to obtain soymilk for consumption in addition to the soy powder or soy flour that they have been using over time. Consumers are now benefiting from the consumption of coconut milk besides the consumption of the traditional coconut fruit. This could promote their nutritional and health wellness as they can take the milk substitutes from different plants in accordance to their choices. Regarding the raised costs of living in most countries, these food products could be key contributors to the economic welfare of food processors and retailers who have ventured in this business to avail nutritious foods to consumers for monetary gain. As the movement towards healthy dietary patterns grows, PBMS will suit well in the consumers diet plans to achieve their health goals.

However, this relies on consumers' perception, motivating factors and willingness to consume these food products. It is unclear whether they are receptive to consumption of PBMS since the majority might be familiar with animal milk. Basing on the understanding that the disparities in economic, social and technological aspects in developing countries may not allow generalization of evidence from developed countries (Beverland, 2014), there is a need to establish the nature of perception of consumers and factors that influence the intention to consume PBMS in Gulu city, Uganda, so as to inform on the state in the developing countries especially in sub-Saharan Africa.

Considering the product aspects, the palatability of PBMS have been objected by most consumers compared to the animal milk. Although several food producers have toiled to mask this by adding different flavors to PBMS, there is limited information on the effect of this approach on the consumption of these food products. For this reason, this study assessed the perception of consumers and factors that motivate the intention to consume PBMS as well as the influence of added flavors on consumption of these food products.

1.3 Objectives of the study

1.3.1 Overall objective

To investigate consumers' perception of plant-based milk substitutes (PBMS), and factors that influence their intention to consume different flavors of PBMS in Gulu city

1.3.2 Specific objectives

The study sought to;

- i. Assess the perception of consumers in Gulu city about plant-based milk substitutes
- ii. Determine the factors that influence the intention to consume plant-based milk substitutes by consumers in Gulu city
- iii. Assess the influence of added flavors on the sensory preference for plant-based milk substitutes by consumers in Gulu city

1.3.3 Research questions

The research study sought to answer the following questions;

- i. What is the nature of the perception of consumers in Gulu city about of plant-based milk substitutes?

- ii. What factors influence the intention of consumers in Gulu city to take plant-based milk substitutes?
- iii. How do the added flavors influence the sensory preference of plant-based milk substitutes among consumers in Gulu city?

1.4 Significance of the study

The data generated from this study on the perception of consumers, and factors that influence consumption of PBMS contributes to the body of knowledge as well as policy formulation. The policymakers, health and nutrition stakeholders could use this information to encourage consumption of healthy plant-based foods and remove obstacles that reduce the availability and accessibility to these foods. The data from sensory evaluation experiment could be used by the food processors to guide them on the flavors to major on in production for consumers in Uganda. Since this is a new product in the market, food processors need to be well informed on what consumers prefer. The data generated from the current study could contribute to creation of business and employment opportunities with regards to local production of PBMS so as to provide adequate amount of the food product in the market. This will in turn boost the role of raw material providers to increase the production of the ingredients to avail to food processors to do adequate production for consumption.

1.5 Conceptual framework

The conceptual framework shown in Figure 1.1 guided this study. It demonstrates that consumption of PBMS is influenced by several factors. This includes socio-demographic factors such as age, level of education, marital status, sex among others (Rosenlow & Hansson, 2020). For instance, the level of education exposes individuals to understand the benefits of consuming nutritious foods such as PBMS unlike animal foods (Estell *et al.*, 2021a). This contributes to a positive perception of the milk substitutes which influences the purchase and consumption of milk substitutes. On the hand, the sensory attributes of the food contribute to the preference of the products which determines the perception and the level of acceptability of the food product (Antonelli & Pin-jane, 2020). In turn, consumers' perception about PBMS motivates the intention to consume the food products will leads to consumption. Therefore, the independent factors were socio-demographic factors, health and product related factors, sensory attributes and perception while the independent factor was the intention to take PBMS (dependent variable).

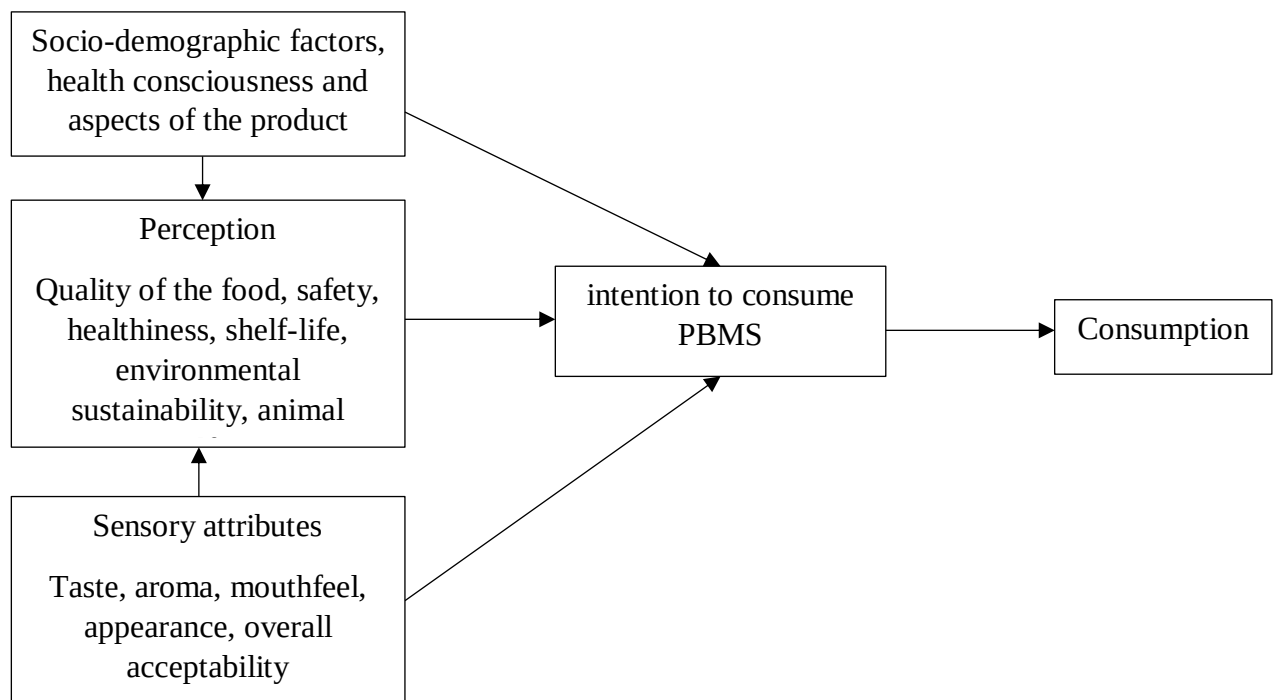


Figure 0.1: Conceptual framework for factors influencing consumption of plant-based milk substitutes (own compilation)

1.6 Scope of the study

The study focused on consumers' perception, intention to take PBMS and sensory evaluation of soymilk flavors. It covered 400 participants with equal number from Gulu University and supermarkets in Gulu city. The two populations were combined in the study to better reflect on the aspects of PBMS as it is new in the Ugandan market. The study assessed the sensory preference of only soymilk flavors sold in Don and Cynibel supermarkets. The study was not able to evaluate the sensory preference of plant milk from other sources besides soy. The study did not also cover other flavors such as strawberries because they were not being sold in the Gulu city market at the time of data collection. The primary way of data collection was by use of questionnaires that were prepared by the researcher. The results of the study are useful to anyone beyond the study participants i.e., food processors, policy makers among others.

1.7 Limitation of the study

There were a few limitations in the methodology of this study. In the sensory evaluation process, participants evaluated only soymilk which limited them to compare its sensory attributes to other PBMS to understand the plant source they would most prefer. They also

evaluated soymilk product from only one manufacturer which limited them from assessing the products from other manufacturers so that they determine their preferred brands.

CHAPTER TWO: LITERATURE REVIEW

2.1 Overview of plant food sources

Consumption of plant foods has been underrated in the past because of its association with poverty, vegetarianism, and religious and cultural guidance against some animal foods (Alcorta *et al.*, 2021). Interestingly, this is steadily changing in the new global economy as the incidence of food-related health complications soar higher (Haas *et al.*, 2019b). This is due to consumers acknowledgement of the health and nutritional benefits of plant food sources because of the diversity of nutrients that can be obtained from foods such as nuts, legumes, roots, fruits and vegetables among others. Overall, plant sources of food have high amount of nutrients that have anti-inflammatory effects hence delay the development and progression of NCDs such as cancer (Rio-Celestino & Rafael Font, 2020).

Notable evidence about the positive impacts of plant-based foods has been witnessed during the management of covid-19 pandemic worldwide. It was agreed upon by scientists, researchers and doctors that effective management of covid-19 patients entailed utilization of plant foods such as fruits, vegetables and spices to reduce the severity of the outcomes (Pieroni *et al.*, 2020). That is, the patients who consumed ginger, lemon, oranges, garlic, spinach etc. were found to have a quick recovery rate, alongside observation of the standard operating procedures such as quarantine and social distancing. This elicited the need to conduct global and national nutrition sensitization and education to save lives of people. In economic lens, the recommendation to take plant foods improves the returns of smallholder farmers from their produces after a long time of being underappreciated (Kang *et al.*, 2021). The knowledge that consumers received on the importance of the nutrients in these foods increased their willingness to pay so as to increase the chances of survival since food was part of the medicine they required (González-Monroy *et al.*, 2021).

While paying attention to PBMS, a variety of plants/crops such as coconut, cocoa, soybeans, rice, oat, hemp and almond have been used to derive milk so as to meet consumer preferences and demand (Bridges, 2018; Yadav *et al.*, 2017). It is intriguing that extraction of PBMS can be done at industrial level for commercialization as well as the household level for family consumption (Duvenage *et al.*, 2013). Consumers in Japan are famous in their homemade preparation of tofu from soymilk using traditional skills passed across through apprenticeship (Meng *et al.*, 2016). A similar observation has been made among consumers in Kenya and Uganda using soybeans to obtain milk (Munialo *et al.*, 2019). This activity is commendable

since households are able to take nutritious plant foods and food products without necessarily going through the hassle of meeting the retail prices of the commercialized food products.

It is also important to know that consumption of some PBMS, just as animal milk, could be based on the familiarity with the plant sources from which the milk is derived, and the availability of the food products. This is because there is a high rate of consumption of soymilk (>50%) which is grown in most countries compared to other PBMS (Han *et al.*, 2021a) that are distinct to a few countries. Generally, consumers in several countries have concurred with the food producers that PBMS are nutritious, healthy, have relatively enough nutrients that are required in their body (Jeske *et al.*, 2018) and are produced in a sustainable manner that protects the environment from harm. Even though the strength of these reasons might vary in relation to the settings of consumers, majority have expressed readiness to consume PBMS as part of their daily meals. As a result, most of these products are mainstreaming in the markets (Nyob, 2012) with an expected addition of varieties due to consumer need and preference (Valgema, 2019) to attain an 80% consumption rate by 2024 (Paul *et al.*, 2020). However, the situation is still vague in developing countries because these products are just finding their way in the market (Aschemann *et al.*, 2020; McClements *et al.*, 2019). In Uganda, specifically in Gulu city, a few PBMS are sold in major supermarkets implying that they could be known by some shoppers who obtain their food items from supermarkets.

Plant-based foods are appreciated for their nutraceutical value and functional properties. Besides their main usage as foods, many consumers use them for medical purposes as they have the potential to fight diseases because of their wide range of nutrients (Pieroni *et al.*, 2020). With regards to PBMS, they have adequate number of phenolic compounds, unsaturated fatty acids and antioxidant properties that serve well in the prevention of NCDs. The bioactive compounds in coconut, cocoa, and soy are mentioned among the key ingredients for a healthy body when include in the consumers diet. Minerals such as calcium are abundant in almond and flaxseed which contribute to the strong bones across age groups. In addition, the vitamin B complex is bioavailable, after processing, in most PBMS which makes it better for use. Generally, the dietary fibers, minerals, vitamins and antioxidants in sources such as cereals, legumes, seeds and nuts are critical in playing a role in the reduction of the fatal CVDs. Moreover, the antioxidant activity and fatty acids reduce risk of cancer and other diseases such as diabetes.

