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Student Preferences on the Development of a Non-Alcoholic Beverage Product to Alleviate the Negative Impact of Alcohol on College Campuses

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Table of Contents

Abstract

Alcohol abuse and peer pressure to drink are prominent issues on college campuses across the nation. More than 50 percent of college students aged 18 to 22 consume alcohol monthly and 33 percent consistently engage in binge drinking (National Institute on Alcohol Abuse and Alcoholism, 2021a). A non-alcoholic beverage product marketed to students as an alternative to alcohol in social settings could alleviate some of the negative impacts, such as peer pressure and the dangers caused by overconsumption.

Through two phases, this study implements University of Arkansas student preferences and recipe modification in the development of a non-alcoholic beverage product to satisfy consumer needs. The survey results revealed that most students not only would purchase and consume this product as an alternative to alcohol, but they also believe it could help alleviate the negative impact of alcohol on college campuses. Student preferences leaned towards a nutritionally functional beverage, which resulted in a recipe that utilized citrus and fruit rind to increase the micronutrient content and nutritional value. Applying survey feedback, final recipes and a product design were developed to serve as a blueprint for future product development.

Introduction

Background and Need

According to a 2019 study, 7.0 million adolescents and teens aged 12 to 20 reported that they had consumed alcohol to a point of intoxication in the past month (National Institute on Alcohol Abuse and Alcoholism, 2021b). Underage drinking is even more prevalent in college students aged 18 to 20, as they are exposed to more freedom. Underage drinking, in some cases, is associated with peer pressure to drink. A comparative study on the effectiveness of peer pressure to drink among college students found that 51 percent of underage college students fall victim to peer pressure and consume alcoholic beverages unwantedly (Mistry, 2019). Many students in the United States go to college without consuming alcohol in heavy amounts prior and inevitably overdrink the first times they experiment with it. Many students also go to college for the first time with plans to not drink and then face social hardships regarding peer pressure (Knee & Neighbors, 2006). As defined by Merriam-Webster, peer pressure is *a feeling that one must do the same things as other people of one's age and social group in order to be liked or respected by them* (Merriam-Webster, para. 1). Peer pressure is not purely a verbal act of shame or persuasion from someone else; it also includes an urge within oneself to feel comfortable in an unfamiliar setting, such as college, where the mass majority might be partaking in a personally uncomfortable activity, like drinking alcoholic beverages.

The versatility of a non-alcoholic beverage product designed to alleviate some of the negative impacts of peer pressure and overconsumption can serve both college students and broader groups of consumers. Whether one is sober or merely wants to limit alcohol intake, annual alcohol consumption in adults has decreased by nearly two liters per person in recent years (Eilenberg, 2020). The desire for non-alcoholic beverages that offer the same social

sentiment as alcohol is not unheard of—in fact, it is a steadily growing market. *No* and *low* (no-low) alcohol spirits are on a steep rise as the distillery world becomes more technologically advanced and people become more ethically, economically, and health conscious. With the rise of non-alcoholic spirits in adult consumption, a line of non-alcohol beverages could become heavily consumed on college campuses and in everyday life. Though this is a niche product for a niche community, it could offer a new perspective on the expectations surrounding alcohol usage in college environments.

Problem Statement

Alcohol abuse and peer pressure to drink are prominent issues on college campuses across the nation. According to the 2019 National Survey on Drug Use and Health (NSDUH), more than 50 percent of college students aged 18 to 22 consume alcohol monthly and 33 percent consistently engage in binge drinking (National Institute on Alcohol Abuse and Alcoholism, 2021a). The development of a line of *mock-tails* or single-serve, ready-to-drink non-alcoholic beverages marketed toward college-aged students may fill the void for underage or sober individuals and offer a unique option at school or work-related events where alcohol might not be appropriate. The goal of this project was to raise awareness about peer pressure, the negative effects of underage drinking, and the dangers of alcoholism to college students through the promotion of a non-alcoholic beverage bearing a positive social attraction.

Purpose of the Study

The purpose of the study was to implement University of Arkansas student preferences and recipe development in the creation of a potential non-alcoholic beverage product intended to serve as an alcohol alternative in primarily social college settings.

Research Objectives

The following objectives guided this study:

1. Research how students are affected by alcohol use on college campuses.
2. Research beverage recipe development processes—specifically how citrus and fruit rind can be utilized to increase the nutritional value in a functional beverage product.
3. Identify if college students will be inclined to buy a new brand of non-alcoholic beverages and consume it in a social setting as an alcohol alternative.
4. Develop a recipe and virtual prototype based on student preferences for the potential beverage product.

Literature Review

When developing a non-alcoholic beverage product marketed towards college students and young adults, it is necessary to understand the role alcohol plays on college campuses and on one's health, as well as to understand the current market for *no-alcohol* and *low-alcohol* (no-low) products. The leading half of this review of literature will discuss former studies related to alcohol use on college campuses. First, the beliefs regarding alcohol's presence in college and the influence drinking alcohol has on peer pressure reveal the modern market for this product in real-life scenarios. Aside from the social impact alcohol elicits, consistently high alcohol consumption can be detrimental to one's physical and mental health, especially when abuse and overuse increase during college-aged years. Moving towards the review of the beverage industry, the consistently rising market for no-low alcohol products, confirms the consumer demand and desire for this product. Finally, it is crucial to understand both the nutrition of the ingredients used and the beverage production process regarding recipe modification, safe packaging, and marketing to create a successful functional beverage product.

Primary Beliefs Surrounding Alcohol in College and Perceptions of the Influence Peer Pressure Has on College Drinking Habits

The role alcohol has in college affects the way it is consumed, the quantities it is consumed in, and the reasons for consuming it. A few of the personal motivations for drinking alcohol among college students include mood enhancement, social courage, and achieving 'normalcy.' These motives are based on positive reinforcers; however, they often lead to overconsumption (LaBrie et al., 2007). The most prevalent channel for consuming alcohol in college is in a social setting, such as a party or Greek life event (LaBrie et al., 2007). An environment where social drinking is common among a vast number of students inevitably creates a culture where heavy drinking becomes common.

Recent research on college students' perceptions of alcohol shows alcohol-related consequences have more of a positive effect rather than a negative effect on the students' views. Many students do not perceive consequences as negative, causing them to drink again and overconsume alcohol as their tolerance heightens (Fairlie et al., 2016). However, the consequences of alcohol consumption—positive or negative—are not limited to the partaking student. Violence, sexual assault, impaired driving, and community disruption are all results of alcohol consumption that could affect a non-drinking peer. At least one-half of all violent crimes involve alcohol consumption by the perpetrator, the victim, or both (Abbey et al., 2001). On average, 29 people die in car wrecks caused by impaired driving due to alcohol consumption each day (Centers for Disease Control and Prevention, 2020). These are merely two examples of the many opportunities for harm done to non-drinking community members by those who choose to consume alcohol.

The stigma surrounding sobriety on college campuses creates an unhealthy relationship among students, causing peer pressure to drink, which then triggers negative consequences. Because drinking among college students most frequently occurs within a social context, peer pressure is a common experience that students across universities face. A desire to fit in in an unfamiliar environment causes pressure to conform to the majority practice in an uncomfortable situation, and for many, that situation could be drinking. Alcohol consumption has been directly correlated with the social and drinking behavior of surrounding college peers (Knee & Neighbors, 2006). A group of sober students shared their experiences, reporting that peers have verbally shamed them for their choice of abstinence, as well as commented on how drinking culture is central to most sporting and social events (Herman & Kinney, 2013).

