NON-CARBONATED BEVERAGES (HEALTH DRINKS) IN SOUTH WESTERN UGANDA: ANTIOXIDANT POTENTIAL, CONSUMER PERCEPTIONS AND THE ROLE OF NUTRITIONAL AND HEALTH CLAIMS

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DECLARATION

I, **Atukunda Claire,** declare that this dissertation is my original work and has never been submitted for any academic award

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DEDICATION

This dissertation is dedicated to God, my mother, and my circle of friends.

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LIST OF ACRONYMS

ANOVA	Analysis of Variance
CAT	Catalase
DCPIP	2,6-dichlorophenoindophenol dye
DNA	Deoxyribonucleic acid
DPPH	2,2-diphenylpicrylhydrazil reagent
NADPH	Reduced Nicotinamide Adenine Dinucleotide Phosphate
NDA	National Drug Authority
ROS	Reactive Oxygen Species
SMEs	Small and Medium Enterprises
SOD	Superoxide Dismutase
SPSS	Statistical Package for Social Scientists
UBOS	Uganda Bureau of Statistics
UNBS	Uganda National Bureau of Standards
WHO	World Health Organization

OPERATIONAL DEFINITIONS

Non-carbonated drinks	Beverages packaged without carbon dioxide.
Health drinks	Beverages obtained from the infusion of water with fruits, vegetables, and herbs and bottled for longer shelf life.
Antioxidants	Compounds that prevent or inhibit oxidative stress in the body.
Product healthiness	The expectation of a consumer about the influence of a particular product on his/her state of health.
Product safety	Product free of any form of contamination (physical, chemical, biological) and is prepared in a hygienic environment.
Health claims	Statements of/on a food that inform the consumer about the potential health benefits associated with a particular food
Nutritional claims	Statements about particular nutritional properties of a food based on its energy, carbohydrate, fiber, protein, fat, mineral and vitamin content.
Functional foods	Any food or food ingredient that may provide health benefits beyond the traditional nutrients it contains

ABSTRACT

Non-carbonated beverages comprise of fruit, vegetable, and herbal-based drinks, which are largely known as 'health drinks' in Uganda and are widely consumed in Southwestern Uganda. Despite the increased popularity of health drinks on the Ugandan market, particularly in Southwestern Uganda, little is known about: (i) their antioxidant potential; (ii) consumer perceptions of the healthiness and safety of beverages; and (iii) the influence of nutritional health claims (that are widely used on health drinks) on consumption. Thus, the objective of the study was to examine the antioxidant potential and factors associated with the consumption of health drinks in Southwestern Uganda. A cross-sectional study was conducted among 278 adults in Mbarara City and Sheema district using structured questionnaires. Laboratory analysis of vitamin C, total phenolic content, and total antioxidant activity of selected health drinks was conducted using 2,6-dichlorophenoindophenol (DCPIP), Folin-Ciocalteu, and 2,2- diphenyl- 1 picrylhydrazyl (DPPH) assays respectively. Results showed variations in the vitamin C content (14.19-25.12mg/100ml), total phenolic content (0.37-146.01mg/100ml), and total antioxidant activity (35.48-2491.8 µg/ml) of the different health drinks depending on the type of ingredients used. Theoretical calculations showed that consumption of 320 ml of health drinks would be sufficient to meet the vitamin C intake recommendations and about 40% polyphenol intake recommendations for a healthy life. Majority of the consumers had positive perceptions of beverage healthiness (77.4%) and safety (66.2%). Product health benefits, safety, and information influenced perceived healthiness while perceived safety was influenced by regulatory logos, organoleptic cues, age, gender, household income, and perceived healthiness ($p \leq 0.05$). Nutritional health claims influenced about half the respondents to consume health drinks (49.3%). Particularly, nutritional health claims in media advertisements had a significantly higher positive influence on intention to consume than claims on food labels ($p=0.019$). Besides the claims, perceived

healthiness and safety also positively influenced consumption intentions. The results of this study demonstrated that (i) health drinks consumed in Southwestern Uganda are alternative sources of antioxidants for which consumption can lead to substantial contributions to the recommended vitamin C and polyphenol intake; (ii) perceptions of beverage healthiness and safety are important factors that can be exploited to boost consumption of health drinks; and (iii) nutritional health claims can enhance consumption of non-carbonated (health) drinks and are more effective when presented through media advertisements than when presented on food labels.

Key words: Antioxidants; Health drinks; Nutritional health claims; Consumer perceptions; South Western Uganda.

CHAPTER ONE: INTRODUCTION

1.1 Background

Global market trends of different beverages have evolved in recent years concomitant with the rising demand for healthy and natural products (Nazir et al., 2019). A study by Czoli et al., (2019) noted a reduction in sales of carbonated beverages from 2004 to 2015 concurrent with an increase in sales of emergent beverage categories, among which are non-carbonated beverages. Today, the United States spends more than 48% of its entire beverage budget on non-carbonated beverages (Pokharel, 2016). In India, non-carbonated drinks present one of the fastest-growing markets, with annual sales of over 13,000 million rupees (Ali & Mohamed, 2015). A study by Ronquest-Ross et al., (2015) in South Africa also noted a 44% increase in the consumption of non-carbonated beverages, particularly fruit and vegetable juices from 1999 to 2012. Similarly, the non-carbonated beverage industry is one of the fastest-growing segments in the food manufacturing industry in Uganda, as indicated by the significant number of small and medium-sized firms (SMEs) involved (Uganda National Bureau of Standards [UNBS], 2015). Relatedly, UNBS noted that 7 companies were certified to produce energy drinks in Uganda in 2019 (Ahabwe, 2019), while in 2021, a study conducted by UNBS in 2022 found about 90 kombucha manufacturers in Uganda (Rugadya, 2022). In addition, a mini survey by Daily Monitor in 2021 found over 150 types of health drinks manufactured in Greater Ankole sub-region (Amanyisa & Mukombozi, 2021).

Numerous types of non-carbonated beverages including teas, herbal teas, fruit juices, energy and sports drinks, coffee, milk-based products, and flavored waters exist on the market (Jin et al., 2019). In Uganda, non-carbonated soft drinks encompass water-based flavored drinks, fruit drinks, vegetable and herbal-based beverages, ready-to-drink coffees, teas, energy drinks, and sports drinks (UNBS, 2010). Despite their legal categorization as non-carbonated drinks, fruit, vegetable, and herbal-based beverages are widely known as ‘health drinks’ on

the Ugandan market. Similarly, the term ‘health drinks’ is also popular in countries such as China (Cong et al., 2020), India (Bedi & Reeva, 2013), Indonesia, and Malaysia (Lim & Goh, 2019). Henceforth, the term ‘health drinks’ is used interchangeably with non-carbonated beverages in the context of this dissertation to refer to bottled beverages made from infusions of water with fruits, vegetables, or herbs (Thiagarajah et al., 2019).

The concept of health drinks has evolved from the perpetual usage of traditional herbal medicinal extracts for generations (Rashid et al., 2018). The popularity of these beverages has been on the rise in recent years due to their acclaimed health-enhancing properties, convenience, low cost, and wide availability as commercially bottled ready-to-drink products (Corbo et al., 2014). The benefits attached to health drinks stem from the bioactive components of their constituent ingredients (Deoranto et al., 2021). These compounds function as antioxidants and anti-inflammatory agents, which may be of benefit in the prevention and treatment of numerous illnesses including cardiovascular diseases, cancers, diabetes, obesity, and gastrointestinal disorders (Chandrasekara & Shahidi, 2018). Information on the potential benefits of health drinks is often relayed to consumers in form of nutritional health claims either on food labels or in media advertisements. Studies show that nutrition and health claims influence consumer perceptions and affect food purchase and consumption decisions (Tarabella et al., 2021).

Besides nutritional health claims, consumer perceptions are influenced by other product factors such as the safety or healthiness of a food product (Chen & Antonelli, 2020). Food safety has currently become a big concern among consumers due to changes in the food environment (Kregiel, 2015). Hence, it is logical to consider that consumers purchase and consume beverages they believe to be healthy and safe (Ares et al., 2008). The perceived healthiness and safety of foods influence consumer willingness to pay and consume certain products (Pinto et al., 2021), which in turn influences their dietary behaviors. According to

Steinhauser et al., (2019a), a product's likelihood of purchase increases when it is widely recognized as a healthy food product. However, perceptions are generally individual-based factors that differ from one consumer to another. In addition, antioxidant properties and related nutritional health claims vary among different food products. Therefore, it is relevant to assess factors that influence the consumption of different food products among which are health drinks.

1.2 Problem Statement

Uganda registers a high influx of health drinks whose quality is not ascertained. Health drinks are claimed to have health benefits owing to the antioxidant potential of their ingredients. However, there is a scarcity of information on the antioxidant activity of these beverages. This information is relevant because most extraction methods alter the level of antioxidants in beverages under processing (Ağagündüz et al., 2020), thereby changing the antioxidant capacity of the processed products. In addition, health drinks are often produced not from one, but a variety of plant ingredients, which may have a synergistic effect on the level of antioxidants in the processed beverage (Finimundy et al., 2020). The increasing frequency of health drinks on the market has simultaneously escalated the use of related nutritional health claims. However, controversial information exists on the influence of nutritional health claims on consumption. Some studies indicate a positive influence while others show a negative or non-significant influence of nutritional health claims on consumption (Hall et al., 2020). Moreover, most of the information available on nutritional health claims is from studies conducted in developed countries. This information may not apply to low-income countries such as Uganda due to socio-cultural differences in the understanding and regulation of nutritional health claims which affects their influence across countries (Benson et al., 2019). Tepe et al., (2022) noted a general lack of consumer-based research on fruit and vegetable products in East Africa. Most information on consumer perceptions of the

healthiness and safety of healthy beverages exists in Asia and European countries, while the field remains largely unexplored in Africa. Given the heterogeneity of consumer perceptions and their variations across different cultural, geographical, and national contexts (Cong et al., 2020), information from Asian and European consumers may not apply to consumers in Africa. Therefore, this study was designed to fill the above research gaps by determining the antioxidant properties of health drinks in Uganda, assessing consumer perceptions on the healthiness and safety of health drinks, and evaluating the effect of health claims on consumption intentions.

1.3 Objectives of the Study

1.3.1 Overall objective

To examine the antioxidant potential, nutritional health claims, and factors associated with the consumption of health drinks in Southwestern Uganda

1.3.2 Specific objectives

1. To determine the antioxidant potential of commonly consumed health drinks in Southwestern Uganda
2. To determine consumer perceptions of healthiness and safety of health drinks in Southwestern Uganda
3. To assess the effect of nutritional health claims on intention to consume health drinks in Southwestern Uganda

1.3.3 Research questions

1. How do antioxidant levels vary among health drinks consumed in Southwestern Uganda?
2. How do consumers perceive the healthiness and safety of the health drinks?
3. How do nutritional and health claims affect intentions to consume health drinks?

1.4 Conceptual Framework

The conceptual framework guiding this study is portrayed in Figure 1. The framework shows a multifarious interplay of factors that influence consumer perceptions and subsequent consumption behavior of foods. According to Zeb (2020), antioxidants such as phenolic compounds and vitamin C are associated with health benefits. These benefits are relayed to consumers on food labels and in media advertisements in form of nutritional health claims (Curvelo et al., 2019). Studies show that there is a relationship between nutritional health claims and consumer perceptions of the healthiness and safety of food and beverages (Plasek et al., 2021). In addition, evidence also indicates that product attributes such as price and brand as well as consumer attributes particularly demographic factors influence consumer perceptions of food healthiness and safety (Petrescu et al., 2020). Subsequently, consumer perceptions influence their decision-making processes and motivate or deter their purchase and consumption intentions (Hwang et al., 2016). Besides perceptions, nutritional health claims and consumer demographic characteristics have direct effects on consumption intention and behavior (Benson et al., 2018).

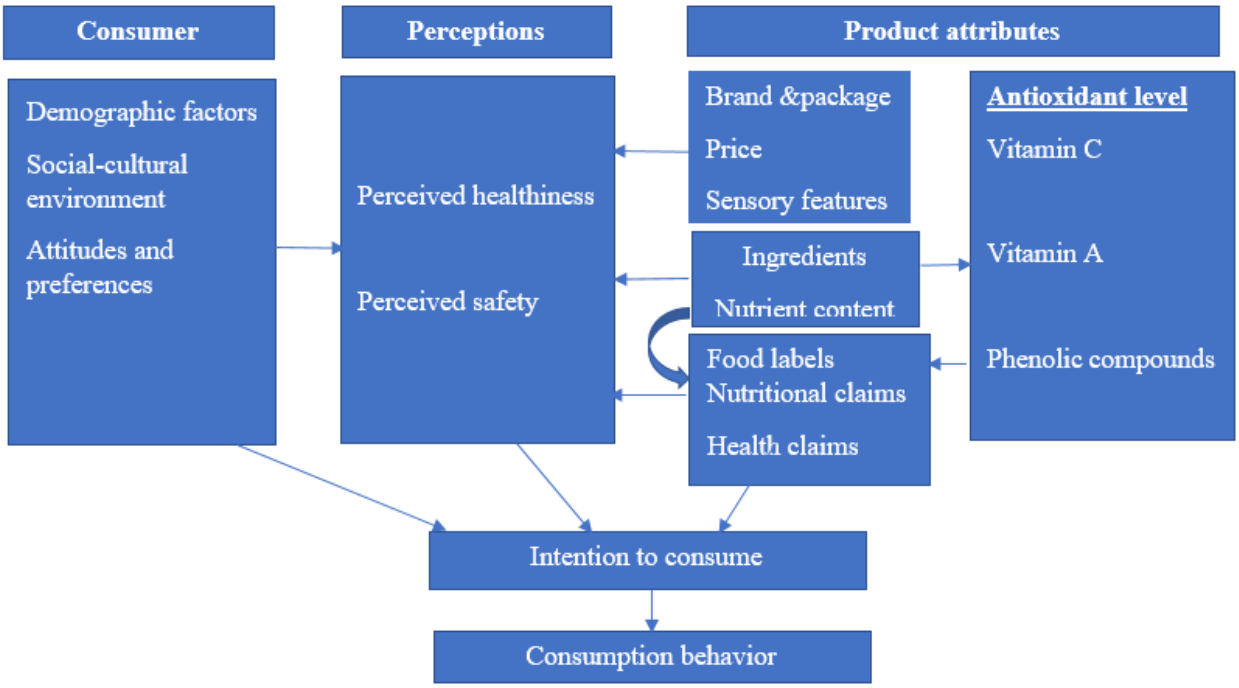


Figure 1: Conceptual framework for consumer perceptions and consumption behavior

1.5 Significance of the Study

This study provides information that contributes to efforts aimed at exploiting fruit, vegetable, and herbal products as a potential resource for improving nutrition and health in Uganda and other developing countries where such products are consumed. It contributes to efforts geared at providing quantitative evidence on the nutritional properties of health drinks on the market, consumer perceptions associated with these beverages, and the effectiveness of nutritional and health claims in influencing food choices in East Africa. Additionally, by assessing consumer perceptions, this research inevitably evaluates the public's needs and demands related to health drinks.

On a macro scale, this study provides beverage companies with potential market demands for business improvement. In addition, it presents policy implications for government bodies, particularly on developing and implementing policies and standards to ensure the authenticity of nutritional health claims in media advertisements, ensure consistency of information between media adverts and food labels of health drinks, and promote consumer usage and understanding of information on labels to make informed food and beverage choices. Further, the evidence from this research provides a basis for promoting the utilization of health drinks as a potential resource for improving the nutrition and health of Ugandans, thereby contributing to Sustainable Development Goal (SDG) 2 on ending malnutrition as well as SDG 3 on promoting good health and wellbeing.

1.6. Scope of the Study

The study aimed to examine non-carbonated beverages (health drinks) in Southwestern Uganda, focusing on their antioxidant potential, consumer perceptions, and role of nutritional health claims. Particularly, the study involved laboratory analyses to assess the level of vitamin C, total phenolic content, and total antioxidant activities of the six most commonly consumed health drinks in Sheema district and Mbrarara city. Concerning consumer

perceptions, the study focused on assessing how consumers perceived the healthiness and safety of the beverages, utilizing a cross-sectional survey. Further, a field experiment utilizing simulated labels and media advertisements with nutritional health claims was used to analyze the effect of nutritional health claims on the intention to consume health drinks. Only adults aged 18 and above in Mbarara city and Sheema district, that had ever heard, seen, or consumed health drinks were considered for the study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Non-carbonated beverages

Worldwide, the rate of production and consumption of soft drinks is astounding (Abdelazim et al., 2017). Today, soft drinks are widely accessible, from the biggest towns to the remotest rural settlements. Classification of different soft drinks is based on their carbonation level, functionality, flavoring, and ingredients used (Kregiel, 2015). The two broad categories under which most soft drinks fall include; carbonated and non-carbonated beverages. Carbonated beverages are packaged with carbon dioxide, which gives them their fizzling properties. On the other hand, carbon dioxide is not used when packaging non-carbonated soft drinks. Although carbonated soft drinks dominate the global market, their demand has decreased over time, in tandem with a rise in the demand for non-carbonated soft drinks (Heng et al., 2018). A study by Goyal et al., (2019) noted a 15-20% decline in the use of carbonated drinks in India and estimated a 35% annual increase in the consumption of non-carbonated soft drinks.

