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DESIGN OF KOMBUCHA PACKAGING TO COMMUNICATE CONSUMER BENEFITS

HEALTH - NATURALNESS - TASTE

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Abstract

This study examines the role of packaging design elements on shaping consumers' perceived taste, health and naturalness of kombucha. Currently, kombucha, a fermented drink, is quickly gaining popularity globally for its potential health benefits from its probiotic content and its unique taste. However, a packaging design challenge arises from the common consumer belief that “healthy = less tasty.” This study investigates how kombucha brands can communicate health and taste on their packaging through verbal claims, colour, imagery, and shape, with naturalness serving as a potential bridge. Through a literature review, a focus group and quantitative research, this study demonstrates that certain design elements, particularly light, muted, and less saturated colour and possibly scientific health claims can influence consumers' health perception of kombucha positively, without lowering perceived taste. The same colour choices and possibly photographic ingredient imagery were found to increase perceived naturalness, which partially mediates the relationship between packaging and perceived health. Packaging did not affect taste perception. These findings suggest that thoughtful packaging design can enhance consumers’ perceptions of kombucha’s health benefits while maintaining its taste perception.

Keywords

Kombucha, Packaging, Health, Taste, Natural, Purchase Intention

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1. Introduction

Obesity and overweight are urgent growing problems in the world (World Health Organization, 2024). Traditional soft drinks dominate the market, playing a role in these health problems by being full of sugar (Prajapati et al., 2024). Kombucha is a naturally fermented drink which contains a low amount of calories and possibly has health benefits from the probiotics inside. However, healthier drinks such as kombucha are often overshadowed by aggressive marketing campaigns promoting high-sugar soft drinks (Prajapati et al., 2024). Nonetheless, the European kombucha market, valued at $550 million in 2023, is projected to grow to $1.4 billion by 2030 (CAGR 15.17%) (Virtue Market Research, 2024).

Consumers are becoming increasingly health-conscious, with a growing focus on improving well-being through dietary choices. This shift has contributed to the rapid expansion of the fermented food market, particularly in the segment of probiotic beverages (Prajapati et al., 2024). Interest in health has also increased people's interest in natural products (Batista et al., 2022). Among these, kombucha has gained significant popularity for its perceived benefits of being tasty, healthy and natural. However, when communicating this in packaging design tensions arise: People often perceive healthier looking food to be less tasty (Raghunathan et al., 2006). While health benefits play a role, good taste remains the primary driver of consumer satisfaction and purchase intent (Kellershohn, 2021).

To compete with traditional soft drinks, the visual appearance of touchpoints such as packaging is important for brands to foster competitive advantage and market success and is crucial in shaping consumer reactions (Kotler & Rath, 1984). Specific benefits such as health, naturalness and taste can be conveyed to the consumer through various packaging elements such as images, text or style, however, findings from literature on these cues are product category and context specific (Plasek et al., 2020). In the case of kombucha, the presence of probiotics can serve as a health benefit and a key product identifier. To support informed consumer decision-making, this study will further explore how probiotic-related health benefits can be effectively communicated on kombucha packaging. A remaining challenge is putting elements together into a cohesive design (Schifferstein et al., 2021). The benefits that should be noticed first need to be positioned well in the visual hierarchy by the designer, enabling the consumer to quickly grasp the key message (Lupton & Phillips, 2008). However, little literature is available on graphic design and literature may not be effective for designers as studies often are focused on conveying one product benefit or use bit-by-bit detailed manipulations, not an integration of elements (Schifferstein et al., 2021).

The method for searching and identifying literature involved reviewing areas of kombucha, probiotics, fermented beverages and packaging design for papers with ‘Packaging’, ‘Health’, “Taste”, “Natural”, “Perception”, “Market” and “Communication” in the title of Google Scholar.

This study investigates how kombucha packaging influences perceived tastiness, healthiness, naturalness and purchase intention. It examines how kombucha brands in Dutch supermarkets use packaging to communicate these consumer benefits and aims to develop and test packaging that encourages healthier choices without triggering beliefs about taste compromise. To provide a theoretical foundation, the following literature review is divided into two main parts. The first part focuses on the product itself and its context, outlining kombucha’s origin, market, production process, and associated health benefits, elements that are essential to understand but not part of the study. The second part reviews the role of packaging design, examining how verbal claims, colour, imagery and shape can influence consumer perception and behaviour. These packaging elements are central to this study.