Research also shows that students tend to have an exaggerated perception of their peers' alcohol consumption, which increases individual consumption (Knee & Neighbors, 2006). Overconsumption, otherwise known as binge drinking, can be defined by more than four drinks on one occasion for women and more than five drinks on one occasion for men (Centers for Disease Control and Prevention, 2021). Around 80 percent of students reported consuming alcohol in college, and of that, 50 percent reported drinking amounts that qualify as binge-drinking (Galbicsek, 2021). Overconsumption of alcohol is particularly heavy in Greek life, specifically in fraternities. 73 percent of students who are members of a fraternity report drinking more than once a week, compared to 37 percent of students who are not associated with a fraternity (Kremer & Levy, 2008).

To eliminate the stigma surrounding college sobriety, it is imperative to understand that sober students often face negative social constrictions. There are large amounts of research on and data supporting alcohol users on college campuses, but an overall lack of attention given to

nondrinkers and how they coexist with drinkers on a *wet campus* (Herman & Kinney, 2013, p. 66). Roughly 20 percent of all college students remain sober during their four years and have similar negative experiences with one another, as well as experiencing negative consequences brought on by others' drinking, such as sexual assault and violence (Kremer & Levy, 2008). Overconsumption of alcohol not only presents a safety issue for surrounding peers but is also a health problem for the individual at hand.

Impact of Alcohol Consumption on Human Physical and Mental Health

Unlike actions that inflict an explicitly negative health impact, such as smoking cigarettes, alcohol consumption has been shown to inflict both beneficial and harmful effects on human health. Research shows a light to moderate alcohol intake increases the palatability and nutrient absorption of various foods (Grønbæk, 2009). A moderated amount of red wine is linked to a reduced risk of coronary heart disease and an overall lower mortality rate (Corder et al., 2006). Resveratrol, one of the most effective antioxidant wine polyphenols, neutralizes free oxygen radicals and reactive nitrogenous radicals, a critical action in the prevention of cardiovascular diseases. Other benefits of a healthy red wine intake include a positive influence on organ function, blood pressure reduction in hypertensive patients, and the potential prevention of chronic disease development (Snopek et al., 2018).

Though research has shown positive health trends in correlation to alcohol consumption, the negative impact alcohol has on one's health outweighs the positive benefits a moderate intake potentially elicits. Alcohol overconsumption and abuse is recognized as the third-leading preventable cause of death in the United States, killing an estimated 99,000 people in 2020—a 25 percent increase from 2019 (White et al., 2022). Between 2011 and 2015, the leading cause of alcohol-related deaths in the United States was due to health conditions, specifically alcohol-

induced liver disease, heart disease, stroke, cirrhosis, liver cancer, hypertension, and alcohol use disorder (AUD), among other preventable chronic diseases (Centers for Disease Control and Prevention, 2020). AUD is a medical condition causing an impaired ability to stop or control alcohol consumption, regardless of health or social consequences (National Institute on Alcohol Abuse and Alcoholism, 2021). The chance of developing AUD increases from adolescence to those aged 18-22, seen notably in college students. In 2019, 8.7 percent of full-time college students within this age group met the criteria for AUD (Substance Abuse and Mental Health Services Administration, 2019). A consistently increased alcohol intake is related to an increased risk of various rare chronic diseases, including alcoholic cirrhosis, liver cancer, and colon cancer. Those who are heavy alcohol drinkers (5-10 drinks per day) have a 10 to 15 times increased risk of developing such diseases, and women who drink heavily are two times more likely to develop breast cancer (Grønbæk, 2009).

Alcohol misuse and overconsumption also have a significant impact on the brain and nervous system. Intoxication disrupts the brain's chemical balance and neurotransmitters and disturbs its natural equilibrium. Short-term overconsumption can cause alcohol poisoning, a potentially deadly consequence that can induce seizures, vomiting, unconsciousness, severe dehydration, respiratory suppression, and sometimes death (National Institute of Alcohol Abuse and Alcoholism, 2020). Long-term use, especially seen in heavy drinkers and alcohol abusers, shrinks the brain's hippocampus over time and opens the potential for the development of physiological dependence and AUD development (Topiwala, et al., 2017). AUD takes a toll on both the physiology of the nervous system, as well as one's mental state. Aside from the physiological diseases AUD causes, the development of depression and anxiety is a common result of AUD (Centers for Disease Control and Prevention, 2020). Other negative cognitive

effects include an increased chance of developing dementia, memory loss, and severely hindered mental functioning (Mosel, 2023).

Overall, alcohol abuse and overconsumption lead to detrimental negative health effects on human physical and mental health. A 2016 systematic review on the health effects of alcohol reduction correlated to a reduction in blood pressure, body weight, and alcohol-related injuries, the recovery of ventricular heart function, a normalization of biochemical parameters, and an improvement in pre-cirrhotic liver disease, as well as a reduction in withdrawal symptoms (Charlet, 2017). Cutting back on alcohol consumption could help prevent the negative health impacts it elicits.

The Marketability and Rise in Demand for No-Low Alcohol Beverages

No-low alcohol products are gaining major traction in the beverage industry due to a rising health-consciousness mindset, widening the market for new non-alcoholic beverages to be developed and desired. Despite a majority of the direct negative health impacts on physical health stemming from consistent alcohol overconsumption and abuse, moderate alcohol consumption can still build up negative tension within the body over time, indirectly causing adverse health conditions. High-calorie foods and beverages, specifically sweetened alcoholic beverages, are two of the main contributors to obesity-related eating behaviors (OREB) (Muñoz-Pareja et al., 2013). Research shows individuals with ≤ 1 OREB had a lower food energy density and lower consumption of sugary, alcoholic beverages than those with ≥ 5 OREB (Muñoz-Pareja et al., 2013). This research shows that limiting alcohol intake is an effective way to lower overall body weight and increase health. Alcohol is not only associated with caloric density and weight gain, but it also increases chances of brain imbalance, Type 2 Diabetes Mellitus (T2DM), and liver failure (Mosel, 2021).

Alcoholic cocktails have been the popular beverage choice in social environments for several years; more recently, however, no-low alcohol alternatives have been growing in consumer desirability (Malochleb, 2021). No-low spirits, beers, and wines are shifting the role that drinks have in many young adult lives. Malochleb (2021) shared an anecdotal quote from Ben Branson, the founder of distilled non-alcoholic spirits brand Seedlip:

> Adult non-alcoholic options have never been more relevant. I think people are also becoming increasingly mindful of their health, origins of their food and drink, and the influence social media-led lives have on consumption. (para. 3)

If obesity continues to be a global and national issue, increasing awareness about the effects alcohol have on one's health will instigate a shift in the consumer market towards no-low alcohol choices (Sikalidis et al., 2020).

The Development of a Functional Non-Alcoholic Beverage Product

One of the main barriers in the no-low alcohol beverage industry is found in the production process, as creating a healthier product with equivalent taste and appearance as its alcoholic alternative requires additional detail. Functional beverages, beverages created with a more holistic and healthful approach to offer benefits of dietary phytochemicals, have grown immensely in popularity for both their medicinal and physical health impacts, and they are significant motivators in recent product development (Bhuiyan et al., 2012).

Non-Alcoholic Beverage Production

Non-alcoholic beverage development involves crucial processes to achieve a palatable, balanced, and safe-to-consume product. Doing so requires specific emulsion methods to attain an affordable and sustainable product. Emulsification ensures stability and, consequently, consumer satisfaction (Tireki, 2021). A study where a functional beverage was created utilizing consumers

through a taste-testing evaluation found that acidity, pH, total soluble solids, and vitamin C were the main flavor developers to take into consideration during the emulsion process (Bhuiyan et al., 2012).