Even though there are numerous benefits associated with PBMS, there are few challenges that are related to the consumption of these food products. Apart from soy, most of the plant sources of milk substitutes have considerably lower protein content (Jeske *et al.*, 2018) in comparison to the traditional animal milk that is almost similar to the amount in breast milk. Numerically, most of plant-milk sources have an average of 2grams of protein in 240 milliliters compared to the 8 grams in similar quantity of animal milk, regardless of being skimmed, semi-skimmed or full fat (Mäkinen *et al.*, 2016a). Secondly, the bioavailability of most nutrients, especially minerals such as iron, is low because of the presence of antinutrients such as phytates (Popova & Mihaylova, 2019). This is because some of these antinutrients and polyphenols overcome fermentation process and hence end up in the final product for consumption. The high quantities of added sugar that are used to sweeten the products to improve consumer acceptance also contribute to oral health problems such as tooth decay and dental carries (Gupta *et al.*, 2022). With regards to sensory preference, most consumers have also expressed dislike of attributes such as aroma and taste which are different from what they are used to in the animal milk (Oliveira *et al.*, 2021).

2.2 Perception of consumers about plant-based milk substitutes

Several definitions have been put forth about perception in relation to consumption of foods. Sijitsema *et al.*, (2016) defined perception as the definite positive and negative feelings attached to the different aspects of a food product. In the event a consumer is unable to confidently express the finite feelings towards the food, perception will then be termed as mixed feelings that a consumer has about the food. Either way, the feelings attached to the food determine consumer's purchase decision and consumption of a particular food presented to them. The process actively involves one's intellectual capacity through thinking and reasoning as well as their mood and attitude towards the food (Agyekum *et al.*, 2015; Troy & Kerry, 2010). This is because consumers are required to interpret what is presented in their environment and express their opinions that inform the producers and other concerned personnel in the food chain to deliver what they prefer and demand. However, this process is complex as it needs one to first be aware of the attributes of the food using different sensory organs (Grunert, 2005).

Perception is shaped by a range of factors such as first experience with a food which could lead to liking the food or aversion, knowledge on different aspects of the food, consciousness about health outcomes from food consumption and health claims attached on the food (Antonelli &

Pin-jane, 2020). Additionally, social media has been reported to significantly facilitate perception especially among modern consumers since individuals access the information easily, get verifications about food claims and learn more about food additives and nutritional composition of the food (Estell *et al.*, 2021b). Currently, the use of prominent or famous individuals such as athletes, artists, doctors etc., that most consumers consider as their icons to advertise foods contribute enormously on the purchase and consumption of the products because of the influenced positive perception (Schifferstein *et al.*, 2021). In addition, provision of extra reports exhibiting the desirable outcomes from consumption of a food i.e., change in the body shape, weight reduction and even skin tone positively influence their perception of consumers who are conscious about their health outcomes from the foods they consume (Nutley *et al.*, 2021). Furthermore, the rise in food delivery channels through mobile apps have contributed to a positive perception about conveniently accessed foods compared to foods that require consumers to step out of the comfort zones to buy (Gavilan *et al.*, 2021).

There is a range of factors that influence consumers perception about food products. With regard to socio-demographic factors, age is one of the significant determinants of consumer's perception about both indigenous and exotic foods within a locality. While the perception of young people could be influenced by peer relationships and the effect of social media (Swoboda *et al.*, 2009), the older consumers on the other hand factor in the experiences and knowledge on different aspects of food which allows them to think rationally before interpreting the attributes of the foods presented to them (Onwezen *et al.*, 2021). Secondly, external factors such as religion, taboos and cultural beliefs equally affect consumers as long as they share the similar environment and subscribe to the same values. With reference to cultural and religious beliefs, the Islamic and Indian groups are known for the strict restrictions against consumption of pork and general animal products respectively (Plasek & Temesi, 2019). As a consequence, the consumers end up missing the particular nutrients that these foods offer even if they are associated with several negative health outcomes. Consumption of plant sourced foods, on the brighter side, has not faced cultural hinderances as animal foods (Nandi *et al.*, 2017b). Thirdly, product-related factors such as branding, packaging materials and sizes of the product, the companies producing the food, food additives and composition, health claims, and the price of the foods are becoming major points of interest to modern consumers (Schiano & Drake, 2021).

Most food producers who have successfully penetrated the market with new food products, have been keen to conduct surveys so as to know exactly what consumers would want in the food products presented to them. For instance, in the study conducted by Kim *et al.*, (2013),

consumers seemed to dislike plant milk over animal milk because of poor branding and the large packaging sizes which were less portable and unaffordable. In another study by Jallinoja *et al.*, (2018), consumers were found to have a positive perception about foods whose health claims were aired out through consistent promotion and advertisement on billboards, posters and televisions. Localization of information through smartphones also influences perception since consumers are able to compare the health and nutritional benefits of new and existing foods from the updates received on their handsets (Pantano, 2011).

Usually, the perception attributes that most consumers analyze and interpret in foods are food quality, safety, affordability, healthiness, shelf-life and nutritional (Golnaz Rezai, 2012; Merlino *et al.*, 2020; Rosenlow & Hansson, 2020). Of recent, attributes such as environmental sustainability in production of foods, and animal welfare are gaining the attention of consumers (Alcorta *et al.*, 2021). Consumers have expressed a positive perception about PBMS due to the healthiness of the products, and adequacy in the required nutrients such as proteins and antioxidants (Haas *et al.*, 2019a). The nutritional richness of PBMS has also invited most of the consumers seeking lifestyle changes by shifting to healthy food sources. Plant-based milk substitutes are perceived to have limited fats which is desirable for heart health hence a positive perception from health conscious consumers (Paul *et al.*, 2020). Furthermore, plant food sources are considered of great medicinal value because of the abundance of phytochemicals and bioactive compounds that are essential in the fight against non-communicable diseases in this era (Mäkinen *et al.*, 2016b).

Apart from soymilk, most of the PBMS are not associated with allergy which is a frequent problem that is encountered from consumption of animal milk (Haas *et al.*, 2019a). Consumers therefore prefer the alternatives to animal milk since they have the extra benefit to reduce the cost of health care from managing allergic reactions. Besides the nutrient and general quality of the milk, PBMS are produced in a sustainable manner which entails protection of the environment to get safe foods that have a considerably longer shelf-life (Nguyen *et al.*, 2020). There has been a lot of disparity, though, on the acceptance of the prices tagged on different PBMS. While consumers in the United States of America consider the prices of PBMS affordable (Collard & McCormick, 2021), consumers in Ukraine are reported to be unable to purchase PBMS because of the high prices (Gereles & Szöllősi, 2019).

Generally, consumers in different countries view the attributes of food products with a varied degree of importance with or without knowledge about the benefits that can be derived from

the foods presented to them. Because of such dynamics, it is important to assess the perception of PBMS in both settings because of the need to understand the exact opinions of consumers rather than generalizing which might not reflect the views of consumers at the local level.

2.3 Intention to consume plant-based milk substitutes

Basically, consumers always plan before they purchase and consume any new food that is introduced in the market. Consumers plan to consume a food by putting in consideration factors several factors that could revolve around the accessibility, utilization and sustainability of the food of interest (Duggal & Verma, 2020). It is important to know that even though some consumers are necessitated to consume some foods because of issues such as health complications, the decision to take those foods still lies with them since food consumption is a conscious multifactorial activity (Plasek & Temesi, 2019). With respect to consumption of plant sourced foods, most consumers have highlighted to be motivated by the nutritional benefits, ease to access different foods, and the well-packaged health claims (Boaitey & Minegishi, 2020; Walsh & Gunn, 2020). It is highly expected that when some consumers are well enlightened about the benefits they will gain from a food, they will get the encouragement to try out new foods such as PBMS (Préjet, 2018). As a result, they spread the awareness to family members and their circle of friends which promotes food purchase and consumption of healthy foods. This is one of the easiest and low-cost promotion and marketing strategy that a few food producers have used for their products to mainstream in the market. Some consumers also consider the shelf life of the food before purchase (Contini *et al.*, 2020).

New foods that have high rate of perishability do not attract most consumers especially in the low-income category because most of them purchase foods to eat for some days after preparation (Dordevic *et al.*, 2020). Therefore, in the event the family has not invested in the modern storage mechanisms such as fridges, the members get discouraged from spending money on such foods because of the fear of food wastage and loss of the little money invested in food purchase. Among the urban working-class consumers, the convenience and ease in preparation of the food of interest is a major factor that influences the intention to consume a food (McClements *et al.*, 2019). This is the reason why consumption of ready-to-eat foods, pasta and processed foods has rapidly increased over the past decade while the rate of consumption of cereals, tubers and indigenous vegetables has fallen. While the situation might be different in the rural areas, the impact of rural-urban migration and urbanization might lead to the shift in the consumption pattern in the rural areas (Blas *et al.*, 2019). Recently, consumers have

become keen about the production methods through which their foods are subjected to due to enlightenment on matters about climate variability and climate change, reduction in the scarce natural resources that need protection, and the long-term consequences from exposure to the effects of environmental pollution (Haas *et al.*, 2019b; Rosenlow & Hansson, 2020; Troy & Kerry, 2010). As a result, consumers are being attracted to foods that are produced in a sustainable way, safe, palatable and deliver the health benefits that are recommended by the health experts (McClements *et al.*, 2019). This is one of the factors contributing to reduction in consumption of animal sourced foods because of the magnitude of negative impacts exerted on the natural resources (Haas *et al.*, 2019b; Schiano *et al.*, 2020).

Socio-demographic factors such as sex, education status, age, marital status etc., influence the intention to consume different foods within the reach of consumers. In the study by Pandey *et al.*, (2021), it is reported that gender, education level and income highly influenced the decision to take yogurt from different plant sources ($p < 0.05$). Females were found to be more likely to take plant sourced yoghurt (odds ratio=2.860) compared to male consumers. The female consumers expressed that they were concerned about their health outcomes and also targeted weight loss hence resorting to plant yogurt. The individuals with a higher level of education were also more likely to take the plant-based yogurt (odds ratio=2.856) contrary to consumers with a lower level of education. On income, consumers who earned a higher income were more likely to consume the yogurt (odds ratio=3.546) unlike those with a lower income level. In another study by (Estell *et al.*, 2021b) it was reported that an increase in age and being employed contributed positively to the intention to consume plant-foods among consumers in Denmark. Marital status was also found to significantly influence the plan to consume plant foods because of the influence of family members especially children.

Product-related factors play an important role in influencing consumers motivation to consume different foods as well. The high sugar content in most processed foods has been found undesirable by most of the consumers as evidenced from the study conducted by McCarthy *et al.*, (2017). Consumers expressed that they found it difficult to consume PBMS because of excessive sweetening. This is disadvantageous to the producers and consumers as it reduces the rate of purchase of the products and lowers the frequency of consumption respectively. The high unaffordable price of PBMS among many consumers, both in developed and developing countries have been observed to reduce the intention to consume PBMS. This is drawn from the studies by Contini *et al.*, (2020); Nandi *et al.*, (2017a). Overall, the intention to consume PBMS is influenced by both personal, product and health related factors and other extrinsic

factors in the environment where the consumers operate in. It is therefore of great importance to determine the exact factors that motivate consumers different settings such as Northern Uganda so as to remove the barriers that lower the intention to consume healthy foods.

2.4 Preference of sensory attributes of plant-based milk substitutes

The effect of sensory attributes on the preference of foods by consumers has been established in several studies. Sensory attributes determine whether consumers like or dislike the food presented to them despite the health benefits it offers (McClements *et al.*, 2019). Most PBMS have received scrutiny in this area because of the objectionable off-flavors, unpleasant taste and poor mouthfeel (Chen *et al.*, 2020). This is because the industrial processing of PBMS results in suspensions that should not be there in the normal milk as experienced in the dairy milk which consumers are familiar with (Tangyu *et al.*, 2019). The chalky and grainy mouthfeel, and the taste of beans and nuts are contrary to the smooth feeling experienced from cow milk. Therefore, several flavors such as vanilla, chocolate, strawberry among others have been added in PBMS to correct the above-mentioned problems and improve the rate of consumption of PBMS. These flavors are expected to impart color, change taste, aroma and mouthfeel of these food products to an extent which consumers like them more than the unflavored milk. Sometimes, nutraceuticals are also added to enhance the color as most consumers like their foods to bear different colors from the original one. Some of the nutraceuticals include carotenoids that give an orange, red or yellow color and curamin which gives an orange color (Paul *et al.*, 2020). The positive influence of flavoring milk has been recorded among consumers in the United States of America who highlighted to prefer the flavored milk to the unflavored one because of improved taste, aroma and color (Murphy *et al.*, 2008).