2. Literature review

2.1 Kombucha origin and production process

Kombucha, a fermented tea, is thought to have originated in northeast China around 220 BC. It is used for its energising and detoxifying benefits (Jayabalan et al., 2015). Presumably in 414 AD, the drink was brought to Japan to treat Emperor Inkyo's digestive issues (Coelho et al., 2020). Later trade routes spread kombucha to Russia and India in 1800 (Freitas et al., 2022). During World War 1, it spread quickly to other European countries, where it became an acceptable habit to drink fermented tea (Freitas et al., 2022; Hartmann et al., 2000). However, this decreased due to the shortages of kombucha's essential sugar and tea ingredients in World War 2. After the war, the drink was very popular in Italy during the 1950s (Hartmann et al., 2000).

Kombucha is a drink made by aerobic and anaerobic fermentation of sweetened (black) tea with a Symbiotic culture of bacteria and yeast (SCOBY). This SCOBY typically includes yeast strains (*Schizosaccharomyces pombe, Saccharomycodes ludwigii, Kloeckera apiculata, Saccharomyces cerevisiae, Zygosaccharomyces bailii, Torulaspora delbrueckii, Brettanomyces bruxellensis)* (Coton et al., 2017), Acetic Acid Bacteria species (*Komagataeibacter, Gluconobacter, and Acetobacter)* (De Roos & De Vuyst, 2017) and Lactic Acid Bacteria species (*Lactobacillus and Lactococcus)* (Marsh et al., 2014). The yeast convert added sugar into ethanol, while Lactic Acid Bacteria ferment it into organic acids. Subsequently, Acetic Acid Bacteria strains transform ethanol into acetic acid. The acids contribute to kombucha's characteristic sour taste (Villarreal-Soto et al., 2018). The fermentation takes place at room temperature for around 10-14 days. Most kombucha sold in retail is flavoured and coloured, with real (fruit) juice or added flavouring or colouring. Often the flavours are a mix of multiple flavours of ginger, lemon, berries, lime, mint and mango (Kim & Adhikari, 2020).

SCOBY frequently evokes a feeling of disgust in people unfamiliar with it (Kuznetsov et al., 2016). Disgusted by the texture and look of SCOBY, a gelatinous brown to creamish-looking slab that is sometimes lumpy or patchy. However, disgust disappears after discovering the benefits and tasting kombucha (Senyildiz, 2021). Bioactive compounds created by these SCOBY microorganisms during the process grant the beneficial health properties of kombucha (Prajapati et al., 2024).

Possibly communicating the historic value and the SCOBY fermentation process on packaging could educate consumers on kombucha's possible health benefits, enhance perceived naturalness, and help differentiate kombucha from other drinks. At the same time, visualising the process too literally, such as showing the SCOBY in detail, may evoke feelings of disgust.

2.2 Market

The modern commercialisation of kombucha started just over 20 years ago, yet the market size and product variety are growing rapidly (Kim & Adhikari, 2020). Currently, the global kombucha market is surging, driven by increasing interest among consumers in functional and healthy drinks. This growth is expected to continue, supported by ongoing innovations to expand the appeal of kombucha with fermentation techniques, flavours and packaging (Prajapati et al., 2024). The functional food movement, coupled with the movement research of microbiome on human health, has driven the popularity of kombucha (Kapp & Sumner, 2018).

Consumers are looking for benefits besides basic hydration from beverages. Preferred additional benefits vary, with top choices including probiotics (46%) (Kellershohn, 2021). Probiotics are live microorganisms that improve the balance of beneficial microbes in the intestinal flora. Probiotics support a healthy gut microbiota, which is essential for maintaining human health, by enhancing immune function, reducing disease risk, and aiding in recovery. These health effects are strain-specific (Abatenh et al., 2018). The global probiotic market is expanding because of two key drivers: increased disposable income and a growing ageing population (Kellershohn, 2021). A study

on health and economic impact of generalised probiotics consumption in France for common respiratory tract infections found that the health benefits contributed by probiotics can generate yearly savings for healthcare between €15-38 million a year (Lenoir-Wijnkoop et al., 2015).