Along with flavor and packaging development, there are three other factors in successful beverage production: energy, economics, and the environment. These three factors are heavily dependent on each other. Efficient energy use is a necessity in sustainable agriculture while the demand for increasing beverage production results in a more intensive energy use. This intensive use of energy directly impacts the environment as energy sources diminish. Therefore, a sustainable use of energy in agricultural systems is imperative to the minimization of negative environmental effects and the increase of product profit (Mohammadshirazi & Kalhor, 2015). One way to implement sustainable agriculture in beverage production is to cut down on environmental waste by utilizing the rind and pomace, otherwise discards, of fruits and citrus.

The Functional Properties of Pomace and Rind

Various studies show fruit and citrus rinds and pomace are lower in sugar content and contain a more concentrated source of the fiber, vitamin, and antioxidant amounts found in the fruit itself (Dubey et al., 2022). Citrullus lanatus, or watermelon rind, is increasingly becoming utilized in food and beverage production for its nutritional value. Watermelon contains rich sources of the antioxidant lycopene and the amino acid citrulline, among several vitamins and minerals. Its high content of lycopene supports cardiovascular health by protecting against cell damage and reducing the risk of heart disease. The fruit's lycopene, vitamin A, and carotenoid contents make it highly anti-inflammatory as these properties neutralize free radicals and contribute toward antioxidant activity. Watermelon rind not only contains a more saturated content of the fiber, antioxidants, minerals, vitamins, and active ingredients present in the inner

fruit itself, but it is also highly palatable (Dubey et. Al, 2022). Watermelon rind has the advantage of high citrulline content compared to its flesh (Du & Ramirez, 2022). The presence of Citrulline in the rind can reduce the accumulation of fat cells as it converts into arginine and blocks tissue non-specific alkaline phosphatase (TNAP) activity within the body (Dubey et. Al, 2022).

Citrus rinds and pomace are other common discards that hold more concentrated nutritional values than the inner citrus. Citrus rind can add functional value to food and beverage products due to its natural source of bioactive compounds, including polyphenols, pectin, protein, dietary fiber, essential oils, and pigments. These compounds contribute antioxidant, antimicrobial, anticancer, and anti-inflammatory properties when used sufficiently. Therefore, utilizing citrus discards could potentially result in nutritional, economic, and environmental benefits (Wedamulla et al., 2022).

Utilizing Discards in Food Production

Several studies have implemented fruit and citrus discards into actual food products with positive results regarding both nutritional value and taste. An experimental study increased the content of dietary fiber in pasta by nearly 100 percent with the inclusion of dried orange pomace powder and over 100 percent with dried cucumber peel powder in the flour (Kaur et al., 2022). The pasta's antioxidant activity and total phenolic, carotenoid, and chlorophyll contents increased, as well. A recipe modification trial on the byproduct utilization of watermelon replaced wheat flour in the development of watermelon rind flour-based cookies. The results of the best accepted cookie proportions (30 percent watermelon flour and 70 percent refined wheat flour) showed a significant increase in fiber, calcium, iron, and phosphorus percentages compared to the control cookie (Ashoka, Shamshad, & Vijayalaxmi, 2021). A similar study

researched consumer preferences on watermelon rind taste in food products. The consumers evaluated a food product with 0 percent, 10 percent, 20 percent, and 30 percent rind and rated the product on levels of sweetness, sourness, greenness, overall watermelon flavor, and refreshing quality. The results found that consumer preferences were accepting of the watermelon rind addition up to 20 percent, but preferences decreased with the higher addition of 30 percent (Ramirez et al., 2021). The results from these experimental studies prove the capacity for a highly minerally-functional beverage product using discards and connect consumer preferences regarding the percentage of discards used in food products.

Summary

Literature related to college students' history and relationship with alcohol, as well as the necessary steps in developing a functional non-alcoholic beverage, were discussed. There is a globally growing fascination with no-low alcoholic beverages, as well as a distinct need for a uniting force between the sober and non-sober community members on college campuses. In conclusion, the development of a non-alcoholic beverage product to minimize this gap begins with the assessment of its market and ends with mastering the technical processes in successful functional beverage production.

Development Plan

Alcohol use on college campuses can have a negative impact on the surrounding environment, especially on non-drinking peers in social settings (Knee & Neighbors, 2006). A non-alcoholic beverage designed to serve as an alternative in such settings aims to alleviate the issues at hand. When developing a beverage, creating a product that is desired and needed by its target audience is crucial to its success. Fifty-two University of Arkansas students—both alcohol drinkers and non-drinkers—answered a survey asking questions regarding their individual

history with alcohol in a college environment, as well as preferences on flavor profiles, consistency, price, and circumstances they would most likely consume the proposed beverage. The survey results assisted the researcher in designing a desirable recipe and recognizing the characteristics of the niche market. Using data from both students who partake in drinking alcohol and those who do not resulted in a non-biased product blueprint designed to please a wide range of students.

The following steps were taken in two phases to develop the product recipe and virtual prototype:

Phase I: Research and Survey Analysis

1. The impact of alcohol on college campuses was researched.
    a. Through an online search, a moderate consumption of alcohol was compared to the average intake of alcohol consumed by college students.
    b. The risk of alcohol overconsumption and the presence of alcohol abuse on college campuses was researched.
    c. The presence of peer pressure and the impact of alcohol drinkers on non-drinkers in a college environment were assessed.
2. The current market was researched.
    a. Current non-alcoholic beverage products similar to this design were reviewed, taking into consideration price, popularity, ingredients, and packaging.
    b. An evaluation of the profitability of each current item on the market was conducted to see what is most needed and desired by consumers.
3. Functional beverages and the functional use of fruit rind in food and beverage products were researched.

   a. The purpose and benefits of functional beverages, as well as what defines a product as nutritionally functional, were reviewed.
   b. The nutritional benefits of utilizing fruit and citrus rind in food and beverage products were reviewed.

4. The target audience was defined.
   a. The target audience was narrowed down to distinct demographics: age, location, current alcohol use, and beverage desires.
5. Relevant research through student surveys was conducted.
   a. A survey was created and sent out to students, which focused on the impact of alcohol specifically at the University of Arkansas and on preferences for the proposed beverage product. The questions were presented in a mixture of Likert scale, multiple choice, multiple selection, ranking, and fill-in-the-blank forms.

      Examples of questions presented:

      i. Have you ever felt peer pressured to consume alcohol in college?
      ii. Would you willingly drink a non-alcoholic beverage at a social event where alcohol might be present instead of consuming alcohol?
      iii. Would you care about the micronutrient content (vitamins and minerals) in this product? Would a higher content of these values, along with focused advertisement on it, persuade you to buy the product more?

   b. The survey answers were analyzed to define the need for this product in its intended market.

See Appendix A for the full survey questions and answers.

Phase II: Recipe and Prototype Development

6. A base recipe was created.
    a. Through recipe development and modification, a base recipe for the beverage was created using functional, fresh ingredients (water, agave, fruit and citrus rinds, herbs, tea leaves, and other natural flavor enhancers).
    b. Ingredients were chosen for their accessibility, cost, and nutritional benefit.
    c. Ingredients were weighed through every step of the recipe development process to obtain exact and repeatable measurements.
7. Different flavor profiles were created through experimentation.
    a. Three distinct flavor combinations were developed to enhance the base recipe and increase consumer selection.
8. Changes were made to the recipe according to survey feedback.
    a. After the survey answers were analyzed, student feedback was applied to further edit the formula of the product.
    b. Recipe modification practices and experimentation were implemented to analyze and modify the recipe to further fit consumer needs and desires.
9. A virtual prototype was designed.
    a. Student preferences on packaging reported through the survey were reviewed to create the most desirable packaging for the intended consumer.
    b. A virtual prototype of the product was created using Canva and Pacdora.
    c. The recipe ingredients were listed to assist in future packaging and label requirements.