The growing desire for products healthier than carbonated soft drinks has influenced the market trend toward different non-carbonated beverages and their ingredients (Gil-Serna et al., 2020). Currently, functional beverages present the fastest-growing market in the functional food category and are estimated to account for up to 40% of total consumer demand by 2025 (Nazir et al., 2019). In addition, Lyubchyk et al., (2019) noted an expected growth of the European market for phytochemicals and plant extracts from $833.7 million in 2014 to $1.25 billion in 2019. In countries like Malaysia, almost three quarters of the population use herbal products (Sulaiman et al., 2017). Similarly, Uganda also registers the herbal, fruit and vegetable-based drink (health drinks) industry as one of the fastest growing subsectors of the food manufacturing industry (UNBS, 2015).

The manufacture of health drinks utilizes a variety of fruits, vegetables, herbs, and spices, such as mint, cinnamon, ginger, garlic, giloba, hibiscus, and citrus fruits (Pyrzynska & Sentkowska, 2019). These plant products and materials are rich in bioactive substances such as vitamins, flavonoids, phenolic compounds, and minerals that act as antioxidants, antimicrobials, antibiotics, anti-inflammatory, antiviral, and anti-proliferative agents in the prevention of disease (Russo et al., 2017). The uniqueness of each beverage in terms of functionality is determined by the type of functional ingredients used and the quantity of bioactive components in the ingredients (Aadil et al., 2019).

2.2 Antioxidants in health drinks

Antioxidants are essential substances in the body's defense against oxidative stress (Salehi et al., 2018), owing to their role in inhibiting of free radicals. The body’s antioxidant system comprises of both exogenous and endogenous antioxidants. The body naturally produces endogenous antioxidants, which include non-enzymatic antioxidants like glutathione (GSH), ascorbic acid, uric acid, lipoic acid, and coenzyme Q as well as enzymatic antioxidants like glutathione peroxidase (GPx), superoxide dismutase (SOD), heme oxygenase, and catalase (Radomska-Lesniewska et al., 2017). Exogenous antioxidants, on the other hand, are acquired from diet and can be either natural or synthetic in nature. Antioxidants in health drinks are majorly obtained from their plant ingredients. These include;

Phenolic compounds

Phenolic compounds are made up of plant phytochemicals such as flavonoids and phenolic acids from fruits, cereals, vegetables, herbs, spices, wines, coffee, and teas (Khoddami et al., 2013). These compounds function as antioxidants through mechanisms such as transfer of electrons, metal chelation, and boosting the activity of enzymatic antioxidants (Zeb, 2020). Numerous studies evidenced the role of different polyphenols in the prevention and management of numerous diseases. According to a study by Serafim et al., (2020), flavonoids

prevent peptic ulcers by boosting the antioxidant activity of enzymes glutathione peroxidase, catalase, and superoxide dismutase, which protect the gastric mucosa from oxidative stress. Studies also show that rutin and epicatechin work as potent reactive oxygen (ROS) scavengers to reduce lipid peroxidation (Koch, 2019), thereby providing protection against cardiovascular illnesses and type 2 diabetes. Additionally, Zhao et al., (2017) reported the important role played by hesperidin in the prevention of ovarian cancer.

Vitamin A

Vitamin A, a water-soluble vitamin, can be obtained from fruits, vegetables, milk and milk products, meats, fish, and eggs (Codjia, 2001). It exists in form of retinols, carotenoids, and lycopene. Carotenoids act as antioxidants through the direct scavenging of singlet oxygen radicals in the body (Liu, 2013). In addition, carotenoids are effective peroxyl radical scavengers, which helps to prevent membranes from oxidative damage (Santos-Sánchez et al., 2012). As a result, carotenoids have been reported to have protective roles against heart disease, colorectal, and stomach cancers (Masri et al., 2015). Evidence shows that lycopene strengthens the stomach mucosal barrier and raises SOD and GSH levels, thereby protecting the body against peptic ulcers and gastric cancer (Başaran et al., 2017).

Vitamin C

Vitamin C is one of the most predominant natural antioxidants, primarily found in citrus fruits. Vitamin C is particularly effective at scavenging reactive oxygen species such as neutrophil oxidants, hydrogen peroxide, and peroxyl radicals (Bulger & Helton, 1998). In addition, it acts as a co-factor for α-tocopherol, a membrane-bound antioxidant. Past studies show the protective role of vitamin C against lipid peroxidation, and related diseases such as cardiovascular diseases (Traber & Stevens, 2011). Additionally, studies have shown that vitamin C protects against H. pylori-induced gastritis and stomach cancer (Aditi & Graham, 2012).

Vitamin E

Oils, nuts, seeds, fruits, and vegetables are all popular sources of vitamin E, a lipid-soluble vitamin. Vitamin E comprises of tocotrienols and tocopherols, with alpha-tocopherol being its most biologically active form (Hamid et al., 2010). This vitamin is a superior membrane antioxidant, majorly acting through the upregulation of the enzymatic activity of glutathione peroxidase, superoxide dismutase, NADPH oxidase, and quinone reductase as well as directly scavenging ROS and repairing oxidizing radicals (Vertuani et al., 2004). Particularly, evidence shows that vitamin E provides primary defense against lipid peroxidation and facilitates wound healing of the gut mucosa (Rezvani et al., 2019).

2.2.1 Effect of processing on antioxidants

In recent years, health drinks, ready-to-drink concoctions, and related beverages have increased on the market (Hassali et al., 2009). A variety of processing techniques are employed in the manufacture of these beverages to extract beneficial compounds such as antioxidants from plant materials (Pyrzynska & Sentkowska, 2019). Common extraction techniques include; hydro-distillation, soxhlet extraction, microwave extraction, pressured liquid extraction, use of solvents and enzymes. (Selvamuthukumaran & Shi, 2017)

The level of extraction of antioxidants from plant materials varies according to the processing method used, which subsequently influences the quantity of antioxidants in the final product (Xu et al., 2017). According to Jideani et al., (2021), some methods of processing increase the bioavailability of antioxidants and give the opportunity to change or even increase the amount of antioxidants in the final product. In addition, the use of a variety of plant ingredient enhances the antioxidant content of the processed beverage (Aadil et al., 2019). On the other hand, some antioxidants are unstable and easily degraded during beverage processing (Nayak et al., 2015). In a study by Ağagündüz et al., (2020), the vitamin C content of oranges was affected by temperature, light, and oxygen concentration during processing

and storage, which in turn reduced the amount of vitamin C in the juices produced. As a result, the antioxidant content of a beverage may differ from that of the original plant material. It is therefore essential to determine the antioxidant content of not only the plant materials but also their respective extracted beverages.

In Uganda, numerous investigations have been conducted on the antioxidant properties of therapeutic herbs, vegetables, and fruits, and evidence exists to show that most indigenous fruits and vegetables have substantial amounts of flavonoids, phenolic compounds, and high antioxidant capacities (Omara et al., 2021). In addition, several analyses have been undertaken to determine the antioxidant activity of fermented milk and cereal based beverages commonly consumed in Uganda (Xiong et al., 2022). However, little information exists on the antioxidant properties of plant-based beverages now offered on the Ugandan market. A few researchers have analyzed the antioxidant properties of the plant-based beverages of their own formulation (Andabati & Muyonga, 2014), but not plant-based beverages already on the market.

2.3 Consumption behaviors associated with health drinks

Owing to the rising global burden of obesity and nutritional-related diseases, consumers are increasingly adopting healthy lifestyles. This has influenced a growing trend toward foods and food products that give consumers a nutritional advantage and enhance their health (Plasek et al., 2020a). On the other hand, the demand for convenient foods and beverages has also increased in the population (Jurado & Gracia, 2017). Health drink manufacturers have taken advantage of these market demands to provide ready-to-drink beverages that are convenient, with numerous health benefits. Nonetheless, consumers must make selection decisions daily because they cannot afford to buy or consume all beverages on the market (Hyeyoung & House, 2014). These decisions are influenced by a number of factors ranging

from individual-based factors, socio-cultural factors, food-product factors, religious, and cognitive factors. (Chen & Antonelli, 2020).

2.3.1 Consumer perceptions of the healthiness of foods and beverages

The concept of healthy food is primarily understood from two perspectives: one relates to the food's nutritional quality and health benefits and the other pertains to food safety and its associated concerns (Petrescu et al., 2020). Some consumers always prioritize product healthiness and are more likely to purchase food products they view as healthy for consumption (Sajdakowska et al., 2018). Perceived healthiness is defined as the consumer's expectation of how a certain food product will affect his or her state of health (Howlett et al., 2009). Consumers generally utilize a variety of cues to assess the healthiness of foods as the parameter cannot be directly assessed (Plasek et al., 2020a). Cues commonly used to determine product healthiness include; product information, ingredients, type of packaging, level of freshness, product origin, and type of food category. For instance, most consumers perceive foods in the organic food category as healthier and safer than conventional items (Ali, 2021). In addition, some consumers believe that fresh unprocessed foods are healthier than processed goods.

Consumers use product information on food ingredients and nutrient content to assess whether a food product is healthy for consumption (Lagerkvist, 2013). Past studies show that consumers attach high health perceptions on foods rich in fiber, vitamins, and minerals while foods with high fat and sugar content are associated with low product healthiness (Bucher et al., 2015). Consequently, the product information provided on labels, health, and nutrition claims becomes a crucial tool in shaping consumer views because it informs the consumer about a food's ingredients, nutrients, and health benefits (Benson et al., 2018).

High perceptions of product healthiness positively influence consumer willingness to pay for a given food product, which in turn increases its likelihood of purchase. This was evidenced by Hyeyoung & House (2014) who noted a 0.79% rise in the consumption of non-alcoholic beverages for every 1% rise in perceived healthiness. In addition, a qualitative study by Benson et al., (2019) noted a positive influence between consumer health perceptions and purchase behavior. However, most information that exists on perceived healthiness of foods and beverages is from studies conducted in developed countries. Given the substantial differences in consumer opinions across various national and cultural settings (Cong et al., 2020), information from developed countries may not apply to consumers in low- and middle-income nations like Uganda. In East Africa, there is a lack of consumer studies focused on processed fruit and vegetable products (Tepe et al., 2022), despite their abundance on the market. As such, consumer perceptions on beverage healthiness are largely unexplored in the region.

2.3.1.2 Consumer perceptions of the safety of foods

Food safety is a major issue of concern among consumers worldwide consumers due to the enormous number of food-borne illnesses and health risks associated with food (Chuanhui et al., 2018). Generally, food is deemed safe when it is devoid of all forms of contamination (physical, chemical, biological) and is prepared in hygienic settings (Grunert, 2005). Enormous evidence shows that consumers in developing countries regard fruits and vegetables (Zhang et al., 2018), animal products (Zhllima et al., 2015), and street-vended foods with high food safety concerns. In particular, the poor operational settings of informal food markets in many low- and middle-income nations raise numerous food safety concerns among consumers (Birgen et al., 2020). However, little information exists on how consumers perceive the safety of processed and packaged food products purchased from shops and supermarkets. A study by Rijswijk & Frewer (2008) in developed countries found that

consumers did not typically view food safety as a significant criterion when making product purchases owing to their belief that food safety was assured for all items available on the market. However, the findings of this study may not apply to low and middle-income countries given the national differences in food technology and regulation.

When making product purchases, consumers frequently rely on numerous product attributes and cues availed by food manufacturers to assess the safety of food (Petrescu et al., 2020). Symbolic elements on food product packages such as seals, expiration dates, and regulatory logos enable consumers to evaluate the safety of food and its suitability for consumption (Marques da Rosa et al., 2019). Particularly, these product attributes influence consumer safety perceptions by fostering consumer trust and confidence, which subsequently influences purchase and consumption decisions associated with a particular food (Ha & Perks, 2005). A case in point is 'natural' food products, which are perceived to be safer than their conventional counterparts (Bahmani et al., 2014). A study by Hassali et al., (2009) found that more than 75% of herbal beverage consumers believed herbal beverages to be safer for consumption and disease management than conventional drugs.

However, beverage safety concerns have risen among consumers owing to the increased availability of unregulated, fraudulent, and contaminated beverages on the market (Rousseaux & Schachter, 2003). In addition, laboratory studies indicate that plant-based beverages are associated with numerous toxicity risks (Caldeirão et al., 2021). However, there is not much evidence to suggest that consumers are aware of these safety risks. (Bukachi et al., (2021) observed a lack of prioritization of consumer perspectives on food safety due to most food safety evaluations being laboratory-based. Moreover, In Southwestern Uganda, a big product safety threat exists given the news reports which have indicated that some health drinks are produced in private residences, packaged in trash waste

bottles, and availed to the market without a license (Amanyisa & Mukombozi, 2021). However, little information exists on how consumers perceive the safety of these beverages.

2.3.1.3 Nutrition and health claims associated with health drinks

Product information is very crucial when making food purchase decisions (Benson et al., 2018). Food and beverage manufacturers avail this information to consumers in form of nutritional facts information, nutrient claims, and health claims. Nutrient claims encompass statements and or visual symbols that inform the consumer about a food's specific nutritional qualities based on its calorie, carbohydrate, fiber, protein, fat, mineral, and vitamin content (Hawkes, 2004). Health claims, on the other hand, are statements and/or visual symbols that inform the consumer of any prospective health advantages associated with the consumption of a given food (Nocella & Kennedy, 2012). Nutritional health claims vary according to the food or beverage category of a product, its ingredients, and its nutritional composition (Bucher et al., 2015). In health drinks, one of the most utilized nutrient claims is "high in vitamin C." (Plasek et al., 2021). Common health claims commonly used in functional foods and beverages include; "improves your general health," "benefits heart health," and "regulates blood sugar" (Cong et al., 2020). For soup, most nutritional healthy claims evolve around sodium namely-“reduced salt”, “low sodium”, “tasty” (Liem et al., 2012).

Studies show that nutritional health claims influence consumer perceptions, purchase intentions, and overall food consumption behavior. However, the level of influence of nutritional health claims depends on the type of claim. A study by Hall et al., (2020) noted that health warning labels decreased the appeal of fruit drinks and negatively influenced perceived healthiness. Another study by Hwang et al., (2016) noted that the use of nutrition claims with health claims had a more significant effect on consumer perceptions than nutrition claims alone. In 2017, a review study noted that health claims elicited a higher

influence on purchasing/consumption intentions than nutrition claims (Kaur et al., 2017). However, Kaur et al., (2017) also noted that most studies depicting a more significant influence of health claims than nutrition claims were conducted in experimental settings and expected studies from realistic settings to give varying results. This was confirmed by Steinhauser et al., (2019a) who conducted a study in a close-to- realistic setting and found a higher influence of nutrition claims on purchase intentions than health claims.

Nutritional health claims are largely availed on food labels, but have in recent years, become more frequent in media advertisements (Tarabella et al., 2021). A study by Whalen et al., (2018) noted a 4.1% increase in the appearance of nutritional health claims in television advertisements from 2008 (20.7%) to 2010 (24.8%). A study by Sriram et al., (2021) noted that media advertisements increase the appeal of foods which positively influences their perceptions and consumption. A study by Bacardí-Gascón et al., (2013) found a relationship between the frequency of food advertising and consumption of the advertised food. However, while ample information exists on the influence of media advertising on consumption, there is a scarcity of information on the influence of nutritional health claims in advertisements on consumption. Most studies have focused on content analysis of nutritional health claims in media advertisements (Tarabella et al., 2021) but not their influence on consumption. More so, there is even less information on comparisons made between the influence of claims in media advertisements and claims on food labels on consumption. The few studies comparing claims on food labels and claims in media advertisements give controversial results. A study by Mazis & Raymond (1997) found that consumer beliefs for different food products did not differ upon exposure to health claims in food advertisements and claims on food labels. On the other hand, a study by Mitra et al., (2019) noted that consumers were more skeptical of claims in food advertisements than claims on labels, which influences their consumption decisions. A replication study by Ringold (2021) noted that consumer skepticism for health

claims in media advertisements may also be attached to health claims on food labels. A viable explanation was given by Mitra et al., (2019) in the context that the influx of health claims in the market may have jaded consumers, and caused them to have high levels of skepticism for health claims regardless of the context in which they appear. This may be the situation in Uganda, where the government warned the populace about fraudulent health claims on health drinks after realizing their influx in media advertising in 2021. (National Drug Authority [NDA], 2021). However, there is a paucity of information providing clarity over these controversies. Cong et al., (2020) recommended for further research to be conducted on the best ways of communicating the benefits of food products to consumers.