While a sugary sweet taste is preferred in most of the beverages and drinks, data from several studies have shown that most consumers do not like the sweet taste of PBMS as it is not naturally found in these product but as a result of excessive use of artificial sweeteners (Jarossová *et al.*, 2020; Verduci *et al.*, 2019). Besides most health experts have sensitized consumers against consumption of highly sugared foods so as to promote positive health outcomes in life (Frank *et al.*, 2019). One of the obvious outcomes of excessive consumption of foods with high glycemic index is diabetes which has debilitating effects and high cost of management (Okop *et al.*, 2019). On aroma, the smell of beans and nuts in milk has been outrightly rejected by consumers as they find it off (Mäkinen *et al.*, 2016b). Most sources of

plant milk are legumes which have a strong smell because of the n-hexanal and hexanol compounds that result from lipid oxidation (McClements *et al.*, 2019).

With age categorization, the overall acceptability of chocolate plant milk has been conspicuous among children and young people unlike the older consumers (Palacios *et al.*, 2010) while strawberry and vanilla flavors are preferred across age groups. These data have been used by most producers in the developed countries to increase the sales so as to generate profits of PBMS through increase in the consumption rate of PBMS (Oliveira *et al.*, 2021). While consumers in the developed countries have expressed the liking for added flavors in PBMS this might not be the same among consumers in the developing countries since flavor preference is reliable on previous exposures, information and other factors that might be different among these consumers. Therefore, it is necessary to assess the effect of added flavors among consumers in developing countries such as Uganda so as to deduce their preference of PBMS.

CHAPTER THREE: MATERIALS AND METHODOLOGY

3.1 Study area

The study was conducted in Gulu City, Northern Uganda. Gulu City is located in Gulu District on the coordinates 02°46'54.0" N, 32° 17'57.0" E covering a total area of 3452.1 Km². It is approximately 333 kilometers from Kampala. It has a population of approximately 150,000 people who speak mostly the Acholi language. It is the main trading centre and the hub for education and culture in Acholi region. It serves as the administrative capital for the whole of Northern Uganda (UBOS, 2017). The map of Gulu city is shown in Figure 3.1.

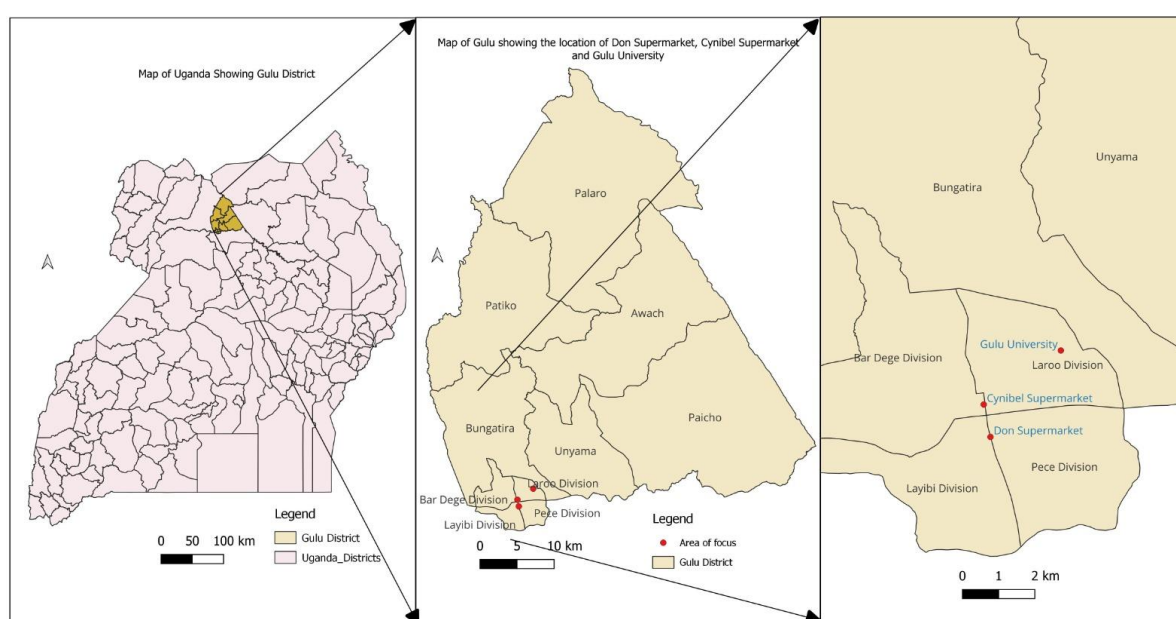


Figure 0.1: The map of Gulu city in Northern Uganda showing the position of Gulu University, and Cynibel and Don supermarkets (own drawing)

3.2 Study design

The study used a cross-sectional design involving consumer survey and sensory evaluation. The survey was conducted using researcher's questionnaire to obtain quantitative data that entailed consumers sociodemographic characteristic, the perception about PBMS, the intention to consume PBMS and the sensory evaluation of soymilk flavors by the study participants. Data on socio-demographic characteristics of study participants were obtained using closed-ended questions while data on consumers' perception, intention to consume PBMS and evaluation of sensory attributes of soymilk flavors were collected using rating questions on Likert scale.

3.3 Study population

The study population comprised of students and academic staff from Gulu University and supermarket shoppers from Cynibel and Don supermarkets in Gulu city. Gulu University was selected for this study due to the assumption that a university population from science-based faculties was more enlightened about the current trends in food-related matters such as food composition and innovations. The supermarkets on the other hand, are centers that serve the general community that buy and/or consume PBMS whether enlightened or not. It was therefore assumed that the shoppers had a higher likelihood to come across PBMS in the supermarkets since they are put close to the entrance and in places where they can easily see. It should be noted that in Gulu city, PBMS are sold only in the supermarkets. Generally, the inclusion criteria entailed being stable from Covid-19 disease. The participants from the university were students and academic staff from only science-based faculties and undergraduate students were at least in their second year. The eligible supermarket shoppers were above 18 years old. To participate in the sensory evaluation of soymilk, the participants were required to have no allergy to soymilk and soymilk products.

3.4 Sample size and sampling procedure

3.4.1 sample size

The study used a sample size of 400 participants. This was determined using Cochran formulae (Cochran, 2003) as illustrated in equation 1;

$$\text{Sample size } n_o = Z^2 pq / e^2 \dots\dots\dots \text{Equation 1}$$

where n_o is the sample size being determined, Z is the level of significance at 5%, P is the proportion of people consuming plant-based milk substitutes in Gulu city (estimated as 50% because of no available data in literature) and e is the estimated level of precision of 5%. Assuming non-responsiveness from participants, the calculated sample size was adjusted by 12% giving a total of 400 people. Half of the participants were selected from the university community while the other half was from supermarkets. The equal distribution between the university and the supermarket samples was because the estimated number of PBMS consumers in each location was not available. One-hundred and fourteen (114) panelists were selected from the total to participate in the sensory evaluation experiment.

3.4.2 Sampling framework

The study participants from Gulu University were selected using simple random sampling. The students were asked to confirm their legal membership, of being part of the faculties under study, by producing the student identification cards. They were then engaged in their respective faculties to avoid misrepresentation. The sampling frame included registered students, and academic staff in the science-based faculties namely; Medicine, Science, Education and Humanities, and Agriculture and Environment which were selected purposively. Shoppers from the supermarkets were selected systematically at an interval of five to avoid overcrowding at the supermarket. Sensory evaluation panelists were exhaustively sampled from 400 participants who took part in the face-to-face interviews in the consumer survey.

3.5 Data collection

Data was collected by a team of six research assistants who were pursuing bachelor's degrees in science-based faculties in Gulu University at the time of the study. The eligibility criteria entailed experience in conducting nutritional surveys using computer-assisted personal interviews (CAPI) and fluency in English and Acholi language. They were thoroughly trained on the administration of the questionnaire and observation of standard operating procedures of Covid-19 before going to the field.

3.5.1 Data collection tools

A structured questionnaire (appendix i) was used to gather data assessing the perception of consumers, and factors that influence their motivation to consume PBMS in objectives one and two, respectively. It was designed and uploaded on open data toolkit (ODK) to facilitate face-to-face interviews. The questionnaire had four sections where section one entailed socio-demographic characteristics of the participants, section two captured data on the level of health consciousness of participants while section three and four captured data on consumer perception and additional factors that motivate consumers to take PBMS, respectively. The questionnaire was pretested on 10 students in the faculty of Agriculture and Environment in Gulu University and 10 shoppers at Cynibel supermarket to ensure reliability of the instrument and to check for accuracy, clarity and consistency in interpreting and answering questions by the participants. These participants were excluded from the final data collection process. The responses from the pretest were analyzed and three statements measuring consumers' perception were rephrased. For the sensory evaluation experiment, a sensory evaluation

questionnaire with Likert questions was used where the panelists rated their degree of liking of the appearance, aroma, taste, mouthfeel and overall acceptability of banana, chocolate, vanilla and unflavored milk on a five-point hedonic scale (1=dislike very much, 2=dislike, 3=neutral, 4, like and 5=like very much).

3.5.2 Assessment of consumer perception about plant-based milk substitutes

The nature of the perception of consumers about PBMS was measured using statements which the participants responded on a five-point Likert scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree as used by Gkana & Nychas, (2018). The examples of the statements used are; (i) Milk from plant sources is natural because they have no added chemicals like antibiotics and growth promoters that can cause harm to my heart and (ii) Milk from plant sources have less fats (cholesterol) hence reduce risks for diseases of the heart such as heart attack, among others (appendix I).

3.5.3 Determination of factors influencing consumers' intention to consume plant-based milk substitutes

Prior to assessing the factors that influence the intention to consume PBMS, all the consumers were asked whether they had consumed milk substitute(s) before participating in the study. The intention to consume PBMS was assessed among consumers who indicated in the previous question that they had not consumed any of the PBMS. They were asked whether they would consider taking PBMS in future. Those who responded 'yes' indicated the intention to consume PBMS. The factors that could motivate the intention to consume PBMS were categorized into socio-demographic characteristics of participants, the level of health consciousness and additional factors.

On socio-demographic characteristics, gender was a categorical variable where the participants indicated whether they were male and female. The marital status of participants was also a categorical variable where participants picked one option among the four that were provided, that is; married, single, divorced, or widowed. On the living status, the variable was categorized into four; alone, with children, with friends and with spouse. The study participants selected one option from the four. The employment status was categorized into six options; employed in a formal job, employed in an informal job, self-employed, pension earner, unemployed and other. The participants selected one option from the answers provided. The data on the academic status of participants was only collected among the Gulu university participants

where they had two options namely; student and lecturer. Regarding income, the variable was categorical and the data was collected by the participants indicating whether they earned Ugx <500, 000, 500,001-1,500,000, 1,500,000-2,500,000, 2,500,001-3,500,000 and >3,500,000.

On the other age and years spent in school were continuous variables. The level of health consciousness of participants was measured using health consciousness statements adopted from Gables, (2009) and Gould, (1990) where participants responded on a five-point Likert scale (1=does not describe me very well, 2=does not describe me well, 3=neutral, 4=describes me well and 5=describes me very well). The statements included (i) I avoid intake of fatty food because I consider them unhealthy, (ii) I do exercise more than three times in a week so as to keep fit, among others (appendix I). The additional factors that could influence the motivation to take PBMS were price, knowledge of the food additives in PBMS, knowledge on the nutritional composition of PBMS, knowledge on the concerns on animal welfare and health claims of PBMS. They were measured using statements which the participants rated the degree of importance in considering them on a five-point Likert scale where 1=not important at all, 2=not important, 3=neutral, 4=important and 5=very important, according to Kokthi *et al.*, (2015).

3.5.4 Determination of the effect of flavors on consumption of plant-based milk substitutes

Sensory evaluation experiment on preference for unflavored milk, vanilla, banana and chocolate flavors in soy milk was carried out in a field and laboratory-based settings. The field-based experiment was carried out at the supermarket premises, an open place with no restrictions in the environment to mimic a family setting while sensory evaluation at Gulu University was done in an enclosed room that mimicked the laboratory environment. The four flavors of soymilk; vanilla, banana, chocolate and unflavored milk were purchased from Cynibel and Don supermarkets in Gulu city and coded as 104, 628, 009 and 201, respectively to avoid misinformation because of previous experiences with these flavors in other foods (Weaver & Brittin, 2001). The samples were served the same day of purchase and the leftovers were stored in the refrigerator to avoid contamination. The panelists washed their hands with clean water and soap then sanitized them before commencement of the sensory evaluation of the different soymilk flavors. Since soymilk is a ready to drink product, 50ml of each flavor were served from the bottles into 100ml disposable cups and given to panelists. A bottle of mineral water was given to panelists to drink and rinse their mouths before taking subsequent

samples to prevent carry over effect. The panelists were provided with the sensory evaluation questionnaire on which they rated their degree of liking of the sensory attributes of unflavored milk, vanilla, banana, and chocolate flavors on a five-point hedonic scale where 1=dislike very much, 2=dislike, 3=neutral, 4, like and 5=like very much. An after-taste assessment was done where the panelists indicated their intention to take PBMS in future, and stated the exact flavors they would consider.