Overall, the procedure for developing the blueprint for a functional, non-alcoholic beverage product included initial research, recipe development, the conduction of a student survey, recipe modification, nutritional analysis, and virtual package design. The application of these measures was vital to identifying the profitability, marketability, and execution of a functional beverage product.

Design Process and Creative Works

The following section includes the survey results and recipe development process, which are reflected in two phases mirroring the development plan.

Phase I

After initial research was conducted, a survey was created to assess the overall need for a non-alcoholic beverage product among the University of Arkansas' student population. The survey was sent to 267 students, and 67 students filled it out to completion. The survey asked about student preferences in four categories: personal alcohol use and history, beliefs regarding alcohol use on the University of Arkansas campus, knowledge of products and likeliness to purchase products currently in the no-low beverage industry, and preferences for flavor, appearance, packaging, and cost of the proposed product. 40 of the students (59.7 percent) reported being under 21 and were therefore excluded from answering the section regarding personal alcohol use. The other 27 students (40.3 percent) reported being over the age of 21. The following table sums up the key findings from the survey.

See Appendix A for the full survey questions and answers.

Item	**Students Under 21,** ***% (n = 40)***	**Students Over 21,** ***% (n = 27)***	**Students Total,** ***% (n = 67)***
Have felt peer pressure to consume alcohol during college	62.5 (25)	55.5 (15)	59.7 (40)
Have witnessed negative consequences due to alcohol during college	77.5 (31)	77.8 (21)	77.6 (52)
Either consume alcohol irregularly, want to reduce intake, or completely abstain	N/A	22.2 (6)	N/A*
Commonly consume alcohol in a social setting, such as a Greek life event or party	N/A	77.8 (21)	N/A*
Commonly consume alcohol at a bar or restaurant	N/A	70.4 (19)	N/A*
Are aware of the non-alcoholic beverage industry	95 (38)	92.6 (25)	94.0 (63)
Feel there are either not enough non-alcoholic beverage options on the market or feel there is room for more	67.5 (27)	66.7 (18)	67.2 (45)
Prefer a moderate sweetness level	37.5 (15)	51.9 (14)	43.3 (29)
Prefer the drink to bear some mental or physical effects (e.g.: mood-boosting, relaxing, stress-relieving, caffeinating)	97.5 (39)	62.5 (25)	95.5 (64)
Reported Lemon Ginger Non-Alcoholic Margarita as their favorite flavor	30.0 (12)	25.0 (10)	32.8 (22)
Reported Blueberry Matcha Non-Alcoholic Mojito as their favorite flavor	45.0 (18)	44.4 (12)	44.8 (30)
Reported Spicy Cucumber Melon Spritz as their favorite flavor	22.5 (9)	22.2 (6)	22.4 (15)
Prefer beverage to contain a high micronutrient content	60.0 (24)	66.7 (18)	62.7 (42)
Prefer the price range to fall between $11-15	65.0 (26)	51.9 (14)	59.7 (40)
Would purchase/consume the beverage provided it reflects their survey preferences	40.0 (34)	51.9 (14)	71.6 (48)
Would not purchase/consume the beverage provided it reflects their survey preferences	2.5 (1)	14.8 (4)	7.7 (5)

Figure 1

*Only the 27 students above the age of 21 were asked these three questions; therefore, total percentages among all participants were not taken into consideration for the results.

Overall, the occasions students reported most likely to consume this product were:

- 67.2 percent at a social event at night/on the weekend where alcohol is offered
- 58.2 percent on vacation
- 56.7 percent at a school-sponsored event where alcohol is not offered
- 54.4 percent at a social event only during the day/weekday

The final two open-ended questions asked the students why they liked the product, why they did not like the product, and what changes could be made to the product to increase their inclination to purchase and consume the product. Overall, the main reasons students liked the proposed product were for its nutritional benefits, to have a beverage to hold at a social event, and to have an option for designated drivers. The top components of the product that would increase the students' chances of consumption were more flavors and enticing packaging that resembles alcohol. The students who said they would not drink this product reported the main reason is they still personally prefer alcohol in social settings.

Phase II

The recipe development process of this project included nine kitchen sessions experimenting with the ingredients in a variety of capacities: developing a range of flavor profiles, implementing several cooking methods and techniques, and testing the recipe using different proportions of each component. After experimentation, it was decided that fruit and citrus rind (e.g. lemon or lime peel, watermelon rind, cucumber skin) would serve as the base functional ingredient of the beverage product. A unique bitter concentration replicative of alcoholic bitters was created for each flavor by softening the respective fruit or citrus rind in a small amount of warm water. It was then blended with the liquid to break down the peel and release its essential oils and aromatics. By utilizing fruit rind in the composition of a beverage

product, the result produced a similar astringency to the flavor commonly found in alcohol, as well as increased the product's vitamin, mineral, fiber, and antioxidant contents. The final base recipe of each flavor resulted in a three-part concentration: a fruit juice; a citrus and/or fruit rind bitter, and an agave-based simple syrup. The final concentration amounts were tested until the most palatable proportions of each were found. Finally, carbonated water was added to dilute the concentration, modeling what the beverage would taste like if fully carbonated through production. The final recipe serves as a blueprint for a future product to be manufactured.

Discussion

The first goal of this project aims to obtain University of Arkansas student preferences on a proposed non-alcoholic beverage intended to be an alternative to alcohol in social settings. In creating the survey, the researcher felt that students would be more inclined to purchase and consume the product provided it includes two components: a higher nutritional value than competing products and a packaging appearing similar to alcohol. Through an optional, open-ended portion of the survey, students confirmed this hypothesis. 46 out of the 67 students who took the survey offered additional information through the open-ended section. Of those 46, 21 students mentioned nutritional value and 16 students mentioned an appearance mimicking an alcoholic beverage as being important convincing factors.

Aside from those two, the next most common reason students liked this product was to avoid peer pressure when socializing. Secondary research established many students have felt verbally shamed by their peers for their choice of abstinence, as well as commented on how drinking culture is central to most sporting and social events (Herman & Kinney, 2013). However, it was unsure if this problem was as currently prevalent at the University of Arkansas as in former studies. This project's survey revealed 40 out of 67 students have experienced peer

pressure during college. 13 out of the 47 students who filled out the open-ended section stated the potential of reducing peer pressure by offering someone an option to drink without "being questioned" at social events as their main reason for liking the product. Many students also mentioned that enticing packaging along with good marketing and advertising would increase their likeliness to purchase the product. These characteristics were all predicted to be somewhat important to students, but the extent to which students cared about the nutritional value and the utilization of this product to reduce peer pressure was unpredicted. The high interest in a nutritional beverage proves the relevance of this product in the nutrition field and among students as the non-alcoholic beverage industry continues to grow and alcohol-related issues remain prevalent on college campuses.

The survey findings guided the second goal of this project, which was to explore the development of a recipe for the product. Student preferences were used to modify the recipe and design a virtual prototype illustrating the preferred packaging choices. Through trial and error with recipe development, it was eventually decided that using citrus and fruit rind to increase the nutritional value and add a bitter flavor resembling that of alcohol would be the best way to make this product stand out from competing beverages on the market. With further steps taken in the future to fully produce the product, this beverage could act as one solution to the problem alcohol poses for many students around the nation.

Conclusion

In the creation of a non-alcoholic beverage product intended to be an alternative to popular alcoholic cocktails and to alleviate the negative impact of alcohol on college campuses, it was first essential to understand the need for it among its target audience and its place in the beverage market. Feedback from a University of Arkansas student survey revealed there is a

need for such a product in a college environment as more than half the students stated they have experienced peer pressure or have witnessed the negative impacts of alcohol during college. A majority of the students expressed a desire to consume this product in social settings both where alcohol is present and not present. Students also revealed a product like this would be beneficial in alleviating the negative impact of alcohol on college campuses.