Today, kombucha is often seen as an alternative healthy soft drink to standard soft drinks, due to kombucha's lower calorie and sugar content (Ariff et al., 2023). Kombucha companies in the Netherlands position Kombucha as a soft drink and an alternative to alcoholic drinks.

2.3 Kombucha health effects

Kombucha is widely drunk globally for its health benefits, yet it has not been tested in human trials (Selvaraj & Gurumurthy, 2022). There are many claims of health benefits of kombucha in nonhuman subjects' literature but there is a lack of human clinical trials that confirm these claims (Kapp and Sumner, 2018).

Studies suggest that kombucha offers many different health benefits. These include being a rich source of probiotics, improved digestion, modulating gut microbiota, antimicrobial, anti-inflammatory and antioxidant properties, improved immune functions, detoxification, prevention of cardiovascular diseases, antitumor and anticarcinogenic (Ayivi et al. 2020; Da Anunciação et al., 2024; Kitwetcharoen et al. 2023; Liburdi et al., 2020; Prajapati et al., 2024; Vargas et al. 2021). Among health-conscious consumers, kombucha has become a popular choice (Kitwetcharoen et al. 2023). In a survey by the International Food Information Council (2020), 65% of people perceived probiotics to be healthy.

A study in the USA about retail kombucha found that eight out of twelve drinks contained viable kombucha cultures. The pasteurisation or other measures to stop the fermentation process likely caused the remaining four to have intact non-viable kombucha cells. Added viable probiotics were found in three out of the four remaining kombuchas. Remarkably, the kombucha in which no viable organisms were found, 'Live Probiotic Kombucha' is used on the packaging (O'Sullivan & O'Sullivan, 2024). Kombucha sold in retail contains many fewer Colony-Forming Units (CFU) than, for example, yoghurt. Kombucha is found to range from 10^2 to 10^9 CFU/ml, which is a comparable amount to traditional Asian fermented foods such as miso and tempeh (Harrison et al., 2023). Probiotic doses should be in the billions of cells is the widely accepted criterion, meaning only samples with more than 10^6 CFU/ml meet a standard of a minimum of one billion cells per 500ml kombucha package. In a study in the US, 39 kombucha drinks from 21 brands were analysed. 74 % used a microbial claim ("live", "probiotic") on the packaging. Yet, only 13% of these packages were found to meet the threshold (Harrison et al., 2023). Nonetheless, multiple studies have found that dead microorganisms or the by-products of their metabolism can stimulate the microbiome, contributing to consumers' health, suggesting that the functionality is not compromised after some ways of processing (Barros et al., 2020).

Kombucha contains fewer calories and sugar in comparison to regular soft drinks such as Cola. Kombucha in retail in 2020 had an average calorie content of 14.12 kcal and an average sugar content of 3.17 g. per 100ml. Whereas on average, Cola has a calorie content of 39.5 kcal per 100 ml and an average sugar content of 10% by weight (Kim & Adhikari, 2020).

2.4 Visual packaging cues for health, taste and naturalness

Consumers often base their purchase decisions at the point of purchase on explicit packaging cues such as claims and price and implicit cues such as graphic design, material, shape and colour (Van Ooijen et al., 2016). The health and taste perception of food can be influenced by multiple cues on packaging (Plasek et al., 2020). However, health and taste is a common tension point in food packaging design, driven by the consumer belief that "healthy = less tasty" (Raghunathan et al.,

2006). This belief can decrease the purchase intention of healthier-looking vice food (Schnurr, 2019). When packaging focuses only on communicating health it can evoke negative associations, such as lower perceived taste and appeal (Fenko, 2018; Lähteenmäki et al., 2010) and do not necessarily lead consumers to prefer healthier food or reconsider unhealthier choices when purchasing (Turnwald & Crum, 2018). Health centred packaging often lacks cues for taste rewards and satisfaction, requiring consumers to restrict themselves with self-control which is frequently not successful. To effectively promote healthier choices, studies emphasize the need to strike a balance between health and taste cues, rather than focusing solely on health benefits (Li et al., 2024; Turnwald & Crum, 2018). Moreover, the influence of packaging cues is context dependent. For example, shapes and colours that positively affect health perception, vary per product category. This makes packaging design a complex topic that requires research within different product categories (Plasek et al., 2020).