3.6 Data Analysis

The data was imported from ODK database to the Statistical Package for Social Sciences (SPSS) version 25 where it was cleaned, coded and analyzed. Data on sociodemographic characteristics of participants were analyzed using descriptive statistics (percentages, frequencies, means and standard deviations).

3.6.1 Assessment of consumer perception about plant-based milk substitutes

To determine the overall perception of consumers about PBMS, a composite variable was created by calculating the mean scores of the eight constructs. The nature of perception was categorized into two where code 1 represented negative perception with mean scores ranging from 1 to 3.49 while code 2 represented positive perception with mean scores ranging from 3.5 to 5 (Balschweid & Thompson, 2002). Chi-square test was carried out to test the significance differences between the responses of consumers from the university and the supermarkets.

3.6.2 Determination of factors influencing consumers' intention to consume plant-based milk substitutes

Binary logistic regression was performed to establish factors that influenced the motivation to consume PBMS among respondents selected from Gulu university and supermarkets in Gulu city. Before running the regression, a Pearson correlation was performed to eliminate the highly correlated independent variables with a coefficient greater than 0.7 according to Dorman & Fraser, (2009). Gender was found to be highly correlated with marriage (0.714) and years spent in school (0.960). Employment was correlating with level of health consciousness (0.922) while living status was correlating with marriage (0.761) and level of health consciousness (0.915). As a result, gender, living status and employment status were not included in the regression model. The independent variables that were included, therefore, were; marital status

(1=married, 0=otherwise), income (1=>500,000, 0=<500,000), academic status (1=student, 0=academic staff), age and years spent in school (continuous variables).

The additional factors entailed price of PBMS, food additives, knowledge on nutritional composition of PBMS, knowledge on animal welfare, knowledge on health claims and the level of health consciousness of participants which were ordinal variables. The binary dependent variable of intention to consume PBMS was a dummy with 1=yes and 0=no. The general model showing the variables used is presented in equation 2.

$$Y_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \dots \beta_{13} X_{13} + \mu \dots \dots \dots \text{Equation 2}$$

Where Y_i is the binary dependent variable depicting the intention to consume PBMS, X_1 to X_{13} are the independent variables shown in Table 3.1. The variables are defined in Table 3.1. The regression constant is defined as α , β is the regression coefficient and μ is the error term.

Table 0.1: The expected priori signs of the independent variables of the binary logistic model

Variable	Definition	Expected priori sign
X_1	Age	+
X_2	Marital status	-
X_3	Living status	-
X_4	Employment status	+
X_5	Years spent in school	+
X_6	Income	+
X_7	Price	-
X_8	Knowledge of food additives	+
X_9	Knowledge of nutritional composition	+
X_{10}	Knowledge of animal welfare	+
X_{11}	Knowledge of health claims	+
X_{12}	Level of health consciousness	+
X_{13}	Academic status	+

3.6.3 Determination of the effect of flavors on consumption of plant-based milk substitutes

The preference of the appearance, taste, aroma, mouthfeel and overall acceptability of the flavors of soymilk was analyzed as means and standard deviations. One way analysis of

variance (ANOVA) was used to test the existence of difference in the aggregated mean scores of the sensory attributes and overall acceptability of each flavor. The post-turkey test was carried out at 5% level of significance to determine the flavors that varied in relation to each sensory attribute and overall acceptability. Frequencies and percentages were used to identify the flavor that highly contributed to the intention to consume PBMS after sensory evaluation.

3.7 Ethical Consideration

Ethical clearance was obtained from Gulu University Research Ethical Committee (GUREC-2022-206) (appendix ii), proprietors of Cynibel (appendix iii) and Don supermarket (appendix iv) and the university Deputy Vice chancellor (appendix v) so as to collect data from the university population (appendix ix). The participants were informed about the aim of the study and its benefits to the general community before signing the consent form in English or Acholi. Confidentiality was maintained throughout the research process by using serial numbers and not names of participants.

To mitigate the risks of spreading covid-19, the research assistants had face masks and hand sanitizers in the field as they conducted the face-to face interviews with participants. This was according to the covid-19 prevention measures. The sensory evaluation panelists also wore face masks and observed social distance to reduce the risk of covid-19 infection within the sensory evaluation area.

CHAPTER FOUR: RESULTS

4.1 Socio-demographic characteristics of study participants in Gulu city

The results on the distribution of sociodemographic characteristics of consumers selected from Gulu University and supermarkets in Gulu city are presented in Table 4.1.

Table 0.1: Distribution of socio-demographic characteristics of academic staff, students and supermarket shoppers selected from Gulu University and supermarkets in Gulu city

Variables	Category	Academics (n=24)		Students (n=176)		Supermarket shoppers (n=200)		Overall (N=400)	
		n	%	n	%	n	%	n	%
Gender	Male	5	21	65	37	79	40	149	37
	Female	19	79	111	63	121	60	251	63
Marital status	Married	19	79	46	26	118	59	183	46
	otherwise	5	21	130	74	82	41	217	54
Living status	With someone	22	92	73	41	71	65	166	44
	Alone	2	8	103	59	129	35	234	56
Employment status	Employed					166	83	166	83
	unemployed					34	17	34	17
income	<500,000	0	0	107	61	112	56	219	55
	>500,000	24	100	69	39	88	44	181	45
Health consciousness	High level	21	87	93	53	114	57	228	60
	Low level	3	13	83	47	86	43	172	40
Age	Mean	44.08±8.752		26.72±6.112		32.23±10.34		30.52±9.649	
Years spent in school	Mean	21.01±2.859		17.05±2.875		14.04±4.094		15.78±4.059	
Consumption frequency of animal milk (weekly)	Mean	2.85±1.103		2.58±0.776		2.92±0.928		2.86±1.002	
Consumption frequency of PBMS (monthly)	Mean	3.07±1.142		2.54±1.226		1.43±1.063		2.16±1.299	

N is the total population of participants in the study (400) while n is the sample size in each category of participants

Results indicated that majority of consumers (63%) were female from Gulu university and supermarkets in Gulu city. Most of the academic staff sampled were averagely older (44.08±8.752 years) compared to the supermarket shoppers (32.23±10.34 years) and the

students (26.72 ± 6.112 years). With regard to marital status, most of the academic staff (79%) and supermarket shoppers (59%) were married and lived with at least with someone at home (92% and 65%, respectively). On the other hand, most of the students were not married (74%) and majorly lived alone (59%). With reference to the number of years spent in school, the academic staff had spent an average of 21.01 ± 2.859 years compared to 17.05 ± 2.875 years for students and 14.04 ± 4.094 years for supermarket shoppers. With respect to income earned, all academic staff earned more than Ugx 500,000 in a month compared to 39% of students and 44% of supermarket shoppers. Generally, the level of health consciousness was above average (60%) among the consumers studied, but higher among the academic staff (87%) compared to supermarket shoppers (57%) and students (53%). Results regarding consumption of animal milk revealed that the supermarket shoppers had a higher frequency of weekly consumption (2.92 ± 0.928) than academic staff and students. However, the trend was different for consumption of PBMS in a month since the academic staff had the highest frequency (3.07 ± 1.142) compared to students and supermarket shoppers (Table 4.1).

4.2 Consumers' perception of plant-based milk substitutes in Gulu City

4.2.1 Evaluation of plant-based milk substitutes in Gulu City

The results obtained from the evaluation of characteristics of PBMS by consumers are summarized in Table 4.2. The overall perception of consumers about PBMS was generally positive with a mean of 3.79 measured on a scale of 1 to 5. Consumers seemed very positive towards the aspects of naturalness and less fat content in PBMS which were rated highest (4.26 and 3.95, respectively) contributing to the overall positive perception about PBMS. However, there were a few areas where consumers were not so positive about PBMS. These included the affordability and the shelf life of the PBMS.

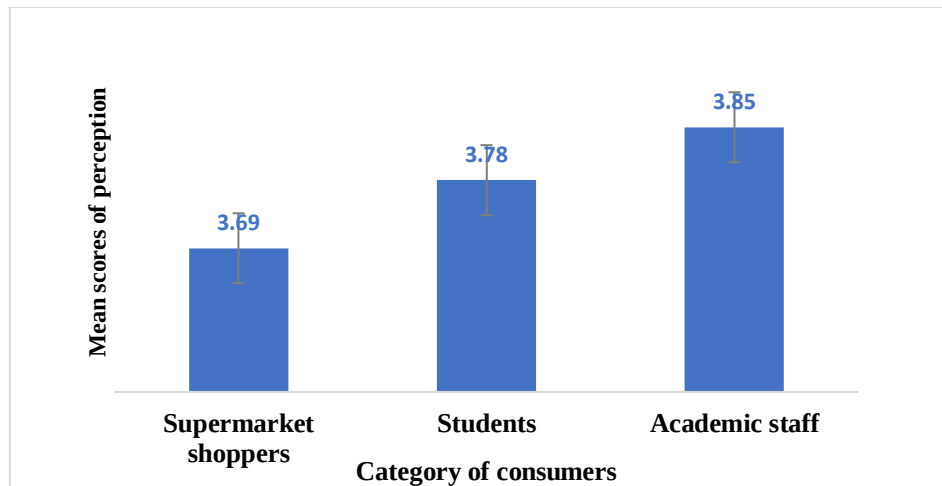
Table 0.2: Scores on the statements measuring perception about consumption of plant-based milk substitutes by consumers selected from Gulu University and supermarkets in Gulu City

S/N	Statements	Gulu university Mean $\pm$ SD	Supermar ket shoppers Mean $\pm$ SD	Overall Sig
1	PBMS are natural with no added chemicals	4.31 $\pm$ 0.699	4.20 $\pm$ 0.979	4.26 $\pm$ 0.851 0.020*
2	PBMS have less fats	3.92 $\pm$ 0.826	3.97 $\pm$ 0.927	3.95 $\pm$ 0.877 0.211
3	PBMS may not cause intolerance and allergies	3.67 $\pm$ 1.487	3.57 $\pm$ 1.451	3.62 $\pm$ 1.468 0.640
4	PBMS can help lose weight	3.75 $\pm$ 1.096	3.46 $\pm$ 1.116	3.61 $\pm$ 1.114 0.003*
5	PBMS have enough nutrients such as proteins	3.49 $\pm$ 1.094	3.82 $\pm$ 1.054	3.66 $\pm$ 1.085 0.008*
6	PBMS have a lower risk of food borne illnesses	3.80 $\pm$ 1.261	3.90 $\pm$ 0.997	3.85 $\pm$ 1.137 0.000*
7	Growing of plants that give milk does not destroy the environment	3.51 $\pm$ 1.264	3.46 $\pm$ 1.247	3.49 $\pm$ 1.254 0.058
8	PBMS have a longer shelf-life	3.13 $\pm$ 1.190	3.18 $\pm$ 1.271	3.15 $\pm$ 1.230 0.210
9	PBMS might be cheaper	2.41 $\pm$ 1.170	2.51 $\pm$ 1.352	2.46 $\pm$ 1.264 0.028*
Overall perception				3.79 $\pm$ 0.571

Perception was measured as Mean $\pm$ SD based on a five-point Likert scale of 1-5 where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree

4.2.2 Variation in mean perception scores among consumers in Gulu city

Figure 4.1 provides the results on mean perception scores on PBMS segregated by type of consumers. While perception was generally positive, consumers from Gulu University had a better perception towards PBMS compared to supermarket shoppers in Gulu city. Specifically, the academic staff had the highest positive perception (3.85).