2.3.1.4 Effect of demographic factors on consumer perceptions

Demographics illustrate the distribution of population statistics such as age, gender, economic status, marital status, health status, level of education, and family structure. (Sharifudin et al., 2012). Steinhauser et al., (2019b) noted that consumer characteristics influence how consumers perceive different products and present critical policy implications. Numerous studies show the influence of demographic factors on consumer perceptions of food. A study by Brečić et al., (2014) noted that women were more health conscious and tended to consume more healthy foods compared to men. Sharifudin et al., (2012) found that a low-socioeconomic status was associated with high consumption of herbal-based beverages. Another study by Mitra et al., (2019) noted that the age and nutrition knowledge of consumers influenced their level of skepticism towards nutritional health claims. Overall, the level of influence of demographic factors on consumer perceptions varies with differences in geography and culture (Baker et al., 2022). Nazir et al., (2019) noted that socio-cultural and socio-demographic differences among consumers influenced consumer acceptance of different beverages, which in turn influenced their growth trends across and within countries. Therefore, it is crucial to understand consumers in various target areas.

2.4 Summary of research gaps

While ample information exists on the potential nutritional benefits of milk and cereal-based beverages (Byakika et al., 2020), there is a paucity of information on the potential of fruit, vegetable, and herbal-based beverages in Uganda. Numerous researchers in the country have analyzed the antioxidant potential of fruits, vegetables, and herbal plants (Omara et al., 2021) however, very few studies have been conducted on products processed from these raw materials. The few available studies on fruit, vegetable, and herbal products are more focused on the physiochemical properties of products under development (Wasswa et al., 2019) but not on ready-made products on the market. In addition, Tepe et al., (2022) noted a general lack of consumer-based information on fruits and vegetable-based products. In Kenya, Bukachi et al., (2021) noted that consumer information on food safety was limited as most studies on food safety were laboratory-based. Caldeirão et al., (2021) noted that while numerous laboratory studies have indicated safety concerns associated with healthy beverages, there was a scarcity of information to show that consumers were aware of these concerns. In addition, most studies analyzing consumer perceptions of food safety mostly focus on food handling practices, animal products and agricultural produce, leaving the context of processed products largely unexplored. Concerning product healthiness, Plasek et al., (2020) noted variations in perceived healthiness of foods across different food categories and countries. Cong et al., (2020) noted that variations in consumer perceptions of healthy foods and beverages result from social, economic, and cultural differences among consumers within and across countries. In Uganda, most consumer information on health drinks is obtained from newspapers and websites due to lack of scientific studies on these beverages. Despite the increased use of nutritional health claims on non-carbonated beverages in Uganda, little information exists on the influence of these claims on consumption. Jurado & Gracia (2017) noted that the understanding and valuation of nutritional health claims differs

among consumers hence findings from one population may not apply to another population. Overall, studies show variations in the influence of nutritional health claims on consumption intentions depending on the type of claim (Kaur et al., 2017), the setting within which the study is conducted, and the source of the claim. While a lot of information exists on the effect of nutritional health claims on food labels on consumption (Benson et al., 2018), scarce information exists on the influence of claims in media advertisements on consumption. Most studies have focused on content analysis of claims in media advertising (Tarabella et al., 2021) while their influence on consumption remains largely unexplored. In addition, little information exists on comparisons of the influence of claims on food labels and claims in media advertisements on consumption of food and beverages. Cong et al., (2020) highlighted the need to identify effective methods of communicating the health benefits of food products to consumers which necessitates comparing the different modes of health claims delivery such as media vs food labels.

CHAPTER THREE: METHODOLOGY

3.1 Study Design

A cross-sectional study design employing laboratory analysis to address objective one and a consumer field survey to address objectives two and three was used in this study. This study design was chosen due to its reliability for use in understanding peoples' opinions, knowledge, attitudes and perceptions (Kesmodel, 2018). On the other hand, laboratory analyses were conducted to collect quantitative data on the antioxidant properties of health drinks. Laboratory analyses were essential in this research as they provided an opportunity to ascertain the quality and authenticity of health drinks on the Ugandan market.

3.2 Study Area

This study was carried out in the Southwest of Uganda, particularly in Mbarara City and Sheema district as shown in Figure 2. These areas were chosen due to the substantial market surge of health drinks in them. In addition, previous research indicates that majority of the population in this region uses a lot of plant and plant products for medicinal purposes (Kamukama et al., 2014). As a result, they are most likely to opt for commercial health drinks as alternatives to homemade concoctions given their high availability and accessibility.

Mbarara City is situated at longitude 30037I East and latitude 0036I South, 270 kilometers Southwest of Kampala. It is located in the Southwestern agroecological zone at an altitude of 1432 meters above sea level. The city receives an average annual rainfall of 1,125 millimeters (mm) and an annual average temperature of 25 °C. Mbarara City has a population of 195,013 people (UBOS, 2017) and is comprised of six divisions; Biharwe, Nyamitanga, Kakiika, Kakoba, Kamukuzi, and Nyakayojo.

On the other hand, Sheema district is situated 33 kilometers west of Mbarara City at coordinates 0032S, 3024E. The district is located in the Southwestern agroecological zone,

with two rainy seasons that occur from November to December and March to May. Overall, the district receives between 1020mm and 1130mm of rainfall annually and experiences a monthly average temperature between 27°C and 31°C (UBOS, 2017). Sheema district comprises of twelve sub-counties including Kitagata, Kasaana, Rugarama, Shuuku, Bugongi, Sheema central, Kagango, Rushozi, Kabwohe, Kigarama, Kyangyenyi, and Masheruka, with a population of roughly 207,343 people (UBOS, 2016).

Overall, while Mbarara city is the biggest city in the western part of the country and serves as the principal commercial hub for the people of Southwestern Uganda, Sheema district has one municipality and numerous emerging small towns. However, both are rapidly growing areas in terms of both population and urbanization. The economy of Mbarara city is predominantly based on the social service sector, the informal sector activities, trade, and industry, with majority of the people in the city deriving their livelihood from employment income and the business industry. On the other hand, most of the population in Sheema district derives its livelihood from farming, comprising of both crop (maize, millet, beans, coffee, sweet potatoes, and bananas) and livestock production (chickens, pigs, goats, and cattle). Largely, both areas are inhabited by the Bantu tribe, who speak Runyankole, the predominant language of the region.

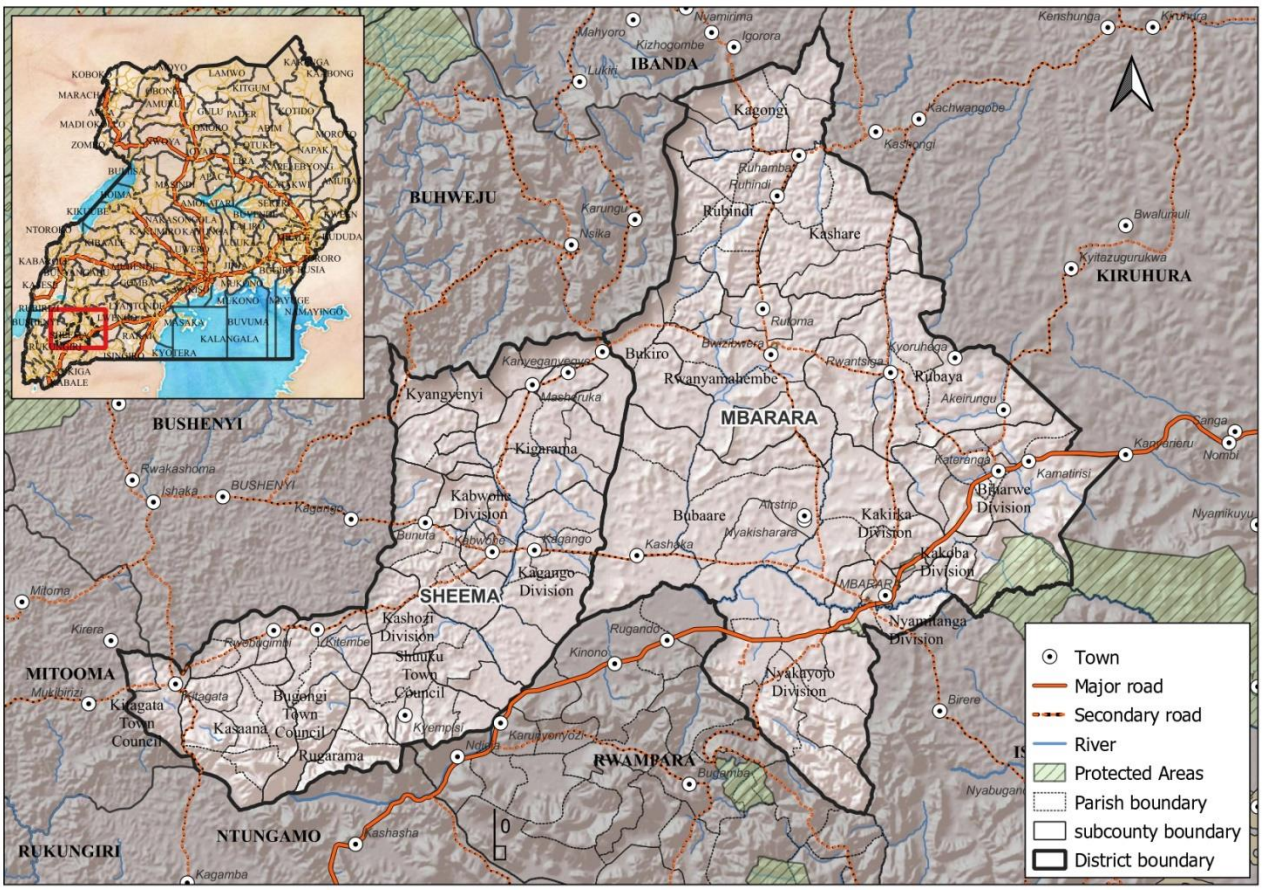


Figure 2: Map of Uganda showing Mbarara and Sheema district where the study was conducted

3.3 Laboratory Analyses

Laboratory analyses were conducted to determine the antioxidant potential of health drinks. Six health drink samples described in Table 1 were analyzed. These were the most commonly consumed health drinks as identified by respondents during the survey instrument described in subsection 3.4.6. The beverages were purchased from local shops. For each drink type, two samples packed in 300ml bottles were purchased from each study area and immediately transported in a cool box to the laboratory where all samples were kept in a refrigerator prior to the analysis of vitamin C, total phenolic activity, and total antioxidant activity. Vitamin C and phenolic compounds were analyzed because they are the primary natural antioxidants present in plant materials (Zeb, 2020). Analyses were conducted from the National Natural Chemotherapeutic Research Institute in Kampala.

Table 1: Description of health drinks selected for analysis

Drink type code	Color	Principal component	Other ingredients
HD01	Brown	Mushroom	Honey, tea, shitake (mushroom), water
HD02	Brown	Ginger	Water, sugar, black tea, rosemary, mulondo (Mondia whitei), honey, aloe Vera (Aloe barbadensis miller)
HD03	Green	Aloe Vera	Lemon, green tea, cactus (Cactaceae)
HD04	Brown	Tamarind	Water, ginger, sucrose
HD05	Red	Beetroot	Pineapple, banana, hibiscus
HD06	Yellow	Pineapple	Eucalyptus (Eucalyptus globulus Labill), water

Reagents; 2,6-dichlorophenolindolphenol (DCPIP), metaphosphoric acid, L-ascorbic acid, gallic acid, sodium carbonate, Folin-Ciocalteu reagent, methanol and 2, 2-diphenylpicrylhydrazil (DPPH) were obtained from BDH Laboratory suppliers, Kampala.

3.3.1 Determination of vitamin C

Vitamin C content was determined using the DCPIP dye titration method. This method was preferred for the study because of its simplicity, ease of replicability, and reliability in measuring vitamin C in beverages (Spínola et al., 2014). The DCPIP assay works on the principle of ascorbic acid reducing the blue indicator die to colorless such that the end-point of titration is revealed when a pale pink color is obtained. This study adopted a procedure from Shivembe & Ojinnaka, (2017) with minor modifications.

100ml of each sample was measured into a conical flask and 20g of activated charcoal was added. The mixture was shaken well and filtered using Whitman's filter paper (Cytiva, Marlborough, United States) to obtain a clear sample. To prepare the standard solution, 0.05 g of L-ascorbic acid was dissolved in 23.5 ml of 85% meta-phosphoric acid, and the solution was brought to the 250 ml mark. Similarly, a 0.05% solution of DCPIP was prepared with distilled water. The DCPIP solution was standardized with a 0.5ml of ascorbic acid. Then, 10 ml of the sample was titrated against the DCPIP solution. All analyses were performed in triplicates. The ascorbic content was calculated using the formula;

Mass =MR (Ascorbic acid) ×C (DCPIP) × V (DCPIP)

Where; MR=Molar Mass, C=Concentration and V=Volume.

3.3.2 Determination of total phenolic content

The total phenolic content was determined using the Folin-Ciocalteu assay. This method was used in cthis study because in addition to being simple to perform, reproducible, specific and cost effective, it has been widely applied to determine the total phenolic content of other food products such as vegetables, teas, wines, fruits and fruit juices (Blainski et al., 2013). The procedure used in the study was adopted from Singleton et al., (1999) with modifications. Analysis was conducted using the blank followed by the sample. For blank determination, 0.5ml of Folin reagent, 1.5ml of 20% aqueous sodium carbonate solution and 4.5ml of distilled water were mixed by shaking to make 6.5ml of solution and the absorbance of the resultant solution was measured at 755nm using a UV-Vis spectrophotometer (Beckman Coulter, Brea, United States).

For sample determination, 0.02ml of each sample was mixed with 0.5ml of Folin reagent, 1.5ml of sodium carbonate solution, and 4.5 ml of distilled water by shaking followed by measuring the absorbance as in the case of the blank. A standard calibration curve was produced using freshly prepared aqueous solutions of gallic acid at concentrations of 20, 40, 80, and 100µl/ml. The concentration of the total phenolic compounds in the sample was derived from the calibration equation $y=0.0119x+0.0249$, $R^2=0.9985$ and results were reported in gallic acid equivalents. All tests were conducted in triplicates

3.3.3 Determination of total antioxidant activity

The antioxidant activity of the samples was analyzed using the 2, 2-diphenylpicrylhydrazil (DPPH) spectrophotometric assay. DPPH method was used in the study because of its wide

application in the evaluation of the overall antioxidant activity of numerous foods and natural products such as fruits, vegetables, oils, wines, flours, and juices (Kedare & Singh, 2011). More so, this method is preferred for its simplicity, time and cost effectiveness and commercial availability. Total antioxidant content was measured using a procedure adopted with minor modifications from Ajima et al., (2020).

As was the case for total phenolic analysis, spectrophotometric assay was conducted on both the blank and sample. For sample analysis, volumes of 20 µl, 30 µl, 40 µl, and 50 µl were measured into test tubes followed by the addition of 5ml of methanoic DPPH (prepared by diluting 3.94mg of DPPH in 100ml of methanol). The mixture was shaken and allowed to stand in the dark for 20 minutes at room temperature followed by measurement of absorbance of the resultant solution at 517nm using a UV-Vis Spectrophotometer. Methanoic DPPH was used as a control (blank). Ascorbic acid was used for the development of the standard curve at concentrations of 5, 10, 15, and 20 µg/ml (R^2=0.9972). Percentage inhibition was calculated using the formula below.

% DPPH scavenging activity = $((1 - [A_{sample} / A_{control}]) \times 100)$; where; A = Absorbance.

Antioxidant activity was expressed in terms of half-maximal inhibitory concentrations (IC50). IC50 refers to the concentration of antioxidants required to inhibit 50% of the initial DPPH concentration in the sample. Lower IC50 values depict higher antioxidant activities (Rivero-Cruz et al., 2020).