Recipe experimentation and modification processes were used in the development of a functional and appealing beverage. Citrus and fruit rinds were used in the recipe to increase the nutritional value of the beverage and add a bitter flavor component, with the added environmental benefit of decreasing food waste. In conclusion, provided the beverage reflects the survey results regarding the taste, packaging, and marketing, a functional, non-alcoholic beverage product could be regularly purchased and consumed by college students as an alternative to alcohol in social settings.

Limitations and Future Research

Concluding there is room on the market and a need for the non-alcoholic beverage product proposed in this project, there is opportunity to move forward with an additional phase. The following recommendations address the limitations of this research and offer suggestions for further product development:

Limitations:

- Majority of the participants were students attaining a degree in nutrition-related fields. This could have resulted in a greater preference for and inclination to consume a functional beverage with high nutritional value. In future research, it is suggested that students across a variety of areas of studies are surveyed to obtain a more accurate representation of the entire student body.

- The exact nutritional composition of this recipe was not assessed. Based on research from other studies, it was predicted there would be an increase in micronutrients and fiber content due to the implementation of citrus and fruit rinds. A full lab analysis should be carried out in a future study to obtain precise nutritional measures.
- Sex of participants was not accounted for. It is possible that the results could be skewed towards a more female demographic.

Suggestions for Future Research:

- Hold a student-based taste-testing group from a small selection of students who have taken the initial survey to receive feedback on the actual recipe.
- After receiving feedback, adjust the recipe to reflect the student preferences if needed.
- Work with the Arkansas Food Innovation Center (or another food and beverage manufacturing facility) to produce the product on a larger scale.
- Use the virtual design to create a physical prototype and conduct a full nutritional analysis of the final product for labeling.

See appendix B for a proposed Phase III methodology plan.

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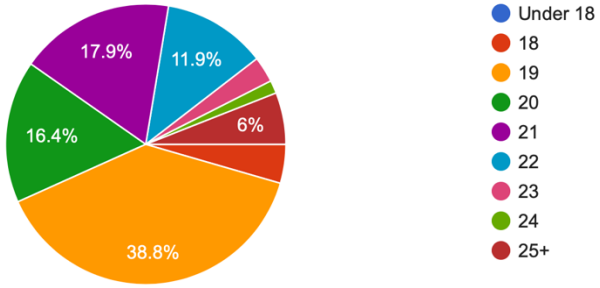
Appendix A: Student Survey Questions and Responses

Section 1: Peer pressure + Perception of Alcohol

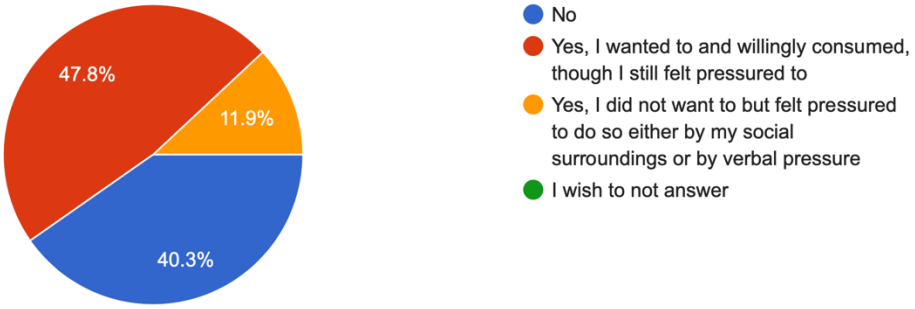
What is your age?

67 responses



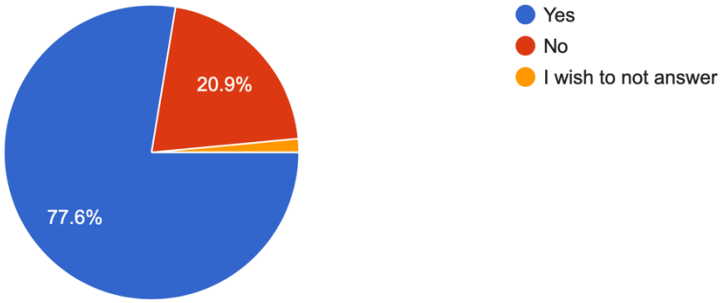
Have you ever felt peer pressured to consume alcohol in college?

67 responses



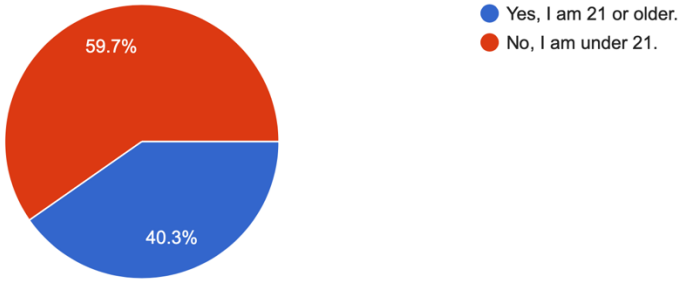
Aside from peer pressure, negative consequences of drinking include driving under the influence, overconsumption, sexual assault, harassment, alcoho...urself, during your college experience thus far?

67 responses



The following questions are for those aged 21+. If you are under the age of 21, please answer "no" and skip to section 4. Are you 21 or over the age of 21?

67 responses



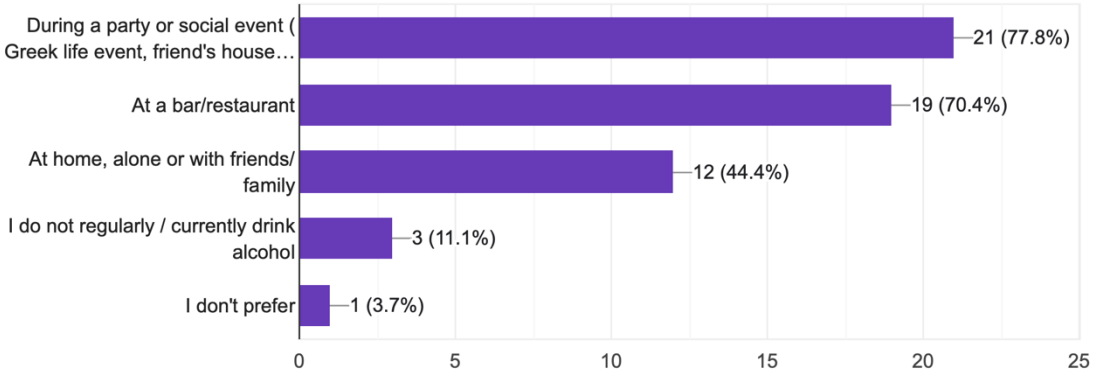
For 21+ Only - Section 2: Alcohol Consumption History and Preferences

What are your current alcohol consumption habits?

27 responses

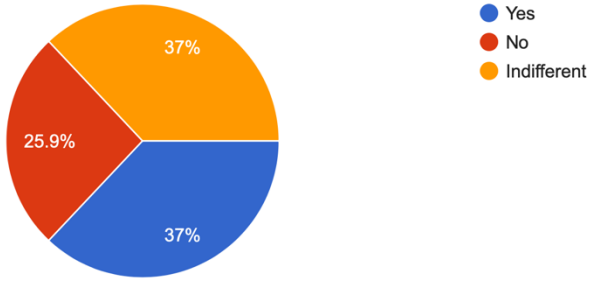
Under what circumstances do you typically consume alcohol? Select all that apply.