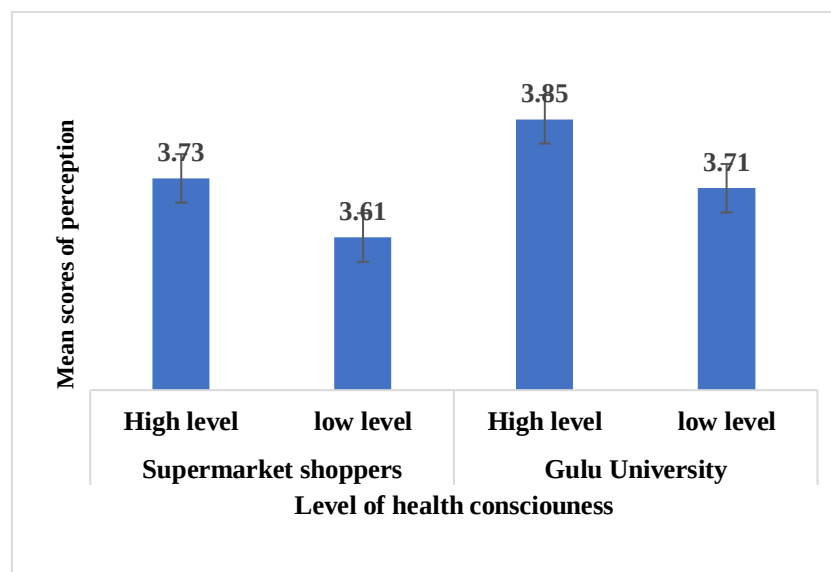


Perception was measured on a scale of 1-5 (1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree)

Figure 0.1: Variation in mean perception score on plant-based milk substitutes segregated by the type of consumers in Gulu city

4.2.3 Variation in mean perception score segregated by level of health consciousness

The variation in mean perception scores on PBMS among consumers segregated by level of health consciousness and categories of participants is highlighted in Figure 4.2.



Perception was measured on a scale of 1-5 (1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree). The level of health consciousness was measured on a scale of 1-5 (1=does not describe me very well, 2=does not describe me well, 3=neutral, 4=describes me well and 5=describes me very well). High level of health consciousness was rated below 2.49 while scores above 2.5 represented high level of health consciousness.

Figure 0.2: Variation in perception of plant-based milk substitutes by consumers selected from Gulu University and supermarkets segregated by their level of health consciousness

From this figure, consumers with a high level of health consciousness held a more positive perception about PBMS irrespective of the category. However, the university-based participants were more positive than those selected from the supermarkets.

4.3 Factors influencing intention to consume plant-based milk substitutes in Gulu City

4.3.1 Consumption of plant-based milk substitutes in Gulu University and supermarkets

The results on the status of consumption, and the types of PBMS consumed by the study participants prior to this study are presented in Table 4.3. Thirty-three percent (33%) of the participants had taken PBMS in the past. The majority of the participants (78%) had consumed soymilk compared to other PBMS. The participants were allowed to indicate more than one type of PBMS they had consumed.

Table 0.3: Status of consumption of PBMS by consumers in Gulu city

Status of consumption of PBMS		
	n	%
Consumed PBMS before the study		
Yes	130	33
No	270	67
Types of PBMS consumed (N=130)		
Soymilk	101	78
Almond	7	5
Oat	9	7
Hemp	3	2
Rice	19	15
Coconut	43	33
Cocoa	24	18

4.3.2 Intention to consume plant-based milk substitutes in future

Figure 4.3 summarizes the results on proportions of study participants segregated by the intention to consume PBMS. In general, fifty-four percent (54%) of the study participants in Gulu city indicated that they had intention to consume PBMS in future. However, a bigger proportion of the supermarket shoppers (>50%) expressed no intention to take PBMS compared to consumers from the university community.

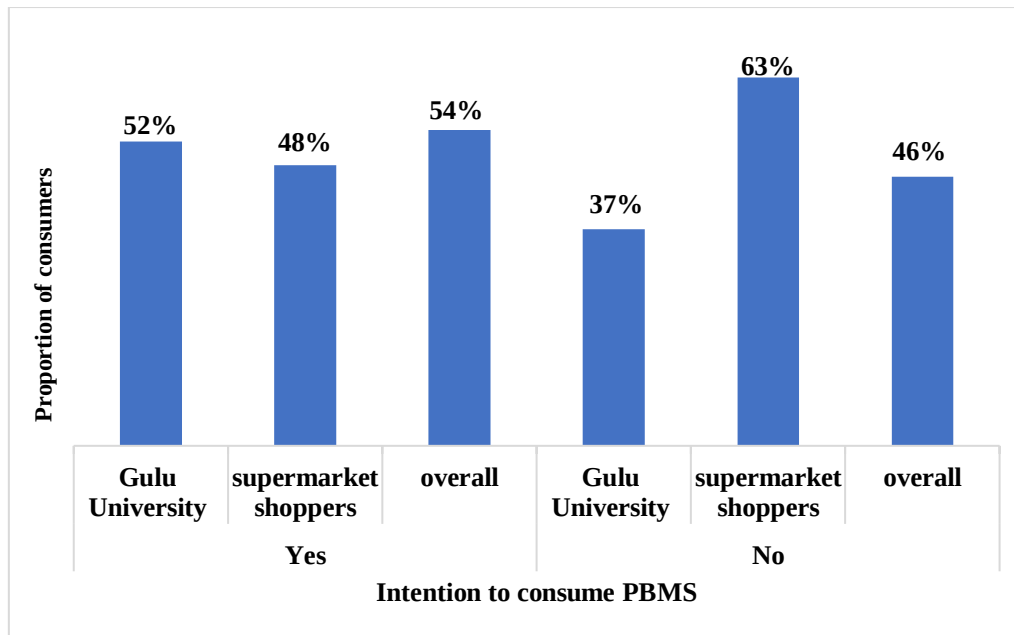


Figure 0.3: Proportions of consumers from Gulu University and supermarkets in Gulu city with intention to consume plant-based milk substitutes

4.3.3 Predictors of intention to consume plant-based milk among consumers

The results of binary logistic regression analysis on the factors that influenced intention to consume PBMS are presented in Table 4.4. The independent variables for the model explained 45.9% and 36.7% of the variance in the dependent variable in the data obtained from supermarket shoppers and the university sample ($R^2=0.459$ and $R^2=0.367$), respectively. The predictors of the intention to consume PBMS among supermarket shoppers in Gulu city were their marital status ($p=0.048$), age ($p=0.001$), years they spent in school ($p=0.001$) and the price of PBMS ($p=0.000$). The predictors elicited both positive and negative scenarios on the intention to consume PBMS. On the positive side, being married increased the intention to consume PBMS by more than one unit (1.097). On the negative side, an increase in price of PBMS decreased the intention to consume PBMS by more than a unit (1.225) and an increase in age and years spent in school would decrease the intention to consume PBMS by 0.11 and 0.230 units, respectively.

On the other hand, the predictors of the intention to consume PBMS by participants in Gulu University were quite different from supermarket shoppers except for the years spent in school ($p=0.045$) and the price of PBMS ($p=0.018$). It was also fascinating that all of them had a positive effect on the intention to consume PBMS among these participants. An increase in the years spent in school by the consumers would increase the intention to consume PBMS by 0.231 units. Intriguingly, a one unit increase in the price of PBMS increased the intention to

consume PBMS by 0.490 units. With regard to the knowledge of participants on nutritional composition of PBMS ($P=0.001$), an increase in the knowledge of consumers about the composition of PBMS would increase the intention to consume PBMS by almost one unit (0.907). Also, an increase in the level of health consciousness ($p=0.028$) of the participants would increase the intention to consume PBMS by more than one unit (1.118).

Table 0.4: Factors influencing the intention to consume PBMS among selected consumers in Gulu University and supermarket shoppers in Gulu City

Factors	Supermarket shoppers			Gulu University		
	β	S.E.	p-value	B	S.E.	p-value
Age	-0.110	0.034	0.001*	0.026	0.043	0.549
Marital status	1.097	0.555	0.048*	-0.376	0.654	0.565
Years spent in school	-0.230	0.069	0.001*	0.231	0.115	0.045*
Income	0.764	0.510	0.134	0.089	0.540	0.869
Price of PBMS	-1.225	0.330	0.000*	0.490	0.207	0.018*
Knowledge on food additives	0.230	0.222	0.300	-0.061	0.267	0.818
Knowledge on nutritional composition of PBMS	0.381	0.241	1.463	0.907	0.273	0.001*
Knowledge on animal welfare	0.020	0.144	1.020	-0.052	0.154	0.733
Health claims of PBMS	-0.073	0.171	0.929	-0.477	0.466	0.305
Level of health consciousness	0.285	0.384	1.330	1.184	0.540	0.028*
Academic status				0.368	1.416	0.795
Constant	-3.346	2.235	0.134	-3.508	3.439	0.308

The R^2 in the data from supermarket shoppers was 0.459 while that of the data from Gulu university was 0.367

4.4 Influence of added flavors on consumer sensory preference for soymilk in Gulu city

4.4.1 Evaluation of different sensory attributes of soymilk flavors

Table 4.5 presents the mean scores on the extent of preference of the sensory attributes alongside the overall acceptability of unflavored milk, banana, chocolate and vanilla flavors in soymilk. The flavors significantly improved the overall acceptability of soymilk ($p \leq 0.05$) with the highest preference being for chocolate flavor. The sensory attributes that were significantly preferred from the added flavors were aroma and taste. While chocolate flavor was the most preferred in terms of taste, the aroma of banana flavor was liked by majority of the panelists. Added flavors had no influence on the mouthfeel and appearance of soymilk among the consumers as these attributes scored higher in the unflavored flavor than flavored milk. The

highest preference for appearance of soymilk was for the unflavored flavor regardless of the low overall acceptability.

Table 0.5: Evaluation of sensory attributes of different flavors of soymilk by consumers selected from Gulu University and supermarket shoppers in Gulu city

	Appearance	Aroma	Taste	Mouthfeel	Overall acceptability
Unflavored	4.02±0.922 ^a	1.07±0.413 ^a	1.03±0.161 ^a	3.44±1.164 ^a	1.04±0.245 ^a
Vanilla	3.84±0.878 ^{ba}	3.30±0.931 ^b	3.52±1.058 ^b	3.46±1.065 ^a	3.66±1.046 ^b
Chocolate	3.64±1.249 ^b	4.02±1.026 ^c	4.98±0.101 ^c	3.51±0.974 ^a	4.71±0.737 ^c
Banana	3.65±1.121 ^b	4.50±0.132 ^d	3.91±1.061 ^d	3.56±1.008 ^a	4.08±0.951 ^d

The sensory attributes were measured on a five-point hedonic scale (1=dislike very much, 2=dislike, 3=neutral, 4=like and 5=like very much). Means in the same column with different superscripts are significantly different ($p \leq 0.05$).

4.4.2 Variation in the overall acceptability of soymilk flavors among different consumers in Gulu city

The results on the variation in the overall acceptability of chocolate, banana, vanilla and unflavored flavors segregated by the type of consumer is presented in Table 4.6.

There were no significant differences ($p > 0.05$) in preference of flavors of soymilk among academic staff, students and supermarket shoppers. However, an outstanding observation in the results was that banana and chocolate flavors were preferred more by the supermarket shoppers and students while the academic staffs on the other hand, preferred vanilla and unflavored flavors.

Table 0.6: Variation in the mean scores of overall acceptability of different soymilk flavors segregated by type of consumer

Flavors	Type of consumers			
	Shoppers	Academic staff	students	P-value
Vanilla	3.54±1.103	4.00±1.000	3.69±0.975	0.239
Banana	3.96±1.085	4.33±0.828	4.14±0.814	0.322
Chocolate	4.74±0.518	4.62±1.035	4.87±0.352	0.428
Unflavored	1.04±0.186	1.07±0.342	1.00±0.00	0.529

The overall acceptability was measured on a five-point hedonic scale where (1=dislike very much, 2=dislike, 3=neutral, 4=like and 5=like very much).

4.3.3 Intention to consume plant-based milk substitutes after sensory evaluation

Figure 4.5 shows proportions of consumers with intention to consume PBMS after taking part in the sensory evaluation of different soymilk flavors. There was a 44% increase in the number of consumers with intention to consume PBMS after tasting different flavors of soymilk.