Another important factor shaping consumer attitudes and positive acceptance is the perceived naturalness of food. Consumers largely prefer natural food because of health and nature benefits, being regarded as natural, pure and unprocessed (Rozin, 2005). Stressing the health-related naturalness of a product has a more direct impact on attractiveness and purchase intention than emphasising its environmental advantages (Binninger, 2015). This reflects a common consumer belief that natural equals healthy and tasty (Wang et al., 2022). In the context of functional foods, the naturalness of functional components is especially valued. Consumers prefer naturally occurring nutrients over those that are artificially added (Kraus, 2014; Teratanavat & Hooker, 2006).

Given that naturalness plays a role in both taste and health perceptions, this study investigates how explicit packaging cues; verbal (health and taste) claims, and three implicit cues; colour, shape, and (health and ingredient) imagery, affect consumers' perceptions of healthiness, tastiness, and naturalness. Additionally, it explores how these cues may help manage the tension between health and taste.

2.4.1 Explicit cues

2.4.1.1 Verbal health claims

For companies to ethically claim health benefits, human trials are needed to confirm the health benefits of kombucha found in nonhuman studies (Selvaraj & Gurumurthy, 2022). Probiotic drink consumers value clear and transparent communication of the product ingredients and benefits on packaging. Seeking confidence that the probiotic drink will fulfil its marketing promises (Kellershohn, 2021).

According to a non-binding EU claim regulation, it is forbidden to use the claim ‘probiotics’ for food products as it is considered to be an insufficiently precise health claim, unless it is used in association with an authorised health claim for a specific microorganism or has been specifically approved as a health claim (European Parliament and Council of the European Union, 2006). The scientific name of a microorganism is generally permitted for communication, for example, yakult features the name *L. casei Shirota* on its packaging, but consumers may not fully understand these technical terms (Food Supplements Europe, 2021). Despite the EU regulation, more and more member states are allowing the use of 'probiotics’ under certain conditions. Currently, in the Netherlands, using Probiotics as a category classification is permitted; however, further explanation of the health effects is not authorised (Buijs, 2024). Regardless, loopholes are used by many brands by using descriptions which refer to microbial content or gut health such as “Living green tea”, “Live cultures”, “Gut-loving”, “Gut friendly” and “GUTsty” (a play on “gut”). This emphasises the need for regulation on food labels/claims referring to probiotics to avoid misleading consumers. While not all kombucha brands use microbial health claims, most promote the healthiness of kombucha explicitly through nutritional claims such as “low calorie” or “zero sugar,” as well as marketing terms like “natural” and certification labels such as “organic”.

Implicit packaging elements for health-positioned products should be used in combination with health claims and labels. If not, it is possibly misleading to consumers when used in isolation to convey healthfulness (Festila & Chrysochou, 2018). Another study also suggests that health claims are essential for communicating the potential benefits of functional foods (Lähteenmäki, 2012). However, this is challenged by findings from an eye-tracking study that revealed that health associations were not elicited by health claims or product descriptions (probiotic milk) but by graphic design (Oliveira et al., 2015). In addition to this, health claims have also been shown to cause a negative effect on the perceived naturalness (Lähteenmäki et al., 2010). While Schifferstein et al. (2021) suggest that consumers tend to place greater trust in verbal claims related to long-term health benefits. Therefore, health claims must be selected with caution, particularly given that the effectiveness of such claims is not always guaranteed (Plasek et al., 2020).