27 responses



Do you feel that college environments, specifically the University of Arkansas, encourage or promote the consumption of alcohol in an unhealthy way/amount?

27 responses



Would you buy a non-alcoholic beverage product that mimics an alcoholic beverage? If so, under what circumstances?

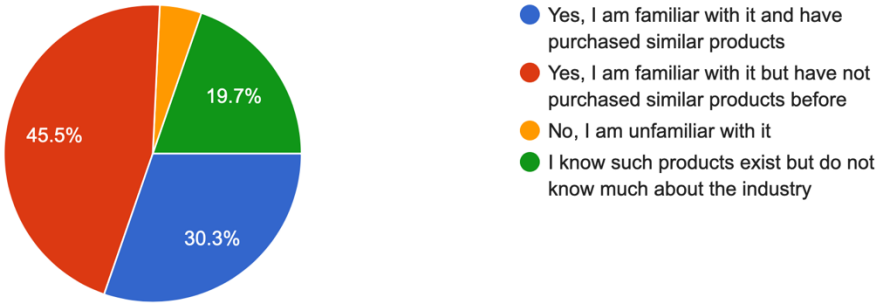
27 responses

Would you prefer a product like this more if it were LOW alcohol, instead of NO alcohol?

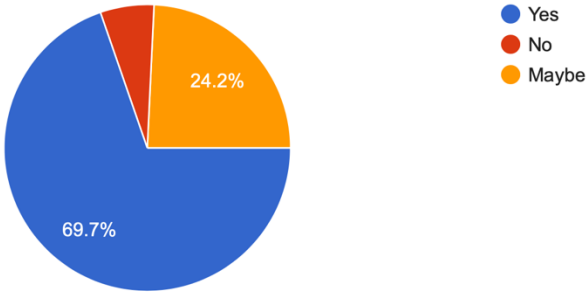
27 responses

Section 3: Knowledge and Perception of the Non-Alcoholic Beverage Industry

Are you familiar with the non-alcoholic, "mock-tail," and zero/low-proof beverage industry?
66 responses



Would you willingly drink a non-alcoholic beverage at a social event where alcohol might be present, instead of consuming alcohol
66 responses

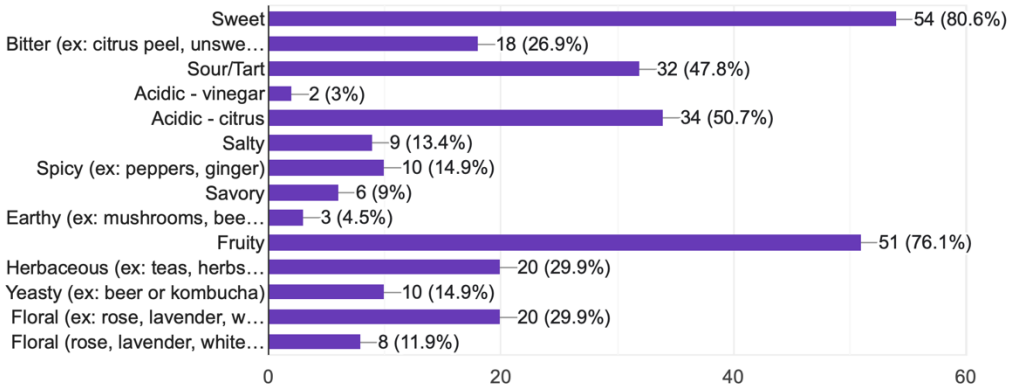


How do you feel about the current non-alcoholic beverage and "mock-tail" market, specifically in products marketed towards sober or sober-curious individuals?
66 responses

Section 4: Taste, Appearance, and Nutritional Composition Preferences

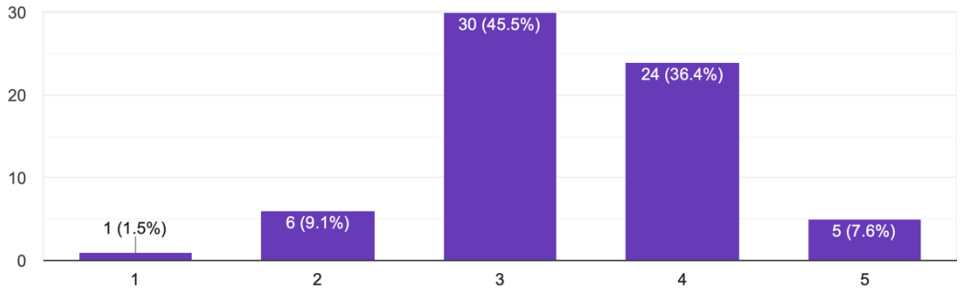
Select the following flavor profiles you would prefer in this product (select all that apply):

67 responses



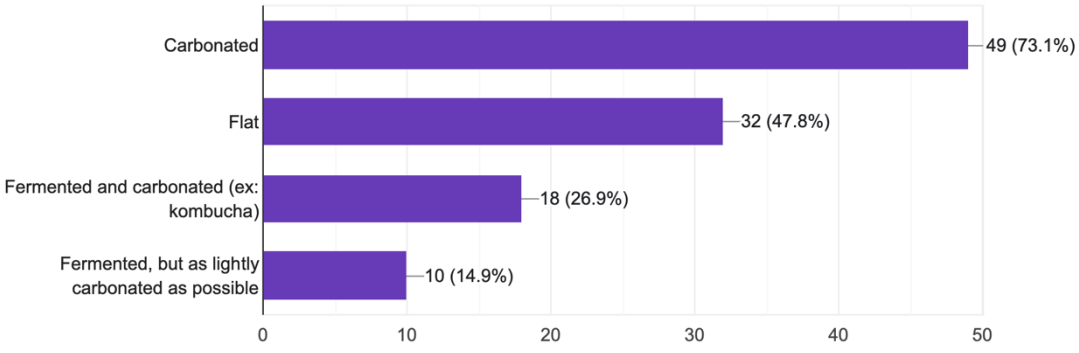
Select your preferences on the product's level of sweetness

66 responses



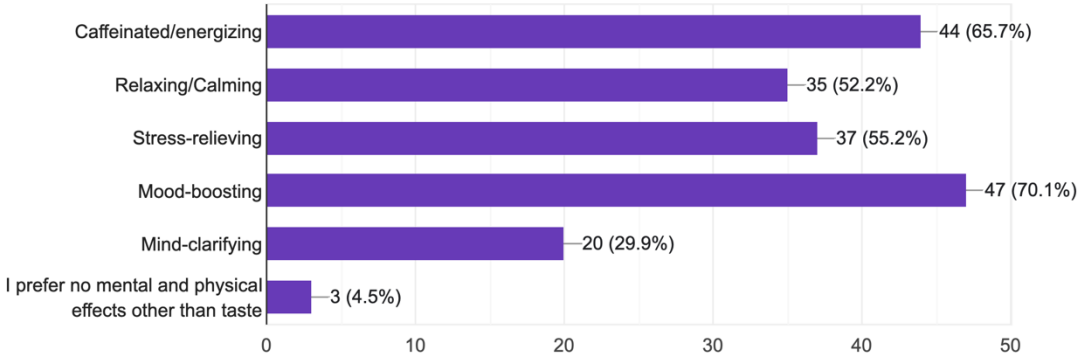
Select your preferences on the product's mouth feel (select all that apply):

67 responses



Select your preferences on the product's potential physical and mental effects (select all that apply):