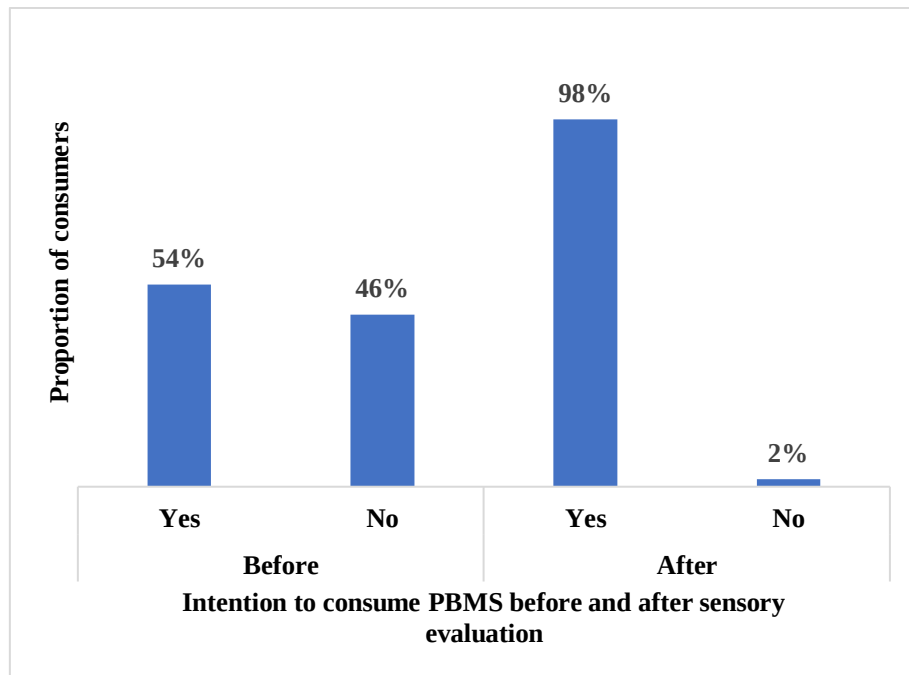


Figure 0.4: Proportion of consumers with the intention to consume plant-based milk substitutes after participating in the sensory evaluation of different soymilk flavors

Figure 4.4 shows the variation in the intention to consume different soymilk flavors by study participants after taking part in the sensory evaluation process. Majority of the participants showed intention to take chocolate flavor (51%) followed by banana flavor (47%) as shown in Figure 4.5. The participants were allowed to choose more than one flavor that they would consider consuming in future.

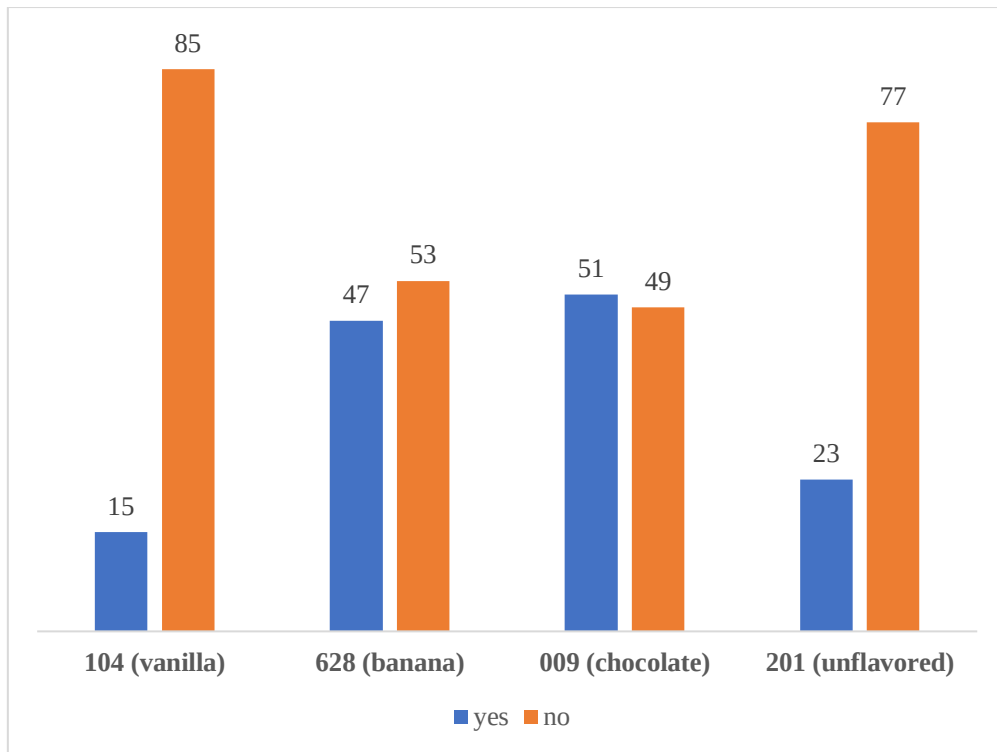


Figure 0.5: Variation in preference of soymilk flavors among consumers with intention to consume plant-based milk substitutes after participating in sensory evaluation

CHAPTER FIVE: DISCUSSION

5.1 Consumers' perception about plant-based milk substitutes in Gulu city

The influence of consumers' perception on purchase and consumption of foods has been well appreciated in several studies. It is encouraging to note that the consumers in the current study (Figure 4.1) had an overall positive perception about PBMS despite the novelty of the products. This finding is consistent with that of McCarthy *et al.*, (2019) among 702 dairy consumers and 172 non-dairy consumers in the United States. Similarly, consumers in Turkey were also found to have positive perception about plant-milk in comparison to animal milk which led to a higher degree of purchase and consumption (Bicer *et al.*, 2023). The consumers in the current study appreciated the naturalness, and limited fat content in PBMS more than other characteristics examined. The study findings also corroborated with the results of Alcorta *et al.*, 2021 and Schiano *et al.*, 2020 who reported that most of the PBMS consumers took these food products due to the absence of fats and added sugars which allowed them to feel the natural sweetness. This observation could be because consumers are gaining a high level of health consciousness hence a positive perception towards healthy foods such as PBMS. This is confirmed by a higher proportion of consumers who were positive towards the healthy aspects of PBMS such as their contribution to considerable weight loss and lower risk of causing food-borne illnesses (Table 4.2).

Contrary to the expectations, the findings of the current study on affordability and the shelf life of PBMS in Table 4.1 did not support the previous research studies which highlighted that consumers were positive about the pricing of PBMS, and the considerable longer period that the products lasted after opening the bottle as compared to animal milk (Boaitey & Minegishi, 2020; Rosenlow & Hansson, 2020). The findings of the current study only marched with the results of the study by Gereles & Szöllősi, (2019) where price was listed among the major setbacks to consuming PBMS among consumers. The negative perception of consumers in the current study about the price of PBMS could be confirmed by the wide difference in the pricing of these products in relation to animal milk. The price of the least quantity of soymilk (300ml), is tagged at 5000-6000Ugx while a slightly similar quantity of cow milk is sold at less than half the price. Well, the higher price of PBMS could be because of the scarcity in the raw materials used in production of PBMS specifically soy in this case.

A report by (Mirembe, 2021) shows that a kilogram of soybeans ranges between USD 0.58-0.74 (2030-2590 Ugx) per kilogram which then is required to produce only 7.5litres of milk

according to the data from Soya Based Food Products company (SBFP, 2022). With other inputs also required to facilitate the production process, the total cost ends up being high hence the necessity to meet the profits through the retail prices. However, since accessibility to food products is dependent on the socioeconomic status of individuals (Peano *et al.*, 2019), it is reasonable that most consumers in this study found it difficult to identify with such high prices as they highlighted to get less than Ugx 500,000 in a month except for the academic staff as shown in Table 4.1. This is simply because in the situations of low income level, most families tend to spend money to purchase basic needs, staple foods (Turrell & Kavanagh, 2005) and maybe animal milk (Boaitey & Minegishi, 2020) when it proves to be affordable than PBMS as in Gulu city. This is evidenced by the high rate of consumption of animal milk among the supermarket shoppers in Table 4.1. Anyhow, a positive perception about the prices of PBMS could be cultivated by enlightening the consumers that the significant difference from that of animal milk is as a result of nutritional and health advantages obtained from the consumption of these products over the latter. As a matter of fact, most consumers are willing to pay a premium on the food products especially when they are aware of the benefits that they will derive from the products more so in this era of high prevalence of NCDs (Shafie & Rennie, 2012).

With regards to the shelf life of PBMS (Table 4.2), consumers in the current study did not positively perceive it despite the fact that PBMS last longer because of no cholesterol as in animal milk. This was dissimilar to the results in the study Aydar *et al.*, (2020b) where PBMS were regarded highly because of low wastage from spoilage after opening them. They lasted at least a week in the refrigerators unlike animal milk that lasts not more than three days. The study by Sethi *et al.*, (2016) also supports that most PBMS have a better shelf-life because of the application of heat treatment that reduces pathogenic spoilage that would otherwise be a major issue in plant-milk since it has a wide range of nutrients that could promote their growth. In addition, the shelf life was improved through cooling systems that curb the growth of microorganisms. This could explain why most consumers in this study were skeptical about the shelf life of PBMS since in absence of the cooling systems such as refrigerators after opening the bottles of PBMS, the shelf life is minimized to at most two days after which the products are wasted (Astolfi *et al.*, 2020). For this reason, this study suggests that the PBMS could be packaged in quantities as small as 150ml which can be consumed in one sitting or a day hence eliminate the burden of leftovers that require refrigeration system which might not be available in many households in Gulu city.

To answer the general research question of the current study, another important finding was that possession of knowledge on nutrition related issues contributes positively to the perception of consumers about PBMS as shown in Figure 4.1. These results are in accord with the observation made by Schiano & Drake, (2021) that educated people with basic processing and nutrition knowledge about dairy products made nutritionally sound judgements compared to those without knowledge. In a four-week quasi experimental study carried out by Yao *et al.*, (2013) on the influence of nutrition education intervention on perception of whole grain foods, it was observed that the perception of participants in the intervention group was significantly higher, with the rate of consumption of whole grain foods being more than 2.8 times in one month compared to the control group. Gkana & Nychas, (2018) add that consumers who are knowledgeable about consumption of healthy, safe and nutritious foods perceive plant-foods highly because most of them define what they consider to be right in food consumption. In the current study, it is believed that the academic staff and students in science-based faculties read and involve themselves in several nutrition-related research works on development of new products, their benefits and shortcomings. Being updated about current affairs in food sector alongside continuous learning could be an important positive influence on the perception about new healthy foods that are seeking a place in the market. The lower perception about PBMS among the non-university sample in the current study would suggest a concerted effort to raise awareness of the importance of PBMS through community nutrition.

5.2 Factors influencing intention to consume plant-based milk substitutes in Gulu city

A considerable number of consumers had taken PBMS prior to the current study. In as much as this proportion is smaller compared to that reported by Aydar *et al.*, (2020), Jarossová *et al.*, 2020 and Haas *et al.*, (2019b), it is promising that there will be a steady rise in consumption of PBMS in Gulu city considering that consumers access and consume these products irrespective of being sold only in major supermarkets. Several factors ranging from socio-demographic, health and product-related factors among others influence the consumption of different foods (Boaitey & Minegishi, 2020; Kuhar & Juvancic, 2010). Overall, the price of PBMS and the years spent in school by participants significantly predicted the intention to consume PBMS ($p < 0.05$) among both the supermarket shoppers and the university-based sample.

It was interesting to note that while an increase in price decreased the intention to consume PBMS by supermarket shoppers, it was on the other hand associated with increased intention to consume PBMS in the university community. This could be because of the consideration of

the benefits attributed to PBMS evidenced by the high positive perception by the university community as shown in Table 4.2, hence overlook the price differences compared to animal milk. Regardless, our results are generally comparable to those reported by Jarossová *et al.*, (2020) and Gereles & Szöllősi, (2019) in Ukraine where consumers indicated price as the second most important factor they considered before purchasing and consuming PBMS. With closer comparison to Africa, consumers in South Africa expressed similar sentiments in the study conducted by Vorster *et al.*, (2013). They emphasized that plant-based milk analogues were priced so highly more than animal milk and other animal-sourced foods hence a barrier to access them. This observation also indicates that irrespective of whether consumers are from a developed or developing country setting, the price of a product affects them equally. This is because price determines the quantity and choice of food purchased for consumption in a household hence high prices that consumers cannot meet limit the capacity to access food especially among the low-income earners (Ekou, 2014).

With respect to the years spent in school, the increased intention to consume PBMS among the university community with an increase in the number of years spent in school could be due to constant upgrade in knowledge about new healthy foods such as PBMS. This assertion is due to the fact that individuals with high education level are more enlightened and express willingness to try out healthy foods because of clearly weighed benefits and risks that the food could have. Our results are comparable to the results from a study by Pandey *et al.*, (2021) on factors that influence intention to consume plant-based food alternatives where participants with a higher level of education were found to be 2.856 more likely to consume plant-based yoghurt compared to their counterparts.

On the other hand, the decrease in the intention to consume PBMS exhibited by supermarket shoppers could be due to limited nutrition knowledge specifically about PBMS. This is in agreement with the results from the study by Clark *et al.*, (2022) in which nutrition experts were reported to be more positive about PBMS and encouraged other developments in production and processing to be done so that consumers take nutritious foods unlike other professionals who were a bit skeptical about the same matter. This could imply that an increase in number of years spent in school studying other themes besides food nutrition does not necessarily increase the intention to consume PBMS. This observation among supermarket shoppers, therefore, disagreed with the evidence from the study by Padilha *et al.*, (2022) who asserted that a general higher education level was associated with reception of new healthy foods. On that account, community nutrition education about the composition and benefits of

different foods within the reach of consumers should be carried out constantly so that consumers are empowered with sufficient knowledge to make informed choices towards purchase and consumption of healthy and nutritious foods such as PBMS.