3.4 Consumer field survey

A field survey was conducted to assess consumer perceptions of the healthiness and safety of health deinks as well as the influence of nutritional health claims on consumer intention consume these beverages

3.4.1 Study population

The target population comprised of adults (18 years and above) with knowledge about health drinks. Adults were selected for this study owing to the high prevalence of nutritional-related non-communicable diseases such as type II diabetes, obesity, hypertension, and cancers typical of this age group (Nkambule et al., 2021). To prevent these health challenges, adults, more than any other age group, are more likely to consume health-sensitive foods and beverages, making them the primary target market for health drink manufacturers. In addition, adults can legally make their own financial, health-related, and consumption decisions. Hence, eligible respondents in the study were adults or persons aged 18 years and above, who had knowledge about health drinks (those who had heard of, seen or used health drinks). Ineligible respondents included persons below 18 years and/or those who had no knowledge whatsoever about health drinks.

3.4.2 Sample size determination

The sample size for the study was calculated using a modified Yamane's formula as stated by Adam (2020). This method of sample size determination was used because it accounts for variance of survey research conducted using Likert scale assessment as used in this study.

The formula is presented in the equation below;

$$n = \frac{N}{1 + N(e)^2}$$

Where; 'n' is the required sample size, 'N' is the population and e is the adjusted margin of error. 'e' $= pa/t$, where p is the number of standard deviations that would include all possible values in the range, 'a' is the degree of accuracy and 't' is the t-value for the selected confidence level at 95% (1.96). The number of standard deviations for a five point or more is

4 while the acceptable margin of error (a) at 95% confidence level is 0.03 (Adam, 2020). Using this method, the adjusted margin of error was calculated to be 0.0612245. The populations of the two areas (207,343 for Sheema district, and 195,013 for Mbarara City) were aggregated to get N= 402,356. On the basis of the parameters defined, the sample size was determined to be 267. To cater for attrition, the sample size was adjusted by 4% (Kamukama et al., 2014), resulting in a final sample size of 278. To obtain the number of respondents from each area, proportionality was used (51.5% in Sheema district and 48.5% in Mbarara). Overall, data was collected from 142 respondents (51.1%) in Sheema district and 136 respondents (48.9%) in Mbarara City, there by observing the set proportionalities.

3.4.3 Sampling strategy

A multi-stage sampling procedure was applied to locate the study participants. This method of sampling was chosen because of its applicability in studies with geographically diverse populations and no sampling frame, as was the case with this research. First, one sub-county and division was randomly selected from Sheema district and Mbarara City respectively. Secondly, from each sub-county/division, two parishes were randomly selected. Thirdly, from each parish, two villages/wards were randomly selected. Participants were selected from the subsequent villages using random sampling. The sub-counties, parishes and villages where the study was conducted are presented in Table 2.

Table 2: Sub counties, parishes and villages of the study areas

District	Sub county	Parish/ward	Village/cell
Sheema district	Kagango	Kiziba	Ngoma, Rushoroza
		Kihunda	Bwabambari, Kagongi
Mbarara City	Kakoba	Kakoba	Rugazi, Kiswahiri
		Nyamityobora	Kijungu, Rubiri

3.4.4 Assessment of consumer perceptions on healthiness and safety of health drinks

The study applied individual face-to-face interviews using structured questionnaires to collect data on perceived healthiness and perceived safety. The questions were designed with responses based on a 5-point Likert scale (1= strongly disagree and 5= strongly agree). Likert scale was used in this study due to its high applicability in collecting data on individual difference estimates such as people's attitudes, opinions, and perceptions (Nemoto & Beglar, 2014). More so, it provides a wide range of categories from which consumers can choose thereby increasing data reliability. Questions on perceived healthiness and safety were adopted with modifications from Petrescu et al., (2020). The modifications were made to focus the direction of questions to health drinks as described in subsection 3.4.6.

3.4.5 Assessment of the effect of nutritional and health claims on the intention to consume health drinks

The study applied individual face-to-face interviews using a field experiment approach adopted from Mazis & Raymond (1997). A field experiment was employed in this study due to its effectiveness in analyzing causal relationships (Gerber & Green, 2011). The experiment employed two simulated food labels and media advertisements, created by a qualified graphics designer. The labels and advertisements contained two types of claims adopted from Rebouças et al., (2019) and Franco-Arellano et al., (2020). Nutrient content claims used in the study included; 'High in Vitamin C', 'Has no added sugars', 'High in Vitamin A', and 'Has lots of potassium and Zinc'. Health claims used in the study included; 'Detoxifies the body', 'Treats high blood pressure and diabetes', 'Improves immunity', and 'Delays aging'. The food labels and advertisements were simulated in two sets such that each set of food label and corresponding advertisement had the same type of claim. Fictious brands were used

to prevent respondent bias due to brand loyalty. Labels were designed in English while advertisements were simulated in both English and Runyankole following observations from the local market.

3.4.6 Study instrument

A consumer questionnaire comprising of five sections was used. The first section consisted of questions assessing demographic factors, which included age, gender, education level, income level, marital status, and employment status. The second section comprised of questions on the level of consumption of health drinks, commonly consumed health drink brands, and consumption behaviors. These were majorly dichotomous, single-choice, and multi-choice questions. The third and fourth sections involved questions on perceived healthiness and perceived safety respectively. Questions in these sections were designed in form of statements based on 5-point scale responses. Respondents were presented with statements like “Health drinks reduce the risk to certain diseases.” Responses were assessed using a 5-point scale ranging from 1= strongly disagree to 5= strongly agree. Concerning perceived safety, respondents were presented with statements such as “Health drinks are manufactured in safe environments”, which were also assessed with 5 answer options (1= strongly disagree. 5= strongly agree). The fifth section involved questions on nutritional health claims and their effect on consumption. These questions were also based on a 5-point Likert scale. Questions asked included; “How likely are you to consume this drink after hearing this advertisement?” Likert scale responses ranging from very unlikely (=1) to very much likely (=5) were used. Prior to data collection, the questionnaire was pretested among 20 adults in Kazo district to improve its reliability. Kazo district was chosen because it presented homogenous characteristics as those of the respondents in the study. The test-retest strategy was used to standardize the tool and enhance its reliability and validity. The

reliability of Likert scale questions was confirmed using reliability tests, which showed Cronbach's alpha (α) values above 0.6.

3.4.7 Data collection

Data collection involved face-to-face interviews with respondents. Prior to data collection, the research team was trained to ensure accurate participant recruitment and data collection. The research team comprised of individuals fluent in Runyankole, the predominant local language of the study area, to enable comprehensive explanation of survey questions to respondents for accurate responses. The trained research assistants interacted with respondents in their respective locations. The study objectives and procedures were explained to respondents and consent forms presented. Only those who consented to the study were interviewed. For the field experiment, each respondent was given an imaginary market experience of health drinks with the simulated labels and advertisements. Respondents were first presented with food labels and asked corresponding questions. The process was then repeated with pre-recorded advertisements. Upon completion of the survey, preliminary data analysis was done to attain the six most commonly consumed health drinks. These were transported to the laboratory for analysis. Laboratory analysis was done following the methods explained in subsection 3.3.

3.5 Data Analysis

Data analysis was conducted using Statistical Package for Social Scientists (SPSS) version 22. Prior to data analysis, data cleaning was performed to enhance the quality of data. For the antioxidant potential of health drinks, descriptive statistics in form of means and standard deviations were used to summarize data on vitamin C, total phenolic content, and total antioxidant activity of the beverage samples while percentages and graphs were used to depict the contribution of different beverages to the recommended intake levels. One-way

analysis of variance (one-way ANOVA) was used to compare vitamin C, total phenolic content and total antioxidant activities of the different samples. ANOVA was used for analysis because it enables the comparison of three or more independent groups of data. Pearson correlation analysis was conducted to determine the correlation between vitamin C, total phenolic content and total antioxidant activity.

With regard to consumer perceptions of healthiness and safety of the health drinks, Factor analyses and reliability analyses were conducted to ascertain the consistency and reliability of statements on beverage healthiness and safety. Descriptive statistics were used to analyze consumer opinions on the different statements measuring perceived healthiness and safety. Based on the normality tests, perceived healthiness and safety scores did not meet the requirements of normal distribution. Hence, ordinal logistic regression was used to analyze predictor factors of perceived safety and healthiness, given its wide use in consumer studies with non-normally distributed data (Zhao et al., 2020).

With regard to the effect of nutrition and health claims on intention to consume health drinks, descriptive statistics were used to summarize data on the likelihood of consumption of health drinks in the sample population. A paired sample t-test was used to compare the influence of claims on food labels and claims in media advertisements on intention to consume health drinks. Similarly, a paired t-test was also used to compare the influence of nutrition-related claims and health-related claims on intention to consume health drinks. Paired t-test was used in this analysis owing to its high reliability in comparing two groups of data from the same population. Finally, cluster analysis was used to analyze correlations between exposure to nutritional health claims and intention to consume health drinks while ordinal logistic regression was used to analyze factors that influenced consumption intentions. In all situations, a 5% ($p \leq 0.05$) level of statistical significance was used.

3.6 Ethical Considerations

Ethical approval was obtained from the Gulu University Research Ethics Committee (GUREC-2022-219). Permission to carry out research in Sheema district and Mbarara City was obtained from the Chief Administrative Officer of the district and the Mayor of the City respectively (see Appendix A). Respondents were fully informed of the purpose of the study and the information required from them before being interviewed. Only those who consented to the request for information were interviewed. In addition, the anonymity of respondents was observed as the questionnaires did not have any questions on identification. Furthermore, COVID-19 protection procedures were observed during data collection through wearing of masks and social distancing.

3.7 Limitations of the Study

Primarily, the study focused on health drinks, that is, packaged beverages processed from the infusion of water with fruits, vegetables, nuts, seeds, herbs, and other plant materials. As such, the study did not consider other categories of non-carbonated or carbonated soft drinks. In addition, the study focused on on only adults aged 18 years and above, from Mbarara and Sheema district, with knowledge of health drinks. As such, there was no consideration of children and adolescents in the study area, populations from other regions of the country, or populations with no knowledge about health drinks. Further, the study only focused on the analysis of Vitamin C, total phenolic content, and total antioxidant activity of the six commonly consumed health drinks in the region, without considering other quality parameters of health importance or common health drinks in other regions of the country. More so, the study utilized a cross-sectional survey to assess consumer perceptions. As such, changes in perceptions over time were not assessed.

CHAPTER FOUR: RESULTS

4.1. Socio-demographic characteristics of the study participants

Majority of the study participants comprised of men (54.7%) from Sheema district, aged 26-35 years (Table 3). There was a significant difference in the education levels of study participants between the two study areas, as most respondents in Mbarara City (23.7%) had attained tertiary education as compared to those in Sheema district ($p<0.05$). Similarly, household size also significantly varied between the two districts, with respondents in Mbarara City mostly having small households (1-3 people) compared to those in Sheema district who mostly had large households (6 or more people). Almost two-thirds of the population was married, with a monthly household income range of 100,000- 500,000 UGX. Comparatively, there were twice as many respondents with higher monthly household incomes (>500,000 UGX) in Mbarara City (11.5%) as those in Sheema district (5.4%).

Over three-quarters of the respondents had ever consumed health drinks. In addition, a weekly consumption frequency was observed among the respondents since over two-thirds of them consumed health drinks at least once a week. Furthermore, almost two-thirds of the respondents had consumed health drinks for 1-2 years. Comparatively, there were twice as many respondents had consumed health drinks in the period of 1-2 years as those who had consumed health drinks in less than a year. More so, the percentage of respondents who had consumed health drinks within a period of two years (87.9%) was seven times higher than that of those who had consumed health drinks for more than two years (12.1%). Nonetheless, there were no significant differences between the two locations (Mbarara city and Sheema district), with respect to the consumption aspects investigated.

Table 3: Socio-demographic characteristics of respondents segregated by location

		Mbarara City (%)	Sheema District (%)	Total (%)	p-value
Gender	Male	27.0	27.7	54.7	
	Female	21.9	23.4	45.3	
Age	18- 25 years	14.7	12.2	26.9	
	26-35	18.7	19.1	37.8	
	>35 years	15.5	19.8	35.3	
Education level	Lower education	9.0	15.1	24.1	**
	Secondary level	16.2	24.5	40.7	
	Higher education	23.7	11.5	35.3	
Occupation	Unemployed	12.2	11.5	23.7	
	Self-employed	27.3	33.1	60.4	
	Employed	9.4	6.5	15.8	
Marital status	Single	21.2	12.6	33.8	**
	Married	24.5	35.6	65.5	
	Divorced	3.2	2.9	6.1	
Monthly household income	<100,000UGX	9.4	8.6	18	**
	100,000- 500,000	28.1	37.0	65.1	
	>500,000	11.5	5.4	16.9	
Household size	Small household	18.7	14.8	33.5	**
	Average household	18	16.5	34.5	
	Large household	12.2	19.8	32	
Consumption status	Consumers	40.3	37.4	77.7	
	Non-consumers	8.6	13.7	22.3	
Frequency of consumption	Everyday	7.9	10.6	18.5	
	A few times a week	16.7	14.8	31.5	
	Once a week	11.6	9.7	21.3	
	<once a week	15.7	13.0	28.7	
Duration of consumption	<1 year	13.9	10.6	24.5	
	1-2 years	32.9	30.1	63.0	
	>2 years	5.1	7.4	12.5	

** Represents 5% level of significance; Lower education level comprises of primary and no formal education levels; small household size =1-3 people; average household size= 4-5 people; large household size= 6 or more people; n= 278; Consumers include individuals who had previously consumed health drinks; Non-consumers include individuals who had never consumed health drinks

4.2 Antioxidant potential of health drinks selected from Southwestern Uganda

Results of the antioxidant potential of the six health drinks examined in terms of vitamin C, total phenolic content (TPC) and total antioxidant activity (TAA) are presented in Table 4. Results show that the vitamin C levels of the samples ranged from 14.19 to 25.12 mg/100ml

with a mean value of 20.25mg/100ml. In terms of beverage type, the ginger-based and beetroot-based beverages contained the highest and lowest vitamin C levels respectively. The total phenolic content of beverages ranged from 0.37±0.04 to 146.01±7.91 mg/100ml with a mean of 73.38mg/100ml while the total antioxidant activities ranged from IC50 values of 35.48 to 2491.8 µg/ml with an average of 456.97 µg/ml. The total antioxidant activities and total phenolic contents of the different beverages were all significantly different ($p<0.05$), with the aloe vera-based beverage having the highest total phenolic content. Additionally, the aloe vera-based drink had the highest antioxidant activity (35.48±0.26 µg/ml) while the pineapple-based drink had the lowest antioxidant activity (2491.8±0.10 µg/ml).

Table 4: Antioxidant contents and activities of dominant health drinks consumed in Southwestern Uganda

Sample code	Beverage	Vitamin C (mg/100ml)	TPC (mg GAE/100ml)	TAA (IC50 µg/ml)
HD01	Mushroom based drink	21.84±1.89^{a,c}	114.23±0.58^{a}	41.89±0.42^{a}
HD02	Ginger based drink	25.12±1.89^{a,b}	94.78±0.17^{b}	51.37±0.16^{b}
HD03	Aloe vera-based drink	19.66±0.00^{c}	146.01±7.91^{c}	35.48±0.26^{c}
HD04	Tamarind based drink	20.75±1.89^{a,c}	56.95±0.38^{d}	44.50±0.31^{d}
HD05	Beetroot based drink	14.19±1.89^{d}	27.91±2.16^{e}	76.76±0.063^{e}
HD06	Pineapple based drink	21.11±1.66^{a,c}	0.37±0.04^{f}	2491.8±0.10^{f}

TPC, Total phenolic content; TAA, Total antioxidant activity; GAE, Gallic acid equivalents; IC50, amount of sample that inhibits 50% of 2,2 diphenylpicrylhydrazil (DPPH) reagent. The lower the IC50 value, the higher the antioxidant activity; Values for each measurement are expressed in terms of means and standard deviations; means with different superscript letters in the same column are significantly different ($p>0.05$)

In order to gain a deeper appreciation of the antioxidant potential of the health drinks, a comparison was made between antioxidant activities of the health drinks and that of the dominant ingredient in each beverage (mushroom, ginger, aloe-vera, tamarind, beetroot and pineapple). The results (Table 5) indicate that the total antioxidant activities of health drinks were significantly different from that of the dominant ingredient for each beverage type ($p<0.05$). Specifically, all health drinks had significantly lower IC50 values compared to their dominant ingredients (Higher antioxidant activity compared to their respective ingredients).

However, a comparison with standard ascorbic acid (IC50= 11.99 µg/ml) found that all health drink samples had significantly lower antioxidant activities than standard ascorbic acid.