67 responses

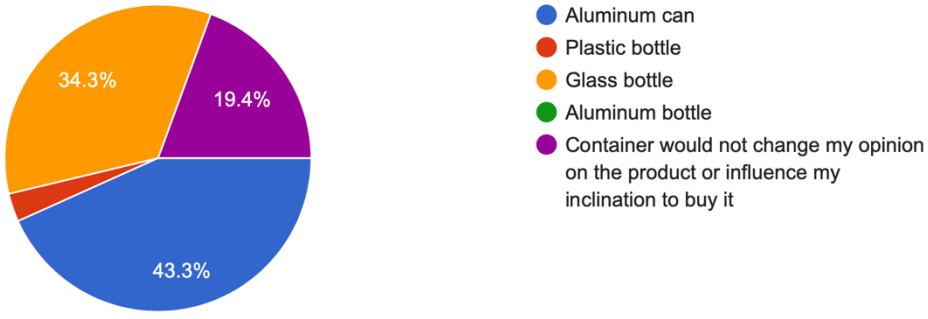


Select your preference on the product's appearance (of the actual beverage, not the packaging):

67 responses

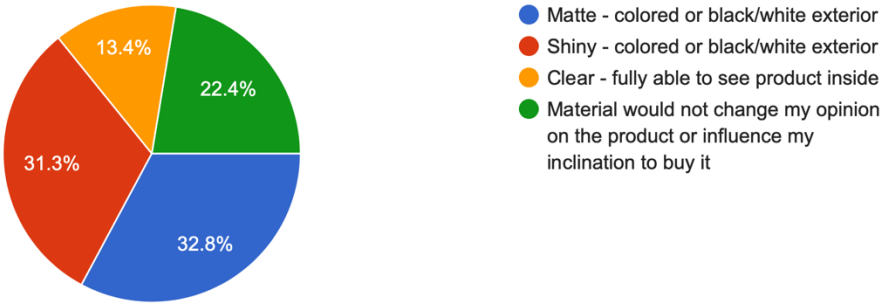
Select your preference on the product's packaging container:

67 responses



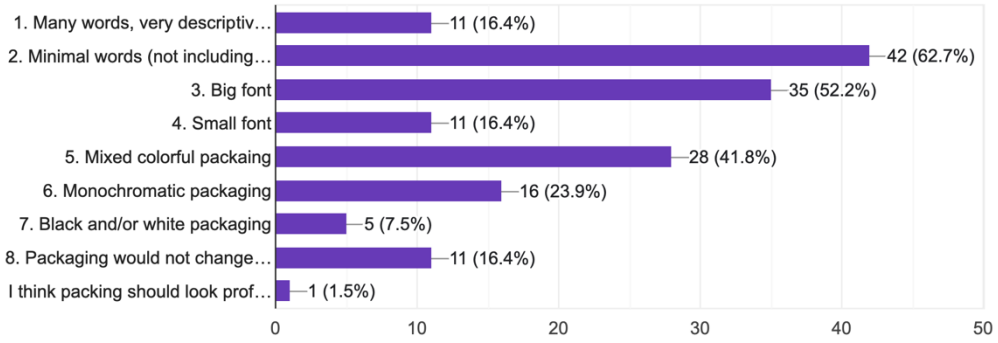
Select your preferences on the product's packaging and material appearance:

67 responses

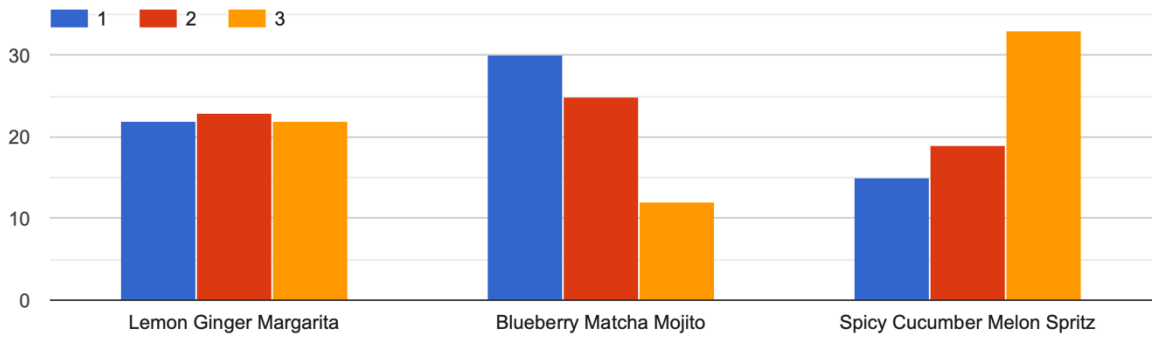


Select your preferences on the product's packaging and wording (please select 1 out of 1-2, 1 out of 3-4, 1 out of 5-7, or only 8):

67 responses

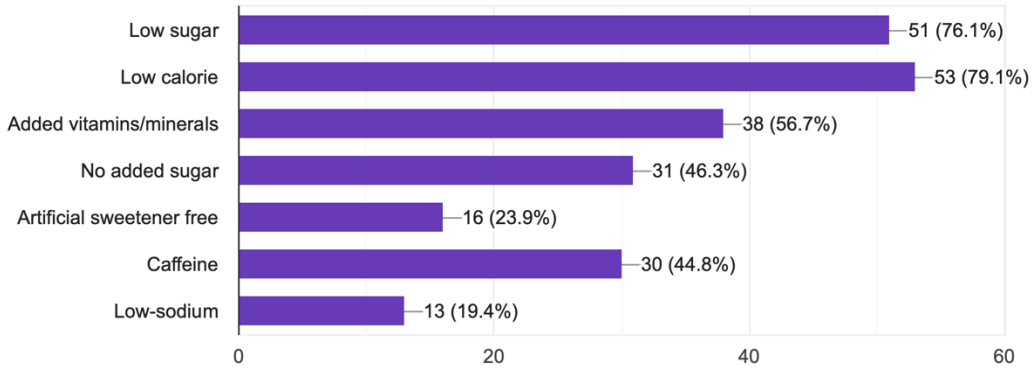


This product's three potential flavors are: Lemon Ginger "Margarita" Blueberry Matcha "Mojito" Spicy Cucumber + Melon Tonic Rank these flavors based on...). If none of them entice you, please write that.

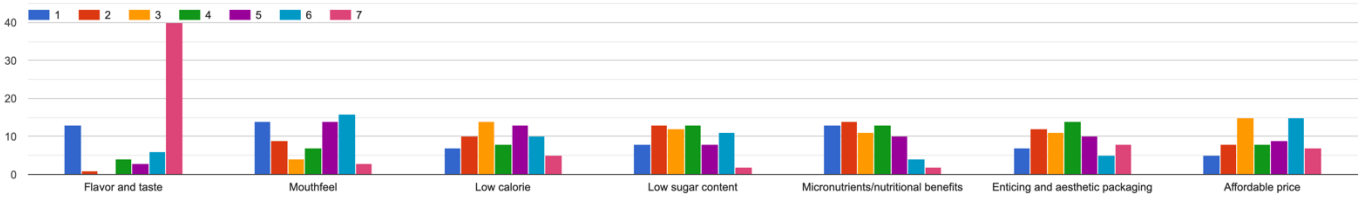


Select all of the nutritional factors you would look for/prefer in this type of beverage:

67 responses

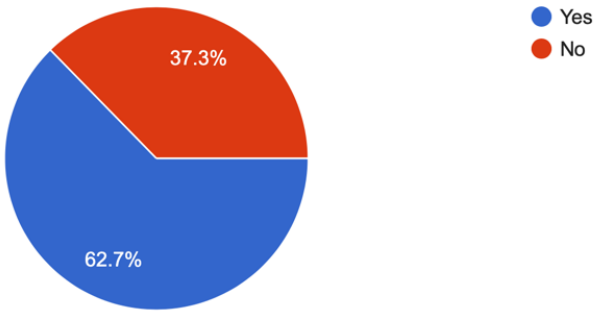


Rank the following based on what matters from least (1) to greatest (7) if you were buying this product



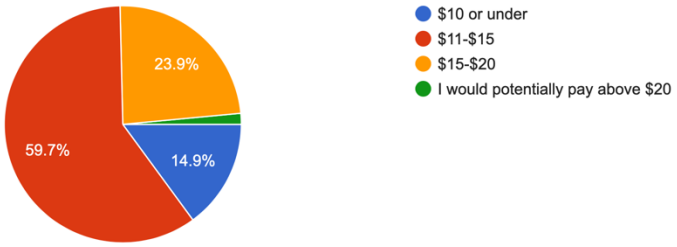
Would you care about micronutrient content (vitamins and minerals) in this product? Would a higher content of these values, along with focused advert...ment on it, persuade you to buy the product more?