Specific to the university community, the predictors of intention to consume PBMS entailed the level of health consciousness and the nutritional composition of PBMS. It was not surprising that the intention to consume PBMS would increase with an increase in the level of health consciousness among these consumers. This is because health consciousness is mainly grounded on the awareness and apprehension of the existing and emerging health conditions, and the application of appropriate foods to correct them (Su *et al.*, 2022). The current results were similar to a consumer survey by Bazzani *et al.*, (2020) on the effect of health consciousness and the knowledge on the benefits of wine consumption in Italy. They reported that consumers with a higher level of health consciousness were keen on the content, and health and nutritional benefits of the wine in their body. After clarification and assurance about the product, they were more willing to consume than when they knew nothing about it. Tran *et al.*, (2020) emphasize that a high level of health consciousness triggers consumers to make purchase decisions towards healthy foods since they are attentive to their health, are aware about healthy and harmful foods, ready to learn and seek health information, and willing to improve their health with products that are superior in nutritional benefits such as PBMS. This could also justify why the intention to consume PBMS increased with an increase in the knowledge about the nutritional composition of the products only among the consumers in the university community.

Even though the supermarket shoppers could also be aware of the nutrients in different foods from social media and internet (Jallinoja *et al.*, 2019), the knowledge gained by the university community on a day-to-day learning experiences could go past that to include the quantity of the nutrients in the food, the shelf-life of the food with the nutrients of interest, and the physicochemical changes that take place in the food with the nutrients they intent to gain. This postulation is supported by the study carried out by Estell & Hughes, (2021) on the attitude of community-based consumers and the nutrition professionals in Australia on the consumption of plant-protein and plant-based meat alternatives. It was reported that the professionals were more positive about the ingredients, protein level, fiber, vitamins and minerals in plant-based foods hence willing to pay and consume them compared to consumers who were more interested in the social and environmental gains associated with the production of plant-based foods. To improve the frequency and the rate of consumption of PBMS among the elite

consumers, the nutrition facts used in marketing and advertisement of these food products should center around the health attributes of the products such as low-fat content and naturalness, and their association with a low risk of NCDs. Such attributes promote a positive perception of consumers as shown in Table 4.2 hence the purchase and consumption of PBMS. This is because health-conscious consumers tend to move towards foods that will aid them to keep a healthy lifestyle and avoid diseases.

With regards to the supermarket shoppers, age and marital status peculiarly influenced their intention to consumer PBMS. While several studies have reported that an increase in age is positively associated with consumption of plant-based foods, this did not seem to be the case in the current study (Table 4.3). The decreased intention to consume PBMS with advancement in age could be due to food fussiness and reduced interest in trying out new foodstuffs because of the difference in the sensory appeal compared to the foods that have been consumed before. Evidence to support this is drawn from the study by Grasso *et al.*, (2019) who reported that the wider the range of choices from which the older consumers are expected to choose a food, the lower the willingness to pick and consume new plant-protein alternatives. The situation is similar even in the case of being adequately knowledgeable about the health conditions that require them to concentrate more on the plant-protein alternatives. This could imply that as people grow older, they tend to stick to familiar foods that they already agree with the sensory attributes, the known benefits and other product-related factors as opposed to young people who positively take the chance to explore a variety of foods available to them.

On the other hand, the positive effect of being married on the intention to consume PBMS among supermarket shoppers could be due to the influence of each other's diet during family meals since most of them reported to be staying with another person in their homes. Nguyen *et al.*, (2020) reported a similar trend in southern Vietnam where married participants consulted each other about food choices before purchase of foods. Another reason could be that married people are more conscious about the types of foods consumed by the members as a responsibility to keep the family members healthy so as to avoid the expenses of health care that result from consumption of less nutritious and unhealthy foods. This assertion is drawn from the study by Tudela *et al.*, (2010) in New Jersey that families mainly direct nutritional caregiving to members who are advanced in age, have health conditions such as cancer and children so as to prevent progression and development of diseases which require investment of the little family income to correct the situation besides inflicting emotional distress on the healthy members. For promotion of PBMS, the food producers should mimic the sensory

appeal of the animal milk which the old consumers are familiar with for easier identification with these new products. Nutrition education should be conducted among both married and unmarried consumers so as to understand the benefits of PBMS. As the unmarried consumers will choose own foods from a nutrition perspective, the married consumers will also influence each other's diet with the understanding of the benefits that these foods contribute in the body.

5.3 Influence of added flavors on consumer sensory preference of soymilk

It has been established in various studies that sensory preference plays an important role in the consumer food choices (Chen *et al.*, 2020; Meng *et al.*, 2016; Oliveira *et al.*, 2021). Many food processors and scientists have explored this area and provided a variety of flavors in different foods as per consumers' preference (Liem & Russell, 2019). The commonly used flavors in different foods are strawberry, vanilla and chocolate, but banana and lemon flavors are also gaining pace (Greis *et al.*, 2022). Acceptability of any of these flavors is usually dependent on the familiarity, habitual usage, availability and food carriers and the sensory attributes (Onwezen *et al.*, 2021). While some flavors negatively affect the sensory attributes of food products, most of them impact a positive effect. For instance, in the current study (Figure 4.5), the addition of flavors had a very big influence on the preference of soymilk.

The overall acceptability of chocolate, banana and vanilla was significantly higher than that of the unflavored flavor. This finding concurred with the study by Gupta *et al.*, (2022) where flavored plant-based yoghurt was significantly preferred to the unflavored one. The high preference of flavored soymilk was contributed by their taste and aroma which were highly preferred to the unflavored flavor in this study. By the fact that PBMS are derived from plant sources, the unflavored milk usually possesses a 'planty', nutty, beany or grainy tastes that have been abhorred by most consumers in the previous studies (Chen *et al.*, 2020; Mäkinen *et al.*, 2016a; McClements *et al.*, 2019). The current results (Table 4.5) have evidenced that the unpleasant tastes could be masked by the different flavors making the products more palatable to consumers (Abou-arab & Abu-salem, 2017; Chen *et al.*, 2020). With focus on the chocolate flavor whose taste was most preferred by the consumers, the high preference could have been because of the sweet cocoa taste that is familiar to many people. This assertion is supported by the studies by Aydar *et al.*, (2020b) and Kim *et al.*, (2013) that reported that the chocolate flavor was acceptable among young people and children because of the sweet taste. Furthermore, Palacios *et al.*, (2010) reported that addition of chocolate flavor in plant milk

improved the rate of consumption by children which in turn influenced their parents to buy and consume them in the family.

By far, the aroma of added flavors was preferred to that of the unflavored milk. From food technology point of view, processing of PBMS results in off-flavors due to lipid oxidation. As a consequence, consumers have a low acceptance of these products as milk since the fresh clean animal milk is typically odorless. From the current study, the pleasant aroma of the added flavors could have contributed to the high preference of flavored soymilk which was preferred more than three times compared to the unflavored one. With reference to banana flavor whose aroma was the most preferred, the high acceptability could be attributed to the sweet smell of ripe bananas. This is evidenced by the findings from Thakur & Kumar, (2012) that consumers' sensory acceptability of banana flavored soy yoghurt was significantly preferred ($p < 0.05$) to the unflavored one not only because of a better consistency in the mouthfeel but also the intense aroma.

Despite the low overall acceptability of the natural soymilk, it was interesting to note that its appearance was the most preferred to all the added flavors. The color of unflavored soymilk is characteristically whitish which is relatively similar to that of animal milk. Among the added flavors, only the color of vanilla was rated relatively high as the natural flavor probably because of the similar reason. These results were similar to the studies by Thakur & Kumar, (2012) and Osundahunsi *et al.*, (2007) where the whitish appearance of the unflavored soy yoghurt was preferred to the yellow color of banana and the brown-chocolate flavored yoghurt, respectively. Additionally, the mouthfeel of flavored milk was not significantly different from that of the unflavored soymilk. In the past, consumers have lamented about the solid particles that are felt on the tongue while taking 'plant-milk' and the bad aftertaste feeling. However, this seems to remain unsolved from the findings of this study even with the addition of flavors in soymilk. Overall, more developments such as repeated filtration should be carried out to retain the color of animal milk in the added flavors, and refine the particles of soybeans to attain a smooth mouthfeel of soymilk to promote the acceptability by consumers.

The huge increase in the proportion of consumers willing to take PBMS in future was unique to the current study as most consumers had not taken PBMS prior to this study. It can be deduced that the opinions of consumers about novel products can be evaluated better in a two-step process where sensory evaluation is a confirmatory stage as proposed by Greis *et al.*, (2020). Therefore, food processors/developers should incorporate sensory evaluation

experiments of the new developed products besides the general consumer surveys to assess the opinions and attitudes of consumers towards the foods. The combination of the generic and practical views expressed by the consumers will give the exact opinions without assumptions or extrapolations.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

Consumer perception about different foods is an important factor that determine the purchase and consumption of foods. Overall, in the first objective about the perception about PBMS, the study findings demonstrated that the participants were positive about these food products. There were aspects such as the naturalness of some PBMS and less fat content that consumers perceived highly about PBMS that contributed to the positive perception. However, consumers had a negative perception about the high price of PBMS as well as the short shelf-life in comparison to animal milk.

In the second objective about the factors that influenced the intention of consumers in the current study to take PBMS, it was noted that the price of PBMS and the number of years that consumers spent in school were common predictors among consumers from the university and supermarket shoppers. Whereas socio-demographic factors were essential predictors among the supermarket shoppers representing the general community, the study demonstrated that the major predictors among the enlightened consumers from the university were related to the product aspects and consciousness about their health outcomes from consumption of foods. Furthermore, the study illustrated that consumer interaction with foods through sensory evaluation improved the intention of participants to take PBMS.

Finally, in the third objective that was assessing the sensory preference of consumers for the flavors of soymilk, the study results showed that consumers had an overall high preference of flavored milk to unflavored one. However, the appearance of unflavored soymilk was highly preferred (being white) even though other attributes such as aroma and taste were not so much liked.

6.2 Recommendations

From the observations made from this study, recommendations on the promotion of PBMS in Uganda, and for further research can be made as follows;

6.2.1 Recommendations for promotion of plant-based milk substitutes in Uganda

- i. Since consumers negatively perceived the shelf life of PBMS, the food manufacturers should consider repackaging PBMS into smaller quantities so that consumers who do

not have the cooling systems are able to take them in one sitting so that they do not risk food wastage.

- ii. Most consumers were not comfortable about the prices of PBMS in the supermarkets which reduced their intention to consume the products. The government and regulators could consider introducing subsidies on raw materials used in the production cost of subsequently selling prices. Producers of PBMS should also elaborate to consumers through media channels, product labels and advertisements the additional benefits of PBMS that are valued through the extra cost compared to the animal milk.
- iii. In order to improve the acceptability and consumption of flavored PBMS, the sensory appeal should be enhanced by improving appearance. More developments should be put in place to retain the white color of milk as consumers preferred the unflavored milk that had this color since they are familiar with it in animal milk.

6.2.2 Recommendations for further research

This study focused on the sensory evaluation of only soymilk flavors. However, some consumers would prefer other types of PBMS compared to soymilk. Therefore, a study should be conducted to elucidate the influence of added flavors on the consumption of other types of PBMS such as coconut milk, almond milk, oat milk, hemp milk among others.