Table 5: Comparison of the antioxidant activities of the dominant health drinks consumed in Southwestern Uganda with that of the primary ingredients of the products

Beverage	TAA of beverage (IC50 µg/ml)	TAA of natural ingredient (IC50/(µg/ml))
Mushroom-based drink	41.89**	1060
Ginger-based drink	51.37**	250
Aloe vera-based drink	35.48**	86
Tamarind-based drink	44.50**	5340
Beetroot-based drink	76.76**	1760
Pineapple-based drink	2491.8**	2900

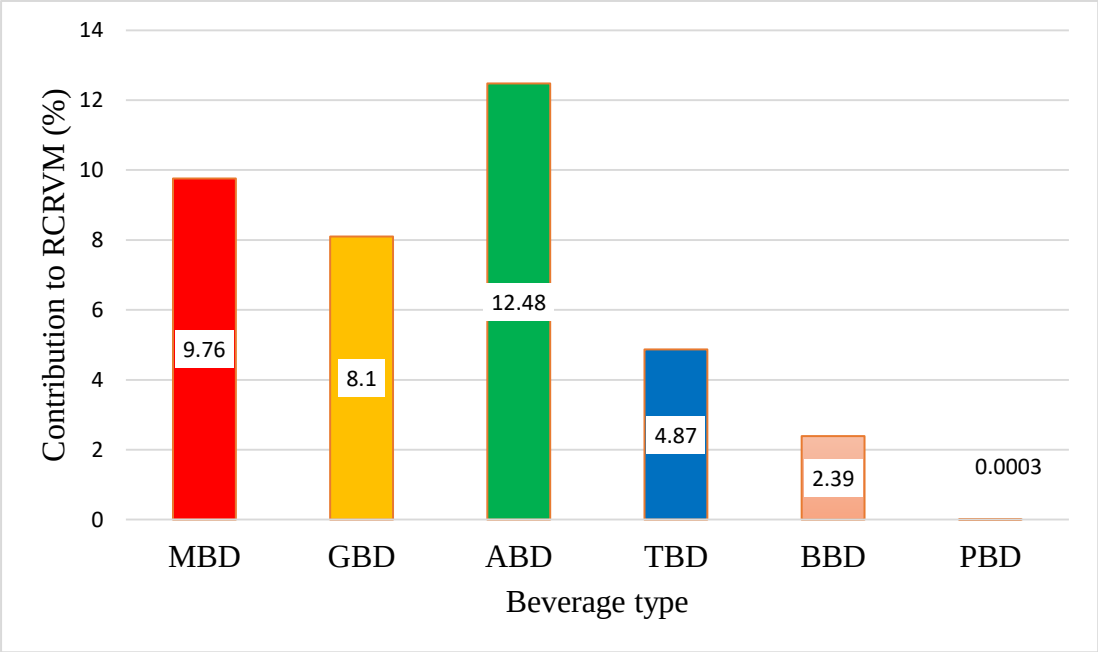
TAA: Total antioxidant activity. Lower IC50 values indicate higher antioxidant activities; ** indicates 5% significance; TAA for the respective natural ingredients from past studies acted as the reference values; Mushroom (Erbiai et al., 2021); Ginger (Alam et al., 2020); Aloe vera (Hęś et al., 2019); Tamarind (Fagbemi et al., 2022); Beetroot (Djenidi et al., 2020); Pineapple (Jovanović et al., 2018).

In a bid to provide insight into the contribution of health drinks to the intake of antioxidants, Table 6 and Figure 3 provide results on the contribution of health drinks to the recommended intakes of vitamin C and total phenolics, respectively. With respect to vitamin C, results (Table 6) show that health drinks contributed up to 33.49% and 27.91% of the recommended vitamin C intake among women and men, respectively. Based on the product type, the ginger-based beverage had the highest contribution to the recommended intake of the vitamin for both men and women while the beetroot-based beverage had the least contribution. In the case of total phenolics, the results were based on the contribution of the beverages to the recommended intake level of 1170 mg/day for the reduction of cardiovascular risk events and mortality (Figure 3). Overall, the aloe vera-based product had the highest contribution at 12.48% followed by the mushroom-based product, which contributed about a tenth to the recommended intake level of polyphenols.

Table 6: Contribution of various types of health drinks to the recommended dietary intake level for Vitamin C segregated by gender

		Percentage contribution	
Sample	**Vitamin C content (mg/100ml)**	**Women (RDI=75 mg/day)**	**Men (RDI=90 mg/day)**
Mushroom-based drink	21.84	29.12	24.27
Ginger-based drink	25.12	33.49	27.91
Aloe vera-based drink	19.66	26.21	21.84
Tamarind-based drink	20.75	27.67	23.06
Beetroot-based drink	14.19	18.92	15.77
Pineapple-based drink	21.11	28.15	23.46

RDI: Recommended dietary intake, RDI for women= 75mg/day, men= 90mg/day (Kazmierczak-Baranska et al., 2020)



MBD: Mushroom-based drink; GBD: Ginger-based drink; ABD: Aloe vera-based drink; TBD: Tamarind-based drink; PBD: Pineapple-based drink; RCRVM: Recommended level of intake (1170mg/day) to reduce cardiovascular risk events and mortality (Ruiz-torralba et al., 2018)

Figure 3: Contribution (%) of dominant health drinks consumed in Southwestern Uganda to the polyphenol intake level (1170mg/day) for reduction of cardiovascular disease risk and mortality

4.3. Consumer perceptions of the healthiness and safety of health drinks

With respect to healthiness, a factor analysis of eleven statements resulted in the loading of items on one component. Testing for sampling adequacy and internal consistency led to the deletion of 3 items leaving 8 items with a high Kaiser-Meyer Olkin index (KMO) of 0.897, a

significant Bartlett's measure of sphericity ($p<0.05$), and a high internal reliability ($\alpha=0.898$). As presented in Table 7, the mean score of perceived healthiness was 3.87 out of 5, or 77.4% when expressed as a percentage. Over 63% (177 out of 278) of the study participants had their mean scores of perceived healthiness above the overall mean score. Overall, Respondents believed that the beverages were generally healthy for consumption (4.06±0.887) and had more health benefits compared to carbonated beverages (4.04±0.966). Particularly, participants highly believed that health drinks could reduce the risk of certain diseases (4.11±0.944) and even cure some diseases (3.88±1.064). However, respondents had low perceptions of health drinks having many vitamins. A more detailed analysis showed that over 27.7% of the respondents neither agreed nor disagreed with the question of health drinks having many nutrients.

Table 7: Consumer perceptions of the healthiness of non-carbonated health drinks

Statements	Mean	Std. Dev.	Factor loadings
Health drinks can reduce the risk of certain diseases	4.11	0.944	0.761
Health drinks can cure certain diseases	3.88	1.064	0.735
Health drinks have more health benefits than carbonated beverages	4.04	0.966	0.784
Health drinks have a lot of nutrients	3.69	1.004	0.734
Health drinks give energy	3.77	1.163	0.727
Health drinks have a lot of vitamins	3.61	1.002	0.801
Health drinks improve immunity	3.79	0.929	0.847
Non-carbonated beverages are healthy for drinking	4.06	0.887	0.746
Overall perceived healthiness	**3.87**	**0.762**	

Percentage variance explained= 58.973, KMO value= 0.897, $\alpha=0.898$.

With regard to safety, a factor analysis of ten statements analyzing related consumer perceptions yielded two components. Two statements were removed due to cross-loading leaving 8 statements with a high composite KMO of 0.819 and a significant Bartlett's measure of sphericity ($p=0.000$). Factors in the different components were then analyzed independently and were found to have KMO values above 0.618 and internal reliability above

0.713 as presented in Table 8. The first component comprised of statements highly related to constituents external to the beverage itself namely- labels, information on the beverage, and verification by the government. Thus, this component was labeled "Extrinsic" perceptions of safety (EPS). Statements in the second component related more to the internal constituents of the beverage such as ingredients and were therefore labeled as "Intrinsic" perceptions of safety (IPS)

Table 8: Consumer perceptions of the safety of health drinks

Statements	Factor 1	Factor 2	Mean	Std. Dev.
Health drinks have no added chemicals	0.478		2.78	1.392
Information given on health drinks is enough to judge their safety	0.736		3.29	1.305
Health drinks are safe because they have labels	0.783		3.32	1.250
Health drinks are safe because they are produced in Uganda	0.736		3.07	1.247
All health drinks on the market are verified by the government	0.823		3.04	1.356
Health drinks are safe for consumption		0.860	3.76	1.075
Health drinks are safe because they are natural products		0.869	3.81	1.000
Health drinks take long to expire		0.580	3.40	1.253
KMO value for each factor	0.813	0.618		
Cronbach's alpha for each factor	0.798	0.713		
Percentage variance explained (60.80%)	43.94	16.86		
Mean perception of safety under each factor	3.10±0.975	3.66±0.888		
Overall perception of product safety			**3.31**	**0.817**

The overall mean perception of the safety of health drinks was 3.31 on a 5-point Likert scale or 66.2% when expressed as a percentage. Out of the 278 participants who undertook the study, 143 (55.4%) had their mean scores of perceived safety above the overall mean score. Considering the extrinsic perceptions of safety (Factor 1), respondents moderately believed that health drinks were safe owing to the presence of labels (3.32±1.250). Additionally, respondents also believed in the sufficiency of information as a tool in judging the safety of health drinks (3.29±1.305). However, respondents did not believe that health drinks had no added chemicals (2.78±1.392). In addition, compared to the overall mean score, respondents also had a lower conviction that the government verified all health drinks on the market.

Considering the intrinsic perceptions on safety, respondents highly believed that health drinks were safe owing to their manufacture from natural ingredients.

4.3.1. Factors that influence perceived healthiness and safety of health drinks

Results of ordinal logistic regression used to determine the factors that influence the healthiness and safety of health drinks segregated by consumer category are presented in Table 9 and 10, respectively. With regard to healthiness, perceptions were influenced by numerous product and consumer characteristics (table 9). In general, product health benefits, safety, and information positively influenced perceived healthiness ($p<0.05$). Specifically, product health benefits, information, and safety increased perceived healthiness by a factor of 0.714, 0.854, and 0.714, respectively. Considering socio-demographic characteristics, only consumption status had a significant influence on perceived healthiness. A comparison of predictors of perceived healthiness among consumers (individuals who had previously consumed health drinks) and non-consumers (individuals who had never consumed health drinks) showed that consumer perceptions of beverage healthiness were positively influenced by product safety and household size while marital status had a significant negative influence ($p<0.05$). On the other hand, only product health benefits had a significant and positive influence on perceptions of beverage healthiness among non-consumers.

Table 9: Factors that influence perceptions of healthiness of non-carbonated health drinks segregated by consumption status

	Total		Consumers		Non-consumers	
Predictor	**B**	**p-value**	**B**	**p-value**	**B**	**p-value**
Health benefits	0.714	0.016**	0.426	0.262	1.608	0.004**
Taste	0.384	0.227	0.386	0.237	0	Na
Color	-2.268	0.060	-2.306	0.053	0	Na
Product safety	0.714	0.032**	0.772	0.023**	0	Na
Information	0.854	0.017**	0.647	0.102	1.816	0.075
Gender	-0.200	0.435	-0.439	0.152	-0.064	0.904
Household income	0.351	0.305	0.562	0.199	-0.058	0.922
Education level	-0.473	0.088	-0.387	0.244	-0.240	0.668
Marital status	-0.379	0.136	-0.603	0.048**	0.251	0.659
Household size	0.389	0.144	0.629	0.043**	-0.666	0.300
Consumption status	2.115	0.000**				

Total population Cox& Snell=0.269; Nagelkerke=0.300; Consumers Cox& Snell=0.108, Nagelkerke=0.127; Non-consumers Cox & Snell=0.222, Nagelkerke= 0.241; B=coefficient; **shows 5% level of significance; Na depicts not applicable (none of the non-consumers considered taste, color, and product safety as a factor when choosing health drinks)

With respect to safety (table 10), the presence of regulatory logos on the product, organoleptic cues (taste/smell), and perceived healthiness increased the odds of perceived safety by 0.953, 0.688, and 1.292, respectively ($p<0.05$). In terms of gender, being male had 0.876 higher odds of increasing perceptions of beverage safety than being female. Similarly, compared to youth, being older had 0.786 higher odds of increasing perceived safety. On the other hand, high household income negatively influenced perceived safety ($p<0.05$). A comparison of predictors of perceived safety among consumers and non-consumers showed that consumer perceptions of beverage safety were positively influenced by expiry date, regulatory label, gender, age, and perceived healthiness ($p<0.05$) while high household income ($p=0.008$) had a negative influence. Among non-consumers, product labels ($p=0.046$) negatively influenced perceived safety while perceived healthiness had a significant positive influence ($p=0.000$).

Table 10: Predictors of perceived safety of health drinks segregated by consumption status

	Total		Consumers		Non-consumers	
Predictor	**B**	**p-value**	**B**	**p-value**	**B**	**p-value**
Product label	-0.288	0.442	0.408	0.368	-1.758	0.046**
Expiry date	0.333	0.411	0.959	0.048**	0.931	0.316
Regulatory logo	0.953	0.004**	0.975	0.011**	1.112	0.147
Brand	0.415	0.265	-0.007	0.988	1.101	0.205
Smell/taste	0.688	0.023**	0.671	0.056	0.834	0.277
Perceived healthiness	1.292	0.000**	1.141	0.000**	2.115	0.000**
Gender	0.876	0.000**	0.823	0.004**	0.443	0.501
Age	0.786	0.006**	0.872	0.007**	-1.067	0.237
Household income	-0.896	0.011**	-1.145	0.008**	-0.564	0.433
Marital status	-0.279	0.328	-0.203	0.527	0.246	0.729
Consumption status	1.181	0.001**				

Total population Cox & Snell=0.404, Nagelkerke=0.439; Consumers Cox & Snell=0.262, Nagelkerke=0.291; Non-consumers Cox & Snell=0.508, Nagelkerke=0.567; B= coefficient; **shows 5% significance

Further comparison of perceived safety and perceived healthiness among consumers and non-consumers was conducted based on area of residence. Results are presented in Figure 4. Generally, perceptions of product safety were predominantly positive among consumers and negative among non-consumers irrespective of location. On the other hand, non-consumers in Sheema district (53.2%) had more negative perceptions of beverage safety than those in Mbarara (33.9%). With regard to perceived healthiness, consumers generally had more positive than negative perceptions of product healthiness regardless of location. However, among non-consumers, respondents in Sheema district had more positive (35.5%) than negative (25.8%) perceived healthiness, while the reverse was true for non-consumers in Mbarara City (positive perception:11%, negative perceptions 27%). Overall, consumers in both districts had more positive perceptions of beverage healthiness than beverage safety.

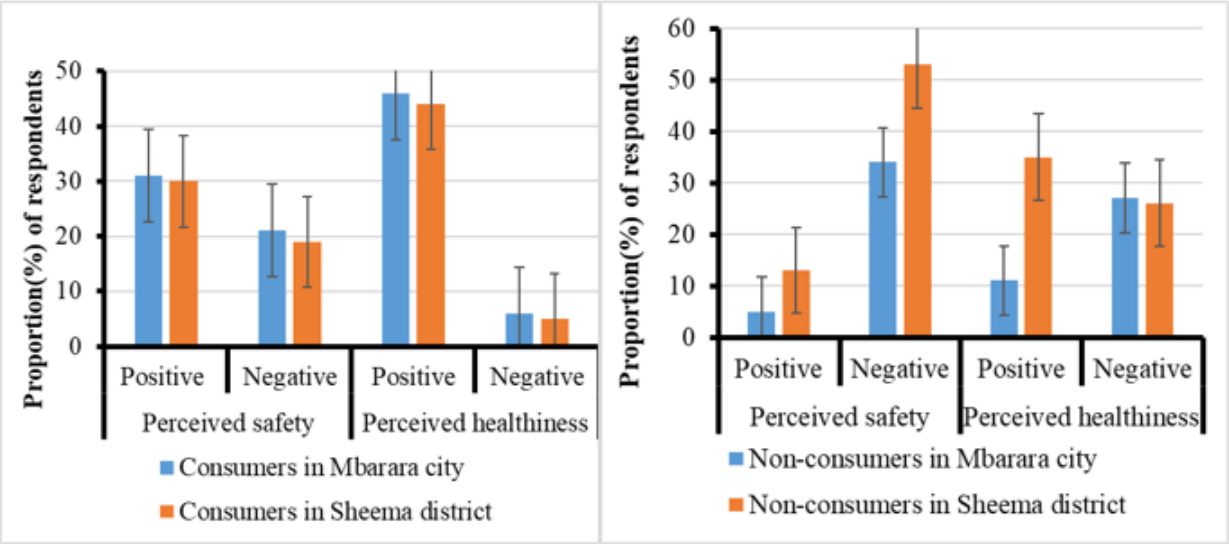


Figure 4: Status of perceived healthiness and safety of health drinks segregated by consumption status and area of residence

4.4. Effect of nutritional health claims on intention to consume health drinks

Results showing the proportion of respondents that expressed intention to consume health drinks based on various claim dimensions are presented in Table 11. Overall, the claims motivated about half the respondents to consume health drinks. In addition, the claims motivated almost 30% of individuals who had never taken health drinks (non-consumers) to consume these beverages. Nonetheless, nutritional health claims influenced more consumption intentions among consumer respondents (55.1%) than non-consumers (29.0%). Nutrient claims delivered through media advertisements had the highest influence on consumption intentions as they motivated 51.4% of the sample population to consume health drinks. While both In terms of consumption status, consumers were mostly motivated by nutrient claims in media advertisements (59.8%) while non-consumers were mostly motivated by nutrient claims delivered through labels (40.3%).