67 responses

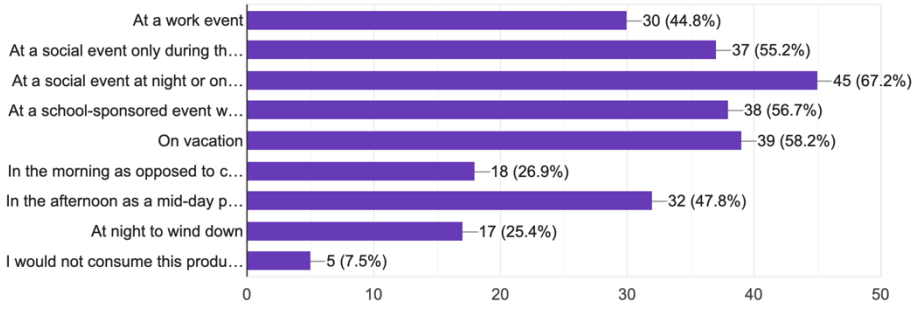


Section 5: Inclination to Purchase and Consume Product

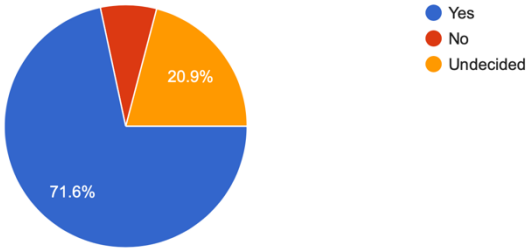
The average price of a 6-pack of White Claws is roughly $15. The average price of a 6-pack of Red Bull or a 6-pack of Starbuck's cold brew beverages ...tional value and acts as a replacement for alcohol.
67 responses



I would consume this product (select all that apply):
67 responses



Provided the drink reflects the choices you've selected through this survey, would you be inclined to purchase this product?
67 responses



Final optional, open-ended questions:

- If you selected yes above, please briefly explain what you like about the product. If you selected no, please explain what is stopping you from buying this product.

- Finally, please explain what this product could further offer or change that would persuade you to buy/consume it more.

Appendix B: Suggested Phase III for Project Continuation

PHASE III:

1. Research safe packaging and preserving methods
    a. Research preservation methods and safety measures for the ingredients used, specifically focusing on the bottling process for the product's future.
2. Obtain more student preferences
    a. Send out the initial survey to a group of students across a wider range of majors.
3. Form a student-based taste-testing team
    a. Advertise the need for a student-based taste-testing team to the participants who took the initial survey to provide feedback on the actual recipe.
    b. Obtain a diverse group of students composed of both students who choose to consume alcohol and those who abstain.
    c. Have the students fill out waivers and allergen awareness forms *(see attached allergen form below).*
4. Conduct a taste-testing session
    a. Hold a taste-testing session to the selected team with samples of all three beverages.
    b. Have the students complete a second survey regarding preferences of the actual product *(see attached survey below)*
        a. The created survey includes questions regarding the beverage's taste, appearance, and price point.
5. Finalize the recipe and analyze its nutritional composition

a. Upon completion of the taste-testing session, make recipe modifications in correspondence to the student responses.

b. Analyze the product's nutritional content for labeling.

6. Follow proper and safe packaging protocol to bottle product

a. Produce the product at a manufacturing plant, such as the Arkansas Food Innovation Center.

b. When bottling the product, follow safe packaging protocol to preserve the product's shelf life and taste.

Allergen form:

Ingredient Consent and Allergy Awareness Form

To participate in the taste-testing session and survey, you will be asked to taste **three** different beverage samples. You will be given a **4-ounce** serving of each sample. You may drink as much or as little as one sip of it as you would like.

Listed below are the names of beverage samples you will taste and their ingredients:

Lemon Ginger "Margarita"
water, agave nectar, lemon juice, lemon peel, ginger juice, lemon balm tea, salt

Blueberry Matcha "Mojito"
water, agave nectar, lime juice, lime peel, matcha powder, butterfly pea tea, blueberries

Spicy Cucumber Melon Spritz
water, agave nectar, lime juice, lime peel, watermelon rind, watermelon flesh, cilantro, cucumber, jalapeño

By signing this, I _____ confirm I am not allergic to any of the ingredients listed above and am willingly agreeing to participate in this study. By participating in this study, I consent to drink each of the provided beverage samples and in return, provide honest and thoughtful feedback on the survey to follow the taste-testing session.

Participant Name Signature Date

Taste-testing Survey:

Developing a Non-Alcoholic Beverage Product - Taste Testing

Thank you for volunteering as a taste-test participant in the creative thesis project, Developing a Non-Alcoholic Beverage Product. The following survey will ask questions on your preferences regarding the flavor, appearance, texture, and likeliness of purchasing the product samples you just tasted.

* Required

1. Rank the flavors from 1-3, 1 being your favorite and 3 being your least favorite. *

Mark only one oval per row.

	1	2	3
Lemon Ginger "Margarita"	◯	◯	◯
Blueberry Matcha "Mojito"	◯	◯	◯
Spicy Cucumber Melon Spritz	◯	◯	◯

2. What do you like **most** about the Lemon Ginger "Margarita" flavor? *

3. What do you like **least** about the Lemon Ginger "Margarita" flavor? *

4. What do you like **most** about the Blueberry "Mojito" flavor? *

5. What do you like **least** about the Blueberry "Mojito" flavor? *

6. What do you like **most** about the Spicy Cucumber Melon Spritz flavor? *

7. What do you like **least** about the Spicy Cucumber Melon Spitz flavor? *

8. What would you change about the overall product? *

9. Would you purchase/drink this product now that you've tasted it? *

Mark only one oval.

- ( ) I would both purchase and drink this product.
- ( ) I would drink it if it were offered, but I would not pay for it.
- ( ) I would neither purchase nor consume this product.

10. What do you like **most** about the appearance of this product's packaging and design? *

11. What do you like **least** about the appearance of this product's packaging and design? *

12. What would you change about this product's packaging and design? *

13. The average price of a 6-pack of White Claws is roughly $15. *
The average price of a 6-pack of Red Bull or a 6-pack of Starbuck's cold brew beverages is roughly $17. The average price of a 6-pack of kombucha ranges from $18-$30, depending on the brand.

Now that you've tasted the beverage samples, what is the max price you pay for a 6-pack of this product?

Mark only one oval.

- ◯ $10 or under
- ◯ $11-$15
- ◯ $15-$20
- ◯ I would pay above $20

14. Select the advertisement platforms you would most likely be convinced to purchase this product if you were to see an ad on one of them. *

Check all that apply.

- ☐ Instagram
- ☐ Tik Tok
- ☐ Facebook
- ☐ Online ad
- ☐ Magazine
- ☐ In a grocery store/market
- ☐ In a campus convenience store, like Club Red
- ☐ Other: _____