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APPENDICES

Appendix i: Questionnaire

SECTION ONE: PERSONAL INFORMATION

Date of Interview	Name of Interviewer	Respondent serial number:
Where is the interview taking place?	1. Gulu University 2. Don supermarket 3. Cynibel Supermarket	
1. Gender:	1. Male 2. Female	
2. What is your age in years?		
3. What is your marital status?	1. Single 2. Married 3. Divorced 4. widowed	
4. what is the name of your area of residence?		
5. Who do you live with in the same house? (tick appropriately)	1. Alone 2. With spouse 3. With children 4. With friends	
supermarket		
5. How many years have you spent in school?		
6. What is your employment status?	1. Employed in a formal job 2. Employed in an informal job 3. Self-employed 4. Pension earner 5. Unemployed 6. Other (specify)	
7. How much is your monthly income in Ugx?	1. <500,000 2. 500,001-1,500,000 3. 1,500,001-2,500,000 4. 2,500,001-3,500,000 5. >3,500,000	
Gulu University		
8. Name of the faculty	1. Agriculture and Environment 2. Science 3. Medicine 4. Education and Humanities	

9. What is your academic status in the university?	1. Undergraduate student 2. Masters' student 3. PhD student 4. Academic staff	
12 (a) How much is your monthly salary/allowance in Ugx? (Academic staff only)	1. <500,000 2. 500,001-1,500,000 3. 1,500,001-2,500,000 4. 2,500,001-3,500,000 5. >3,500,000	
(b) How much money, in Ugx, do you receive for upkeep; i) in a month? ii) in a semester? (Students only)	1. <500,000 2. 500,001-1,500,000 3. 1,500,001-2,500,000 4. 2,500,001-3,500,000 5. >3,500,000	
13. How often do you consume dairy milk from animals such as cows, goats on a weekly basis?		
14. Have you ever consumed 'milk from plant sources?	YES	NO
(a) If yes, how many times do you consume in a month?		
(b) which one of the following have you consumed? (tick all that apply)	1. Soy milk 2. Almond milk 3. Oat milk 4. Hemp milk 5. Rice milk 6. Coconut milk 7. Cocoa milk 8. Other (specify)	
(c) if no, would you consider taking them in future?	YES	NO

SECTION TWO: HEALTH CONSCIOUSNESS SCALE

In this part I would like to know the degree to which you factor in health concerns in your daily activities. Please respond to the following statements using a 5-point scale of agreement whereby (1= **does not describe me well at all**, 2=**does not describe me well**, 3= **neutral**, 4=**Describes me well** and 5= **describes me very well**).

No.	statement	1	2	3	4	5
1	I avoid intake of fatty food because I consider them unhealthy					
2	I do exercise more than three times in a week so as to keep fit					
3	I attend health talks in the community and frequently ask questions concerning health and nutrition					

4	I only worry about health when I am sick					
5	It is the responsibility of the doctors to keep me healthy					
6	I worry that there might be chemicals in my food					
7	I voluntarily go for general body check-up even when I am not sick					
8	Living without diseases is very important to me					
9	I avoid soft drinks such as soda and purchase nutrient-rich foods such as milk					
10	I seek information and read food labels on nutritional composition before purchasing foods					

SECTION THREE: PERCEPTIONS OF CONSUMERS ON PBMS

In this section I would like to understand your opinion on ‘milk from plant sources’ such as soy milk, coconut milk, rice milk among others. Please respond using 5-point Likert scale of agreement whereby (1 = **strongly disagree**, 2 = **disagree**, 3 = **neutral**, 4 = **agree**, 5=**strongly agree**).

No	Questions	1	2	3	4	5
1	Milk from plant sources is natural because they have no added chemicals like antibiotics and growth promoters that can cause harm to my heart.					
2	Milk from plant sources have less fats (cholesterol) hence reduce risks for diseases of the heart such as heart attack.					
3	Milk from plant sources may not cause intolerance, and allergic reactions such as skin rashes, vomiting and swelling when consumed.					
4	Milk from plant sources can help me lose weight.					
	Milk from plant sources has enough nutrients such as proteins, calcium and antioxidants that are essential for growth, development and normal functioning of my body.					
5	Milk from plant sources has a lower risk of causing food borne illnesses compared to cow milk.					
6	Growing of plants that are used to give milk does not destroy the environment by releasing dangerous gases as does wastes of animals.					
7	Milk from plant sources can stay for long without going bad which reduces food wastage.					
8	Milk from plant-based sources might be cheaper for me to afford compared to animal milk.					

SECTION FOUR: ADDITIONAL INFORMATION

In this section I would like to understand your score on some product-related factors that you would consider to make decision to buy/consume ‘milk from plant sources’. Please indicate the level of importance of the following factors whereby (1= **not at all important**, 2=**not important**, 3= **neutral**, 4= **important** and 5=**very important**).

No.	Factor	1	2	3	4	5
-----	--------	---	---	---	---	---

1.	Price					
2	Food additives					
3	Nutritional information on the labels					
4	Concerns on animal welfare					
5	Health claims such as naturalness of the milk, eco-friendly production					

SENSORY EVALUATION OF SOY MILK FLAVORS

In this section we would like to know your score on the following sensory attributes of soymilk. You will taste the four samples and record your degree of liking for appearance, aroma, taste, mouthfeel and overall acceptability.

Before you are four samples of soy milk labelled 104, 628, 009 and 201. You are required to taste one sample at a time and tick how much you like each of the attributes on a scale of 1 to 5 whereby **(1= dislike very much, 2=dislike, 3=neutral, 4=like and 5= like very much)**. Please rinse your mouth with the water provided before tasting the subsequent samples.

Please indicate your willingness to participate by signing

Sign:

FLAVOR 104

	Degree of liking				
Sensory attribute	Dislike very much	Dislike	neutral	like	Like very much
Appearance					
Aroma					
Taste					
Mouthfeel					
Overall acceptability					

FLAVOR 628

	Degree of liking				
Sensory attribute	Dislike very much	Dislike	neutral	like	Like very much

Appearance					
Aroma					
Taste					
Mouthfeel					
Overall acceptability					

FLAVOR 009

	Degree of liking				
Sensory attribute	Dislike very much	Dislike	neutral	like	Like very much
Appearance					
Aroma					
Taste					
Mouthfeel					
Overall acceptability					

FLAVOR 201

	Degree of liking				
Sensory attribute	Dislike very much	Dislike	neutral	like	Like very much
Appearance					
Aroma					
Taste					
Mouthfeel					
Overall acceptability					

1. Having tasted these flavors, would you consider taking 'milk from plant sources' in future?

(YES) (NO)

If yes, which of the samples would you take?

2. Any other comments on the product?

THE END

Appendix ii: Approval from Gulu University Research Ethics Committee (GUREC)



24/05/2022

To: Rhodah Nekesa

Gulu University
0724404210

Type: Initial Review

Re: GUREC-2022-206: CONSUMERS' PERCEPTION AND FACTORS INFLUENCING MOTIVATION TO CONSUME PLANT-BASED MILK SUBSTITUTES IN GULU CITY, 2.0, 2022-04-28

I am pleased to inform you that at the **81st** convened meeting on **17/02/2022**, the Gulu University REC, committee meeting, etc voted to approve the above referenced application.

Approval of the research is for the period of **24/05/2022** to **24/05/2023**.

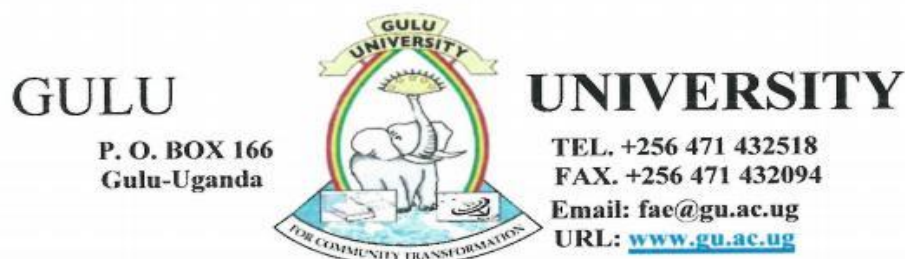
As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes.
3. Reports of unanticipated problems involving risks to participants or any new information which could change the risk benefit: ratio must be submitted to the REC.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by participants and/or witnesses should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Continuing review application must be submitted to the REC **eight weeks** prior to the expiration date of **24/05/2023** in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study.
6. The REC application number assigned to the research should be cited in any correspondence with the REC of record.
7. You are required to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of all documents approved in this application by Gulu University REC:



Appendix iii: Approval from the manager, Cynibel supermarket



FACULTY OF AGRICULTURE & ENVIRONMENT

6th April, 2022

The Manager,
Cynibel Supermarket, Gulu

Dear Sir/Madam

RE: INTRODUCTION OF MS. RHODAH NEKESA

I hereby introduce to you, Ms. Rhoda Nekesa, who is a student of Master of Science in Food Security and Community Nutrition, Department of Food Science and Postharvest Technology, Gulu University. Her registration number is 20/X/2135/MFN/PS.

Rhodah is conducting an academic research to understand consumer perception and factors that motivate them to consume plant-based milk substitutes. Your premise (supermarket) has been selected for this study because you sell soy milk which is a plant-based milk substitute to be evaluated. The study will involve talking to shoppers to understand their perception about different soy-milk products, and sensory evaluation process where four flavors of soymilk will be tasted by the shoppers to understand their degree of liking for aspects such as taste, aroma, appearance and mouthfeel. During the study, all the standard operating procedures against the spread of Covid 19 will be observed. She is requesting to carry out the study on Thursday 14th April, 2022.

I therefore request you to allow her to conduct the study outside the supermarket. Any assistance rendered to her will be appreciated.

Yours Sincerely,

Dr. Solomon Olum (PhD)
Head, department of Food Science and Postharvest Technology
s.olum@gu.ac.ug , 0779 486193

Request Approved



Appendix iv: Approval from the manager, Don supermarket



FACULTY OF AGRICULTURE & ENVIRONMENT

6th April, 2022

The Manager,
Don Supermarket, Gulu

Dear Sir/Madam

RE: INTRODUCTION OF MS. RHODAH NEKESA

I hereby introduce to you, Ms. Rhoda Nekesa, who is a student of Master of Science in Food Security and Community Nutrition, Department of Food Science and Postharvest Technology, Gulu University. Her registration number is 20/X/2135/MFN/PS.

Rhodah is conducting an academic research to understand consumer perception and factors that motivate them to consume plant-based milk substitutes. Your premise (supermarket) has been selected for this study because you sell soy milk which is a plant-based milk substitute to be evaluated. The study will involve talking to shoppers to understand their perception about different soy-milk products, and sensory evaluation process where four flavors of soymilk will be tasted by the shoppers to understand their degree of liking for aspects such as taste, aroma, appearance and mouthfeel. During the study, all the standard operating procedures against the spread of Covid 19 will be observed. She would like to conduct the study on Thursday, 14th April, 2022.

I therefore request you to allow her to conduct the study outside the supermarket

Any assistance rendered to her will be appreciated

Yours Sincerely,

Dr. Solomon Olu (PhD)
Head, department of Food Science and Postharvest Technology
s.olum@gu.ac.ug, 0750 486193

DON UGANDA LIMITED

1 APR 2022

DOUGLAS MUKHAI
Manager Don Supermarket
0750 705871 & 0789 740212

Appendix v: Approval from the University Deputy Vice Chancellor

GULU

**P. O. Box 166
Gulu - Uganda**



UNIVERSITY

TEL +256 471 432093
FAX +256 471 432946
Email: vc@gu.ac.ug
URL: www.gu.ac.ug

OFFICE OF THE DEPUTY VICE CHANCELLOR

22nd April, 2022

The Chairman
Gulu University Research Ethical Committee

Dear Sir / Madam,

**RE: AUTHORISATION / APPROVAL TO CONDUCT RESEARCH STUDY AT
GULU UNIVERSITY FOR MS. NEKESA RHODAH REG:20/X/2135/MFN/PS**

I hereby write to grant permission for the above-mentioned student, to conduct a survey and sensory evaluation at Gulu University.

Ms. Nekesa Rhodah is a Student at the Faculty of Agriculture and Environment, Department of Food Science and Post-harvest Technology, Pursuing Master's degree in Food Security and Community Nutrition. Her research topic is titled **"Consumers Perception and Factors Motivating Consumption of Plant Based Milk Substitutes in Gulu City.**

The research will involve interviewing Students and Academic Staff to understand their perception about this product and conducting sensory evaluation process where soymilk will be bought from the Super Markets for the respondents to taste and score their degree of liking for aspects such as taste, aroma, appearance and mouth-feel.

I hereby grant permission and clearance to Ms. Nekesa Rhodah to conduct this study as required by the Gulu University Research Ethical Committee (GUREC).

Yours sincerely,

Associate Professor David Okello Owiny (PhD)
DEPUTY VICE CHANCELLOR ACADEMIC AFFAIRS

Appendix vi: Originality Report

nekesa thesis			
ORIGINALITY REPORT			
15%	10%	6%	9%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS
PRIMARY SOURCES			
1	Submitted to Gulu University Student Paper	5%	
2	W Krusong, A Jindaprasert, C Laosinwattana, M Teerarak. "Baby corn fermented vinegar and its vapour control postharvest decay in strawberries", New Zealand Journal of Crop and Horticultural Science, 2015 Publication	<1%	
3	www.coursehero.com Internet Source	<1%	
4	www.mdpi.com Internet Source	<1%	
5	repository.ruforum.org Internet Source	<1%	
6	Prossy Nassanga, Ipolito Okello-Uma, Duncan Ongeng. "The status of nutritional knowledge, attitude and practices associated with complementary feeding in a post-conflict development phase setting: The case of	<1%	