Table 11: Effect of nutritional health claims on intention to consume health drinks

	Proportion (%) of respondents that expressed intention to consume		
Claim dimension	**Total**	**Consumers**	**Non-consumers**
Nutrient claims on a label	50.0	52.8	40.3
Health claims on a label	43.2	47.7	27.4
Nutrient claims in media advertisements	51.4	59.8	24.2
Health claims in media advertisements	44.2	50.9	21.0
Overall likelihood of consumption	**49.3**	**55.1**	**29.0**

Percentages represent participants with a positive likelihood of consumption (4-likely and 5- Extremely likely)

Further analysis was conducted to explore the effect of various claim dimensions (claim type, claim source) on consumption intentions of consumers and non-consumers of health drinks. Results are presented in Table 12. With regard to claim type, nutrient claims had a significantly higher influence on intention to consume health drinks than health claims ($p<0.05$) among both consumers and non-consumers. With respect to claim source, claims delivered through media advertisements had a significantly higher influence on intention to consume than claims on food labels among consumers only ($p=0.019$).

Table 12: Influence of various claim dimensions (claim type and claim source) on intention to consume health drinks segregated by consumption status

	Claim type		**Claim source**	
	Health claims	Nutrient claim	Food label	Media advertisement
Consumers	3.29 ± 0.991^{a}	3.43 ± 0.892^{b}	3.28 ± 1.029^{a}	3.44 ± 0.985^{b}
Non-consumers	2.73 ± 0.948^{a}	2.98 ± 0.781^{b}	2.91 ± 0.921^{a}	2.79 ± 0.894^{a}

Values show Mean± SD (n=278); For each claim dimension, means with different subscripts in the same row are statistically different at $p<0.05$

Results of the assessment of whether frequency of exposure to the nutritional health claims had an effect on intention to consume health drinks are presented in Figure 5. Overall, the influence of frequency of exposure was dependent on the claim source. Claims on labels and those in media advertisements had opposite effects. With regard to media advertisements, an increasing trend in consumption intentions with increased frequency of exposure to the

claims was observed. On the other hand, increased exposure to claims on food labels correlated with decreased intentions to consume health drinks.

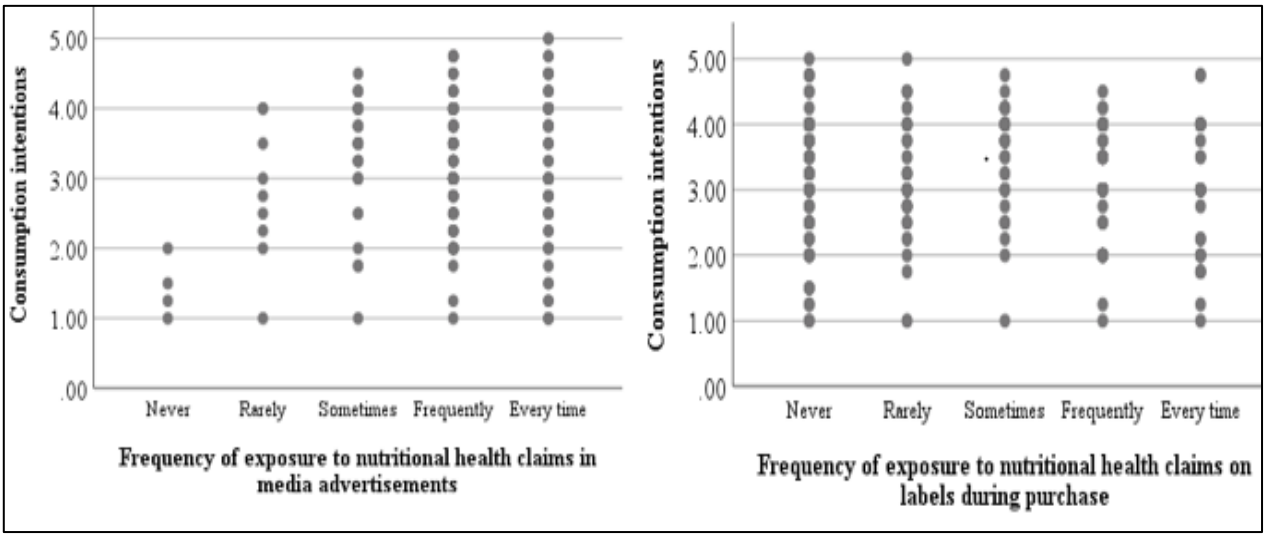


Figure 5: Influence of frequency of exposure to nutritional health claims on intention to consume health drinks

In a bid to gain deeper understanding into other factors (besides nutritional health claims) that influence intention to consume health drinks, a binary regression was conducted and results are presented in Table 13. Of the nine factors examined, only perceived healthiness and perceived safety had significant associations with consumption intentions ($p<0.05$). Particularly, a unit increase in perceived healthiness and perceived safety had the likelihood of increasing consumption intentions by a factor of 2.048 and 1.573, respectively.

Table 13: Factors that influence intention to consume health drinks

Predictor	B	S.E.	Wald	Sig.	Exp (B)
Education level (1= High education level)	-.080	.299	.071	.790	.924
Gender (1= Male)	.362	.278	1.697	.193	1.436
Age (1= Mature adulthood)	-.438	.326	1.812	.178	.645
Household income (1=High income)	.167	.396	.178	.673	1.182
Marital status (1= Married)	.548	.314	3.056	.080	1.730
Occupation (1= Employed)	.203	.350	.336	.562	1.225
Household size (1= Large household)	.411	.302	1.856	.173	1.509
Perceived safety	.717	.211	11.574	.001**	2.048
Perceived healthiness	.453	.229	3.906	.048**	1.573

Nagelkerke: 0.213; Cox &Snell: 0.160; Dependent dummy variable 0: low intention to consume; Significance at $p<0.05$.

CHAPTER FIVE: DISCUSSION

5.1. Antioxidant potential of health drinks in Southwestern Uganda

Fruits, vegetables and their products are considered primary sources of antioxidants in the human diet, therefore, WHO recommends a daily consumption of 4-5 portions of fruits and vegetables for a healthy lifestyle (Ruiz-torralba et al., 2018). Antioxidants play a fundamental role in preventing oxidative stress and its related diseases (Jideani et al., 2021). Numerous studies have underpinned the importance of antioxidants in the prevention and/or management of obesity, diabetes, cardiovascular diseases, gastrointestinal diseases, cancers, and neurodegenerative diseases (Aadil et al., 2019).

All health drink samples examined in this study contained antioxidants with varying antioxidant activities. Similar results have been reported in instant health beverages in Indonesia (Deoranto et al., 2021) and Nigerian herbal preparations (Ajima et al., 2020). The significant difference in the antioxidant activities of the different beverages could be due to variations in the type of ingredients used to make the beverages. Previous studies have shown that antioxidants in plant ingredients vary according to the plant type, morphology of different plant parts, and conditions in which the plant grows namely- climate and soil type (Flieger et al., 2021). In addition, variations in the antioxidant levels may also be attributed to differences in the formulations used. Numerous studies on product development have depicted the influence of various beverage formulations on the amount of antioxidants and subsequent antioxidant activity of the beverage (Natukunda et al., 2016). Furthermore, variations in the level of processing and type of processing method may also have had an effect on the final amount of antioxidants in the beverages, as studies show that different processing methods may increase or reduce the amount of antioxidants in the final product (Nayak et al., 2015).

In this study, antioxidant activity was in terms of IC50 values. Owing to the fact that 1C50 indicates the amount of sample that inhibits 50% of the DPPH solution; lower IC50 values indicate higher antioxidant activities. Hence, all health drinks in this study had higher antioxidant activities than their respective primary ingredients given their significantly lower IC50 values. These findings are supported by Finimundy et al., (2020) who found that herbal blends made with numerous ingredients exhibited higher antioxidant activities than their controls. Pyrzynska & Sentkowska (2019) explained that the use of multiple ingredients in herbal beverages has a synergistic effect on the total antioxidant capacity of the beverages. This context may apply to this study as all beverage samples except the pineapple-based drink contained other antioxidant rich ingredients in addition to their primary ingredients. A case in point is the aloe vera-based drink that contained lemon, green tea, and cactus in addition to aloe vera. Inevitably, the above explanation also accounts for the low antioxidant activity of the pineapple-based beverage.

Polyphenols are considered to be primary antioxidants (Zeb, 2020), and the biggest contributor to the total antioxidant activity of plant extracts and related products. This study also reports a significant correlation between total phenolic content and total antioxidant activity of the sample beverages ($r= -0.659$, $p=0.003$). The mean phenolic content of beverages in this study (73.38mg/100ml) is higher than that obtained by Nowak & Gośliński (2020) in both classic and fruit energy drinks. In addition, the phenolic contents of health drink samples were all significantly different depending on their ingredients (aloe vera> mushroom> ginger> tamarind> beetroot> pineapple-based drink). Different fruits, vegetables and herbs contain varying types and amounts of polyphenols (Ellong et al., 2015), which in turn affects the total phenolic content of their products. However, the lack of stability of phenolic compounds under different processing factors such as temperature and enzyme activity leads to subsequent changes, particularly, reduction during food processing and

storage (Nayak et al., 2015). This may account for why the aloevera, ginger, and pineapple-based beverages contained lower phenolic contents than their respective natural plant ingredients, that is, aloe vera (López et al., 2013), fresh ginger (Ozola et al., 2019), and pineapple fruit (Samreen et al., 2020).

Generally, individuals are advised to consume phenolic-rich foods given their proven effectiveness against numerous diseases especially non-communicable diseases (Koch, 2019). However, recommended daily dietary intakes of polyphenols have not been established. A review study by Ruiz-torralba et al., (2018) recommended a polyphenol intake of 1170mg/day for the prevention of cardiovascular disease risk factors and mortality. Considering this recommended polyphenol intake as a standard, this research found that 100ml health drink samples in this study can contribute as much as 12.48% of the overall recommended intake depending on the ingredients/type of beverage. This suggests that a 320ml bottle of the aloe vera-based drink can contribute over 40% while a liter of the beverage can contribute over 100% of the recommended daily polyphenol intake.

All health drinks analyzed in this study contained vitamin C. The mean vitamin C content of health drinks in this study is higher than that reported in Macedonian non-carbonated soft drinks (Babanovska-Milenkovska et al., 2018), and indigenous Nigerian drinks (Oboh & Okhai, 2012). Interestingly, the vitamin C levels of health drinks in this study are similar to those of ready-made juices from markets but much lower than those of freshly squeezed juices, as reported by (Ağagündüz et al., 2020). This difference could be due to the effect of storage on vitamin C. Numerous storage factors such as light and heat affect the amount of vitamin C in foods, causing its subsequent degradation with increased storage time (Spínola et al., 2014).

The vitamin C levels of beverage samples contrasted with the Vitamin C content of their respective natural ingredients. Comparisons with previous studies showed that fresh ginger (Abara et al., 2021), mushroom (Stadlmayr et al., 2013), and tamarind fruits (Dilfy et al., 2020) had lower vitamin C levels compared to their respective products in this study. The increased ascorbic acid content in the beverage samples may be attributed to the synergistic effect of other ingredients in the beverages. A case in point is the ginger-based drink which contains rosemary, honey, and mondai whitei (mulondo) in addition to ginger. Conversely, the vitamin C content of the pineapple-based drink was considerably low compared to that of pineapple fruit as reported by Ellong et al., (2015). This difference may be attributed to the degrading effect of processing on vitamin C. Moreover, the beverage only contained eucalyptus oil as the other ingredient, thereby lacking the synergistic contribution of other ascorbic acid-rich ingredients as observed in other beverages.

Owing to the fundamental role of vitamin C in nutrition and health, numerous intake recommendations have been made across countries and at global level. According to Uganda Standard *FDUS EAS 797: 2013, Vitamin and mineral food supplements-Requirements*, Uganda recommends a vitamin C intake of 45mg for adult men and women, which is below the WHO recommendation of 75 mg and 90mg for women and men respectively (Kazmierczak-Baranska et al., 2020). By way of explanation, a study by Carr & Lykkesfeldt, (2021) on discrepancies in global vitamin C recommendations noted that authorities that base their recommended daily allowance (RDA) for vitamin C on the prevention of Vitamin C deficiency retain a recommendation of 40–45 mg/d while those that have established their recommendations based on the potential for prevention of chronic disease have increased the daily Vitamin C intake recommendations to 75 mg/d for women and 90 mg/d for men. Given that the context of this study is more focused on the antioxidant potential of Vitamin C in the prevention of disease, the WHO Vitamin C intake recommendations of 75 mg/d for women

and 90 mg/d for men were considered to analyze the contribution of health drinks to daily vitamin C intake. Overall, it was noted that health drinks in this study contributed up to a third of the recommended dietary intake of vitamin C depending on the type of beverage. This implies that on average, consumption of 300ml of the beverage may contribute up to 99% of the recommended intake of vitamin C.

5.2 Consumer perceptions of the healthiness and safety of health drinks

Consumer health perceptions vary for different food products. In the context of this study, perceptions of beverage healthiness were highly positive. Consumers in this study had more positive perceptions of the healthiness of non-carbonated beverages than American consumers, who were reported to have a mean perceived healthiness of 51% (Mean= 4.45 on a 9-point scale) (Hyeyoung & House 2014). A study by Thomson et al., (2017) in five Asian countries reported consumer health perceptions for energy drinks and Asian fruit drinks to be at 14.7% and 44.7% respectively. Similarly, a study by Munsell et al., (2015) found that 30% of consumers considered fruit drinks healthy while health perceptions for regular and diet sodas were at 5% and 7% respectively. This indicates that non-carbonated beverages in Southwestern Uganda are perceived to be healthier than both carbonated and non-carbonated beverages in other localities and may explain why the respondents in this study highly believed in health drinks reducing the risk and/or treating certain diseases. Overall, over 75% of respondents used health drinks to treat over twenty kinds of illnesses ranging from common infections like cough and flu, and infectious diseases like malaria, to non-communicable diseases namely; hypertension and diabetes (see appendix E). These findings concur with other studies on medicinal plants. A study by Kamukama et al., (2014) in the same region reported that over 90% of the sample population believed that aloe vera could cure diseases and used it for treatment of numerous ailments. Given the highly related perceptions in both studies, there is an implication that people in this region perceive non-

carbonated beverages to be as healthy as medicinal plants, which explains their high usage in the treatment of illnesses.

A number of factors that can influence perceptions of the healthiness of non-carbonated beverages (health drinks) were identified. This is not surprising because perceived healthiness cannot be considered a stand-alone construct, but an interplay of numerous precursors such as health and nutritional aspects, level of processing, naturalness and freshness, level of preservation, origin of product, place of preparation, and environmental factors (Pinto et al., 2021). In this study, product health benefits had a significant positive influence on perceived healthiness. Owing to the increase in consumer awareness of the importance of diet on health, there has been a rise in consumer demand for food products exhibiting health benefits in recent years (Asgary et al., 2018). Foods with potential health benefits are considered healthy and are largely recommended to be consumed for disease prevention (Corbo et al., 2014). A study by Karelakis et al., (2020) found that Greek consumers used functional foods to reduce the risk and/or cure health problems such as stomach upsets, low energy, and high cholesterol, a context that is also observed in this study.

A positive association between product information and perceived healthiness was observed. Similar results were reported by Benson et al., (2018) and Pinto et al., (2021). Generally, product health information is a key determinant of consumer acceptance and perceptions of healthy foods (Baker et al., 2022). However, the level to which a consumer comprehends the health information of a product depends on their knowledge level. A review by Topolska et al., (2021) found that high nutrition knowledge and education level were associated with increased perceived healthiness and the desire for products enriched with fiber and antioxidants. On the other hand, the results of this study show that high education level had a negative influence on perceived healthiness (although it was non-significant). This may explain why the respondents had a relatively low belief in health drinks containing a lot of

vitamins. Moreover, almost a third of the respondents neither agreed nor disagreed with the statement that health drinks contained vitamins, suggesting a lack of knowledge regarding the vitamin content of health drinks among consumers in Southwestern Uganda.

Comparison of predictors of perceived healthiness by consumption status revealed varying results, which indicates heterogeneity between consumers and non-consumers of health drinks. Overall, consumers were influenced by product safety, marital status, and household size while perceptions of non-consumers were only significantly influenced by product health benefits. Product safety has become a crucial factor in determining consumer perceptions of beverages today, due to increased consumer concerns regarding the safety of certain beverage ingredients such as guarana and ginseng (Corbo et al., 2014). Hence, foods that consumers associate with low safety risk are perceived as safe and healthy for consumption (Machado-Nardi et al., 2020). This may explain why product safety increased perceived healthiness among consumers in this study.

The positive influence of large household size on perceived healthiness may arise from consumers sharing beverage-related health information with other household members, which may influence their health perceptions towards the products. This explanation is supported by Kamukama et al., (2014) who noted that over 90% of the sampled population in Southwestern Uganda were likely to recommend a plant with health benefits to their families. The negative influence of marital status on perceived healthiness could be due to married individuals being more skeptical about the quality of health drinks, which in turn affects their perceptions. Previous studies show that married individuals have more financial resources and are more concerned about their diets and health than single individuals (Kim et al., 2017). Additional evidence exists to show that high prices increase consumer perceptions of product quality (Baker et al., 2022). As such, married individuals may be skeptical about the quality

of the health drinks on the market given their low cost, which in turn reduces health perceptions of this consumer category.

An overall high positive perception of the safety of health drinks was observed. This result is consistent with the findings from a previous review by Kregiel (2015) which noted that most consumers believed that packaged beverages were safe, with their quality guaranteed. Largely, consumers perceive processed and packaged products as safer than fresh, unprocessed food products and associate them with less safety concerns (Nygard & Storstad, 1998). This is because of the numerous food-borne illnesses associated with fresh/unpackaged foods (Bukachi et al., 2021). Overall, the respondents that participated in this study perceived the health drinks as natural products that are safe for consumption. By and large, consumers usually regard natural food products as those obtained from plant sources, fresh, whole or minimally processed as well as those with no/natural additives. The relevance of food naturalness in motivating consumer perceptions is reflected in the work of Petrescu et al., (2020) which showed that almost a third of consumers used freshness as an important cue to evaluate food quality while 26.2% and 5.8% used the organic label and processing level, respectively as cues to evaluate food safety. In addition, Moscato & Machin (2018) reported that consumers innately associate natural products with positive perceptions and widely seek for them. The aforementioned studies support the findings of the current research, providing credence to the effect that consumers in Southwestern Uganda consider health drinks as natural products and perceive them as safe.

It is apparent that the study respondents also believed in the safety of health drinks based on the presence of labels on the products. This concurs with the findings of Zhang et al., (2018) which showed that two-thirds of Chinese consumers used certification labels on vegetable packages to identify safe vegetables. The observation that consumer trust in product safety motivated intention to consume health drinks is also in line with findings by Zhang et al.,

(2018) that revealed the plausibility of the increased likelihood of purchase of safe vegetables if consumers trusted information on labels. Nonetheless, the fact that some respondents believed that the health drinks on the market contained added chemicals may negatively influence consumer perceptions on beverage safety considering that consumers often associate food additives with increased food safety risk (Miao et al., 2020). In the context of regulatory control, almost half the study respondents did not believe that the government verified all health drinks on the market. This finding is of significance because perceptions of food safety are primarily related to consumer trust and confidence in various actors involved in food production, marketing, and sale (Nygard & Storstad, 1998). Low consumer trust and confidence in food companies, regulatory bodies and information on food often elicits skepticisms, which evoke negative perceptions and subsequently affects purchase and consumption behaviors (Ringold, 2021). Thus, the low consumer beliefs in the verification of health drinks by government may have contributed to the observed overall level of perceived safety among the study participants.

Perceptions of beverage safety were influenced by numerous product and consumer-associated factors. In the context of products, consumer safety perceptions were positively influenced by regulatory logos. A similar result was reported by Maitiniyazi & Canavari, (2021) who noted that consumers trusted the safety of dairy products certified by the government. Nonetheless, it is worth noting that the level of influence of a regulatory logo on perceptions depends on the level of consumer trust in the regulatory body that issues the logos. It was previously shown that high consumer trust induced high safety perceptions while low consumer trust evoked low perceived safety (Machado-Nardi et al., 2020). From a sensory perspective, perceived safety was influenced by two key organoleptic attributes, that is, taste and smell. This finding is not surprising and is corroborated by the findings of

Liguori et al., (2022) which revealed substantial use of smell as a cue to determine the safety of foods in low and middle-income countries, a context that is relevant to the current study.

In the context of consumers, perceived healthiness of the beverages, gender, and age of the respondents had a positive influence on perceived safety. The positive influence of perceived healthiness on perceived safety as observed in this study is supported by Machado-Nardi et al., (2020) who adduced that healthiness of food products increases benefit perceptions and reduces perceived food safety risk, which leads consumers to consider foods they perceived as healthy to be safe. With respect to gender, a study by Osaili et al., (2021) showed that being female had a higher influence on attitudes towards food safety compared to being male, which is in contrast with the findings of the current study. In an attempt to account for the greater influence of the female gender, Osaili et al., (2021) reasoned that women being the predominant involved in food preparation and handling could be the underlying factor that influenced their perceptions towards food safety. Such an argument may have limited relevance in the current study since the products under study are packaged food products whose preparation and handling is not attributed to any gender, the observation that being male had a higher influence on perceived safety than being female may be due to another unknown reason. This is a potential subject for further research requiring a focus group discussion study to generate information to account for this observation.

With regard to age and income, Zhao et al., (2020) noted that respondents with high income and those aged 40 years and above were associated with positive food safety attitudes and behaviors, which partly coincides and contrasts with the findings of the current study. Consumers increasingly recognize the importance of food safety and healthiness as they grow older, a context that may explain why older respondents in the current study highly perceive health drinks as safe. However, the above study contrasts with this research as high income had a negative influence on perceived safety. A plausible explanation is that consumers with

high income generally have increased food safety risk concerns about the quality of low-cost foods and beverages in the market (Zhllima et al., 2015) while individuals with low income choose to trust the work of regulatory bodies to ensure food safety.

It is interesting to note that while expiry dates had a positive influence on consumer safety perceptions, food labels negatively influenced perceived safety among non-consumers in the current study. Consumers often perceive beverages to be safe before their expiry dates. A study by Petrescu et al., (2020) noted that consumers use label information on expiry dates to evaluate the quality of food products. This supports the significant influence of expiry dates on perceived safety among consumers in this study. Additionally, studies also show that food labels increase consumer trust and perceptions of food quality and safety of food products (Mirosa et al., 2021), which contrasts with the findings of this research particularly, among non-consumers. The negative influence of food labels on perceived safety among non-consumers may be explained by Ringold (2021) who noted that some information or lack thereof on food labels can raise concerns among consumers which impacts their perceptions. However, this study did not explore factors of food labeling that negatively influenced consumer safety perceptions. Overall, consumers in both Mbarara and Sheema generally perceived non-carbonated beverages as healthy and safe. On the other hand, a significant number of non-consumers in Mbarara City perceived non-carbonated beverages as both unsafe and unhealthy while those in Sheema district perceived non-carbonated beverages to be healthy but unsafe. Differences in consumer perceptions owing to the location of respondents have been reported previously by Thomson et al., (2017) and are attributed to variations in consumer characteristics, geographical and cultural differences.

5.3 Effect of nutritional health claims on intention to consume health drinks

This study reported a moderate overall effect of nutritional health claims on the intention to consume health drinks. In addition, nutritional health claims influenced consumption intentions in nearly 30% of the respondents who had never consumed health drinks. These findings indicate that nutritional health claims are efficient in creating a positive influence on the consumption of health drinks. The positive effect of nutritional health claims on consumption has been reported in other studies. A study by Hall et al., (2020) found that the claim; “100% vitamin C” highly influenced consumer health perceptions and increased their consumption interests for fruit drinks. Another study by Benson et al., (2018) reported that nutritional health claims significantly influenced portion size selection of some foods.

Previous study findings show that the influence of nutritional health claims on perceptions and consumption is dependent on the type of claim (Coleman et al., 2014). In the current study, nutrient claims had a significantly higher influence on the intention to consume health drinks than health claims. Past studies present contradictory findings. A review study by Kaur et al., (2017) noted that health claims (9.8%) evoked a higher increase in purchase intentions than nutrient claims (7.8%). On the other hand, studies by Franco-Arellano et al., (2020) and Hwang et al., (2016) found that while health claims had a higher influence on consumer perceptions, nutrient claims influenced a higher willingness to pay and yielded higher purchases of related food products. This may be because consumers trust the nutritional profile of foods with nutrient claims than health claims (Davidovic et al., 2021). As a result, Steinhauser et al., (2019) recommended food companies to use nutrient claims on food products for increased sales. Henceforth, producers and marketers of health drinks may adopt this strategy to increase sales in Southwestern Uganda.

The use of nutritional health claims has increased not only on food labels but also in media advertisements. This study found that among consumers, nutritional health claims in media advertisements had a significantly higher influence on the intention to consume health drinks than claims on food labels. In addition, the study found that increased exposure to claims in media correlated with increasing consumption intentions while claims on labels correlated with decreased intention to consume health drinks. The overall low influence of claims on food labels on intention to consume health drinks may be attributed to low usage and/or limited understanding of information on food labels (Chopera et al., 2014). This is because most food label information is presented in English (Adesina et al., 2022), and may not be easily understood by individuals with low education levels. Such may be the case in this study where only 35.3% of the respondents had attained education higher than secondary level. On the other hand, advertisements are often transcribed in local languages, which eases consumer understanding of product information, thereby justifying why claims in media advertisements had a higher influence on consumption than claims on food labels in this study.

The increasing consumption trend due to high exposure to nutritional health claims in advertisements may be explained by Sriram et al., (2021) who noted that high exposure to product advertisements increases the emotional appeal and attention that consumers attach to those products, which increases purchase behavior. Relatedly, a study by Bacardí-Gascón et al., (2013) found a link between the frequency of food advertising and consumption of advertised foods among mothers, which concurs with the findings of this study. On the other hand, the reduction in consumption trends with increased exposure to labels contradicts with findings from other studies (Mirosa et al., 2021; Benson et al., 2018). This contradiction may be attributed to consumers viewing labels with claims as misleading (Talati, et al., 2017), or being skeptical of the authenticity of the information presented on the labels (Ringold (2021).

It may also be due to increased dismissal of products with claims on labels owing to a lack of understanding of the food label information. However, this was not explored in the context of this study. Hence, there is need for future research on predictor factors for the reduction in consumption trends with increasing exposure to food labels, given its critical policy implications.

Besides nutritional health claims, perceived healthiness and safety influenced consumption intentions of health drinks in this study. The positive influence of perceived healthiness and safety on intention to consume health drinks may be explained by Chen & Antonelli (2020) who noted that perceptions influence an individual's attitude towards and preference for a given food, which subsequently influences consumption. Worth noting is that nutritional health claims influence perceptions of product healthiness (De Temmerman et al., 2021) and safety (Petrescu et al., 2020). This was also observed in this study where product information significantly influenced perceived healthiness and safety. Thus, this study indicates a bilateral relationship between nutritional health claims and consumer perceptions in this study. In addition, this study also shows that nutritional health claims influence consumer perceptions, which in turn influence the consumption of health drinks.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

The study aimed to examine non-carbonated beverages (health drinks) in Southwestern Uganda, focusing on their antioxidant potential, related consumer perceptions, and the effect of nutritional health claims on intentions to consume the beverages.

Several conclusions can be drawn from the findings of this study: First, the non-carbonated beverages (health drinks) consumed in Southwestern Uganda are alternative sources of natural antioxidants. Consumption of a regular bottle (320ml) of health drink is sufficient to meet the dietary recommendations for vitamin C and about 40% of the recommended polyphenol intake depending on the type of ingredients used in the beverage. The use of mixed ingredients could increase the antioxidant content and activity of the health drinks. Secondly, communities in Southwestern Uganda hold positive perceptions of the beverage healthiness and safety. However, these perceptions as well as their influencing factors vary among consumers and non-consumers in different areas of residence. Thirdly, nutritional health claims can influence the consumption of health drinks. Nutrient-related claims have a higher influence on intention to consume than health-related claims. Further, consumers are more motivated by claims in media advertisements than claims on food labels and the reverse is true among non-consumers whose consumption intentions are more influenced by claims on food labels than those in media advertisements. Besides nutritional health claims, perceived healthiness and safety positively influence the intention to consume health drinks.

6.2 Recommendations

Three-fold recommendations are put forward in line with the findings of this study.

6.2.1 Recommendations for Practice

Consumers should consume health drinks for health maintenance and disease prevention, as they are a potential source of antioxidants. In addition to nutritional health claims, consumers should also consider the ingredients of health drinks during beverage selection to attain maximum benefits. Health drink companies, especially small and medium beverage enterprises should utilize the significant factors influencing perceptions on non-consumers to attract them to consume healthdrinks. In addition, manufacturers should use media advertisements as primary platforms to convey information on health drinks to consumers but also invest in food labels to attract non-consumers. In addition, beverage companies should primarily use nutrition-related claims to promote the consumption of health drinks as well as adopt innovative forms of labeling such as the use of images in the Front-of-Pack Nutrition Labelling (FOPNL) to enhance understanding of label information.

6.2.2 Recommendations for Policy

The Ugandan government through the Ministry of Health (MOH) and the Uganda National Bureau of Standards (UNBS) should collaborate with the World Health Organization to establish a daily intake recommendation for antioxidants and polyphenols since antioxidants act as a basis for most nutritional health claims on health drinks. This will help to ascertain the amount of health drinks one can consume to meet their daily requirements for a healthy life. Given the significant influence of media advertisements, regulatory bodies, particularly UNBS should enforce the implementation of Uganda Standard *US EAS 805:2013, Use of nutrition and health claims- Requirements* to ensure the authenticity of nutritional health claims in media advertisements and consistency of information in media advertising and food

labels. Furthermore, UNBS and MOH should invest in mass public awareness creation and education to increase consumer understanding and usage of information on labels to make healthy food and beverage choices.

6.2.3 Recommendations for Future Research

Despite the interesting findings, this study incurred some limitations that could inform future research.

1. The study analyzed the antioxidant properties of health drinks but did not explore the sugar, caffeine, and alcohol content of these beverages. Hence, researchers and students should explore these nutritional quality parameters in future studies, given their critical implications on consumer health. In addition, researchers can also conduct further investigations on the type and quantity of bioactive compounds of significance in disease treatment. This is crucial given that numerous consumers believe that health drinks treat diseases and use them as over-the-counter drugs.
2. Indigenous knowledge has an influence on consumer perceptions and consumption of fruit, vegetable, and herbal infusions in rural communities. However, this study did not explore the influence of indigenous knowledge on perceived healthiness and perceived safety of health drinks. Therefore, future research should explore the influence of indigenous knowledge on perceptions of beverage healthiness and safety.
3. This study used nutritional health claims obtained from secondary studies conducted in populations other than this study population. Considering that the use of nutritional health claims varies with differences in regulations in various target markets, employing claims frequently used in this population might have produced more accurate results. Hence, future researchers should conduct a content analysis of

nutritional health claims both on food labels and in media advertisements to determine the most commonly used claims.

4. Information presented in nutritional health claims is legally required to be consistent with information on the nutrition facts table, which should in turn be consistent with the nutritional properties of a food product. Therefore, regulatory bodies, particularly UNBS should conduct comprehensive laboratory and content analyses to assess the consistency of information in nutritional health claims in advertisements, nutritional facts table, and the nutritional properties of health drinks.
5. This study found that increased exposure to claims on labels correlated with decreased intention to consume health drinks However, this study did not comprehensively explore the underlying factors for this correlation. Hence, future researchers should explore the factors influencing a reduction in consumption trend with increasing exposure to food labels, given its critical policy implication.

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APPENDICES

Appendix A: Informed consent forms

Project Title: Nutritional health claims and factors associated with consumption of non-carbonated beverages (health drinks) in Southwestern Uganda

Principal investigator: Claire Atukunda

0774618863

claireatukunda1@gmail.com

Introduction: My name is **Claire Atukunda**, a student offering a master's degree in food security and community nutrition at Gulu University. I am conducting a study on **Nutritional health claims and factors associated with the consumption of non-carbonated beverages (health drinks) in Southwestern Uganda.** I invite you to participate in this research project.

Purpose of the study: The purpose of this study is to get information on health drinks, that is, factors associated with the consumption of these products. For purposes of this study, health drinks are defined as beverages obtained from the infusion of water with fruits, vegetables, and herbs and bottled for longer shelf life. The information obtained from this study will help us better understand how consumers perceive the healthiness and safety of health drinks and the effect of nutritional health claims on the consumption of these drinks. You are invited to this study because you know about health drinks and are eligible for this study.

Procedure: This study will be conducted in form of an interview. A research assistant will ask you questions and note down your answers. In case you do not understand any question, you are at liberty to ask the enumerator for clarity. You may answer at your own pace. Participation in this study will take about 15 minutes of your time.

Risks and benefits: There is relatively no risk associated with this study. We acknowledge that some of the questions may be personal and if you are uncomfortable with answering any question, please let the research assistant know and you will not be penalized. While you may receive no direct benefit from participating in this study, your responses will be contributing to the understanding of factors associated with the consumption of health drinks. This may enable future improvements

Confidentiality: Your information will be kept confidential. Nobody except the principal investigator and study team will have access to the information. A study number will be used instead of your name so no one can trace the information back to you. While the data may be made accessible to the Ethics review committee or published in a journal or elsewhere, participants' names or identities will not be disclosed.

My rights as a study volunteer: Your participation in this study is entirely voluntary and you may decide to withdraw from the study at any time without any form of penalty. All you would need to do is inform the research assistant, and your decision shall be respected. Once you agree to participate, you will be asked to sign this form of consent.
If you have any issues pertaining to your rights and participation in the study, please contact the chairperson, Gulu University Research Ethics Committee, Dr. Gerald Obai, Tel: No.,

0772305621; email: lekobai@yahoo.com/lekobai@gmail.com; or the Uganda National Council for Science and Technology, on plot 6, Kimera Road, Ntinda, Kampala on Tel 0414705500.

CONSENT STATEMENT:

I, _____, hereby give my consent to participate in the research study entitled "**Nutritional health claims and factors associated with consumption of non-carbonated beverages (health drinks) in Southwestern Uganda".** I fully understand the information regarding this study. I fully understand that I may withdraw from this research project at any time without any penalty. I also understand that I am free to ask any questions about this study. Finally, I understand that the information obtained will be kept anonymous.

Name of participant……..Signature/Thumbprint……. Date……

Name of witness……...Signature/Thumbprint……. Date……

Name of interviewer…….Signature…….. Date……

Appendix B: Questionnaire

Hello,

My name is Claire Atukunda, a postgraduate student at Gulu university conducting a study on nutritional health claims and factors associated with the consumption of non-carbonated beverages (health drinks). The information obtained from this study will help us to have a better understanding of how consumers perceive the healthiness and safety of health drinks, and the effect of nutritional health claims on the consumption of health drinks. Your responses and opinions are very important to us and they will be completely anonymous and confidential. All data will be aggregated and individual respondents will not be identifiable. The information from the survey will be used only for academic research. Your responses will be highly appreciated. Thank you.

Sincerely,

Claire Atukunda.

SECTION 1

This section is related to personal information. Please circle the suitable answer.

17. Gender ☐ Male ☐ Female

18. Age …….

19. Education level attainment

☐ No formal education ☐ Primary level ☐ Secondary level

☐ Vocational training ☐ Bachelors and above

20. Occupation

☐ Unemployed ☐ Self-employed ☐ Public servant ☐ Private-sector employee

☐ Other (Please specify)……

21. Marital status ☐ Single ☐ Married ☐ Divorced

22. Monthly household income

☐ <100,000 ☐ 100,000-500,000 ☐ >500,000-1,000,000 ☐ >1,000,000

23. Household size……

24. Chronic illnesses in the family……..

SECTION 2

This section examines patterns and factors associated with the consumption of health drinks. Please circle the appropriate number representing your response. Please give **ONLY ONE** response to each statement.

1. Have you ever taken any health drink? Yes No

2. If yes, how often do you take healthy drinks?

1). Every day 2). Few times a week 3). Once a week

4). Once in two weeks 5). Once a month 6). 2–3 times per year

3. What health drink brands do you mostly consume? .....

4. How long have you been consuming health drinks?

a). Less than 6 months b). 1-2 years

c). 3-4 years d). 5 years and above

5. What factors do you consider when choosing a health drink? (Can choose more than one)

a). Health benefits b). Safety c). Price

d). Information provided e). Color f). Taste

g). Availability h). Brand i). Other (please specify)……

6. Do you take health drinks to treat any illness? (Please tick the appropriate answer)

☐ Yes ☐ No

If yes, please specify……..

SECTION 3

This section examines consumer perceptions on the healthiness of health drinks. Please tick (✓) the appropriate response.

7. Please indicate how much you agree with the following statements. (1= strongly disagree, 2= Disagree, 3= neutral, 4= Agree, 5= strongly agree)

	1	2	3	4	5
'These' drinks are healthy					
Health drinks can reduce the risk to certain diseases					
Health drinks can cure certain diseases					
Health drinks have more health benefits than carbonated beverages					
Health drinks prevent ageing					
Health drinks are made from natural ingredients					
Health drinks have a lot of nutrients					
Health drinks give me energy					

Health drinks have a lot of vitamins					
Health drinks improve immunity					
Health drinks have no added sugars					

SECTION 4

This section examines consumer perceptions on the safety of health drinks. Please tick (✓) the appropriate response.

8. How important are these factors when determining the safety of a healthy drink? (1= not at all important, 2=somewhat important, 3= neutral, 4= somewhat important, and 5= very important)

	1	2	3	4	5
Product label					
Expiry date					
Regulatory body logo					
Nutrients in the beverage					
Health drink brand					
Smell and taste					
Packaging and seals					

9. Please indicate how much you agree with the following statements. (1= strongly disagree, 2= Disagree, 3= neutral, 4= Agree, 5= strongly agree)

	1	2	3	4	5
Health drinks are safe to drink					
Health drinks are safe because they are natural products					
Health drinks have no added chemicals					
Health drinks take long to expire					
Information given on health drinks is enough to judge their safety					
Health drinks are manufactured in safe environments					
Health drink are safe because they are in sealed bottles					
Health drinks are safe because they have labels					

Health drinks are safe because they are made in Uganda (locally produced)					
Health drinks on the market are verified by the government.					

SECTION 5

This section examines the use of nutritional and health claims and their effects on consumption of health drinks. Please circle or tick (✓) the appropriate response.

10. Where do you often see/hear statements on nutritional properties or health benefits of health drinks?

a). Product labels b). Advertisements in media c). Family and friends

d). Other (specify)……

11. How often do you hear nutritional health claims of health drinks in media (radios, TVs)?

a). Never b) Rarely c). Sometimes

d). Frequently e). Every time

12. A label of another health drink indicates that the product has the following uses.

"Detoxifies the body"

"Treats high blood pressure and diabetes"

"Improves immunity"

"Reduces aging"

How likely are you to consume this product?

Not at all likely	Unlikely	Neither	Likely	Extremely likely

13. How often do you read nutritional health claims on labels of health drinks during purchase?

a). Never b) Rarely c). Sometimes

d). Frequently e). Every time

14. The label of a certain health drink on the market indicates that the product has the following nutrients.

"High in Vitamin C"

"Has no added sugars"

"High in Vitamin A"

"Has lots of potassium and Zinc"

How likely are you to consume this product?

Not at all likely	Unlikely	Neither	Likely	Extremely likely

15. An advertisement for a health drink has been recorded and will be played for you. The recording will be played two times. Please listen and answer the question below. Attached is the transcript of the recording.

I gladly present to you G2 health drink. It has wonderful ingredients that help to prevent diabetes, heart disease, weight problems, and ulcers! Get yourself a bottle from the nearest store and enjoy good health"

How likely are you to consume the product in (recording 2)?

Not at all likely	Unlikely	Neither	Likely	Extremely likely

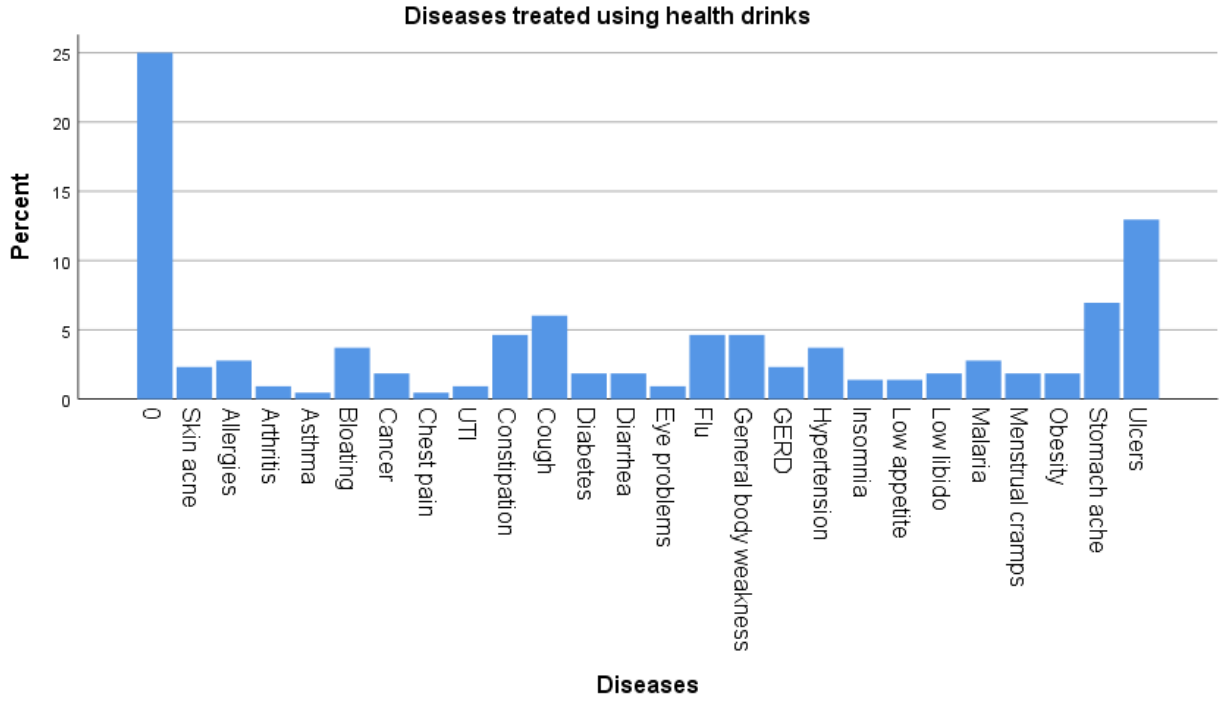
16. An advertisement for a health drink has been recorded and will be played for you. The recording will be played two times. Please listen and answer the question below. Attached is the transcript of the recording.

"Introducing to you A1 health drink. It has lots of vitamins, minerals, fiber and has no added sugars. You can get this drink from any shop or supermarket near you. Cheers!"

How likely are you to consume the product (recording 1)?

Not at all likely	Unlikely	Neither	Likely	Extremely likely

Appendix C: Diseases treated with health drinks in Southwestern Uganda



Appendix D: Introduction and acceptance letters for data collection

GULU UNIVERSITY

P. O. BOX 166
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TEL. +256 471 432518
FAX. +256 471 432094
Email: fae@gu.ac.ug
URL: www.gu.ac.ug

FACULTY OF AGRICULTURE & ENVIRONMENT

14th April, 2022

The Chief Administrative Officer,
Sheema district

Received and noted and permission granted

For: CHIEF ADMINISTRATIVE OFFICER
19 APR 2022
P.O. Box 160, KABWOHE
SHEEMA DISTRICT LOCAL GOVT.

Dear Sir/Madam,

RE: INTRODUCTION OF MS. CLAIRE ATUKUNDA

I hereby introduce to you Ms. Claire Atukunda, a student of Gulu University, pursuing Master of Science in Food Security and Community Nutrition in the Department of Food Science and Postharvest Technology (Reg. No. 20/U/2839/MFN/PS).

Ms. Atukunda is conducting an academic study to understand factors associated with the consumption of non-carbonated beverages (health drinks). Sheema district has been selected for this study because of the high influx of health drinks on local markets in the region. The study will involve talking to consumers and other individuals who have knowledge about health drinks to understand their perceptions towards the healthiness and safety of health drinks, and the effect of nutritional health claims on consumption of these beverages. During the study, all the COVD-19 standard operating procedures will be observed.

I hereby request you to allow Ms. Atukunda to conduct this study in the district.

Any assistance rendered to her will be highly appreciated.

Yours sincerely,

Dr. Solomon Olum (PhD)
Head, Department of Food Science and Post-Harvest Technology
s.olum@gu.ac.ug, 0779486193

CC: The Residence District Commissioner, Sheema district

INCASE OF ANY CORRESPONDENCE
ON THIS SUBJECT, PLEASE QUOTE
Your ref:
Our ref: CR/MC/161

MBARARA CITY
Ensi y'amate n'obwoki

Office of the City Town Clerk
P.O BOX 290
MBARARA –UGANDA
www.mbararacity.go.ug
info@mbararacity.com
mbararara@gmail.com

MBARARA CITY

21st April,2022

Claire Atukunda
Gulu University
P. O Box 166
Gulu.

DATA COLLECTION FOR A RESEARCH PROJECT.

Following your application for data collection on a research project for a period of five days from **25th April,2022** to **29th April, 2022**, you are hereby informed that your application has been honored.

You will collect data for your research project from Mbarara City on "**Understanding consumer perceptions of health drinks with present policy implications to both the manufacturing companies and regulatory bodies in the community**". This will be in strict observance of Covid -19 SOPs as you conduct your research.

You will report to the Principal Community Development Officer, Mbarara City for guidance.

By copy of this all concerned are requested to give you the necessary support.

Yours faithfully,

For: City Town Clerk
MBARARA
P.O.Box 290, Mbarara

Atwiine Dominic
For: CITY CLERK

Copy: The Principal Community Development Officer, Mbarara City.
Dean, Gulu University.

Vision: "An Inclusive and Sustainable City"
Mission: "To provide quality services through inclusive engagement for sustainable development"

Appendix E: Gulu University Research Committee Approval letter

GULU UNIVERSITY

P.O. Box 166, Gulu (U)
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RESEARCH ETHICS COMMITTEE

10/06/2022

To: Claire Atukunda

0774618863

Type: Initial Review

Re: GUREC-2022-219: Nutritional health claims and factors associated with consumption of non-carbonated beverages (health drinks) in Southwestern Uganda, 3.0, 2022-06-04

I am pleased to inform you that at the **82nd** convened meeting on **17/03/2022**, the Gulu University REC, committee meeting, etc voted to approve the above referenced application.
Approval of the research is for the period of **10/06/2022** to **10/06/2023.**

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 **10/06/2023** 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:

GULU UNIVERSITY
INSTITUTIONAL REVIEW COMMITTEE
APPROVED UNTIL
★ 10 JUN 2023 ★
FACULTY OF MEDICINE
P. O. Box 166, Gulu

Appendix F: Plagiarism Check Certificate

GULU UNIVERSITY
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OFFICE OF THE UNIVERSITY LIBRARIAN

PLAGIARISM CHECK

Declaration for Originality Form
This form must be completed and signed for all scholarly work produced.

Name: _ **CLAIRE ATUKUNDA** _____

Personal File No.(staff) Reg. (**student**)._____**20/U/2839/PS**__ _____
Faculty/Institute:___ **AGRICULTURE**_____
Department:____ **FOOD SCIENCE AND POST HARVEST TECHNOLOGY**_____
Title and bibliographic description of the work
ANTITOXIDANT POTENTIAL AND FACTORS ASSOCIATED WITH CONSUMPTION OF NON-CARBONATED SOFT DRINKS (HEALTH DRINKS) IN SOUTH WESTERN UGANDA

Declaration.

1. I understand what plagiarism is and I am aware of the University policy on this regard,
2. I declare that this …**Thesis**… (thesis, dissertation, essay, assignment, paper, report etc.) is my original work and has not been submitted elsewhere for examination, award of a degree or publication. Where other people's work or my work has been used, this has been properly acknowledged and referenced in accordance with Gulu University requirements,
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Yours sincerely,

Dr. Ongaya Kizito (PhD)
Senior Librarian