2.4.1.2 Verbal Taste claims

Kombucha brands may try to increase taste perception with claims on the packaging such as “Delicious taste” and “Great taste.” A study has shown that taste claims on healthy food are experienced as more delicious and indulgent, and were chosen 38% on average more often than with health claims (Turnwald & Crum, 2018). Combatting the common belief that healthy is not tasty (Raghunathan et al., 2006). However, another study found that the taste claim led to higher taste expectations than the health claim, but it did not differ from having no claim, contradicting the other study, possibly due to using sensory taste claim such as ‘sweet’ instead of indulgent taste claims such as ‘mouthwatering’ (Garaus et al., 2023). Jurafsky (2014) suggests that appealing adjective claims such as ‘crunchy’ are informative but might be ineffective because of subjectivity. In contrast, vague claims such as ‘delicious’ offer little information and are suggested to be a linguistic filler. Similarly, Schifferstein et al. (2021) found that using verbal claims that can be verified by the consumer when tasting the product may cause a loss of confidence in the brand. These findings highlight the importance of wording in taste claims and its potential impact on both health and taste perceptions.

These insights prompt the current study to explore if scientific claims and loophole claims that refer to probiotics affect perceived healthfulness, naturalness and taste of kombucha. In addition to how effective taste claims are on perceived tastiness and purchase intention of kombucha packaging.

2.4.2 Implicit cues

2.4.2.1 Colour

Another way kombucha brands may try to increase taste perception may be by using bold colours on the packaging. Colour is a large influential cue on people's perceptions and expectations of flavour, sweetness and calorie content (Fenko, 2018). However, the impact of colour on health judgments is highly context-dependent, varying across product categories, cultures, and individuals. No single colour consistently influences health perceptions across different foods (Steiner & Florack, 2023). Moreover, colour effects are not only product-specific but also sensory attribute-specific (Tijssen et al., 2017). For example, consumers perceive vibrant, high-saturated food packaging as less healthy compared to those in more muted, less saturated, lighter, warmer and balanced colours packaging (Mead & Richerson, 2017; Festila & Chrysochou, 2018). Whereas another study on yoghurt packaging did not find that either high vs low arousal colour evokes health perception (Theben et al., 2020). Other research highlights that perceived sensory expectations are influenced by a combination of colour factors rather than by a single element. Specifically, highly saturated colours combined with red increased taste intensity expectations for dairy and sausage products. In contrast, without red, high saturation mainly raised sweetness perceptions without affecting perceived taste intensity (Tijssen et al., 2017).

Specific colours also trigger distinct associations; Packaging with watered-down, less vibrant blue colour evokes a stronger association with healthiness in comparison to attractiveness, while red

packaging gives the expectation of high flavour intensity, sweetness and creaminess (dairy), fattiness (sausage) (Tijssen et al., 2017). Contradicting this finding, red to yellow gradient colour on cookie packaging was perceived to be healthier. Nonetheless, both red to yellow and blue to green gradients on packaging were perceived to be sweeter than greyscale packaging (Da Rosa et al., 2018). In addition, pink colours are linked to an expectation of sweetness, while yellow colours are associated with an expectation of sourness (Matthews et al., 2019).

Further complicating matters, research on the colour of nutrition labels on packaging found that artificial colours, such as pink, celadon and heather, were associated with artificial additives and thus perceived as unhealthy (Vila-López & Küster-Boluda, 2017).

Research specifically on kombucha packaging colour is limited. However, one study found that green labels were preferred over yellow labels, with the yellow label even evoking feelings of disgust (Jiang et al., 2022).

These findings suggest that careful colour selection is crucial for balancing health, naturalness and taste perceptions in kombucha packaging. While using colours that enhance perceived tastiness might improve flavour expectations, it could simultaneously reduce the perceived healthiness of the product, but it is context specific. Therefore, this study explores how different colour choices influence consumer perceptions of kombucha as healthy, natural and tasty.

2.4.2.2 Health imagery

The health perception of food can be enhanced by using health and nature imagery (Festila & Chrysochou, 2018). Another study found the opposite regarding health imagery. Schifferstein et al. (2021) suggest that health-related images may have a negative effect on the perceived healthiness of the food product; nevertheless, if this effect is the case only for the used stimuli or if omnipresent needs to be studied. The same study suggests that slightly abstracted microscopic images of bacteria on yoghurt packaging may evoke negative feelings of disgust and fear on yoghurt packaging. Possibly causing a low aesthetic rating and convincingness. Another study found that images of human organs and bacteria possibly elicit connections with scientific experimentation and high-tech innovations, which contradict the association of natural food production (Janich, 2017). Representations of organs on food packaging to convey health claims are often abstracted and cartoonish to possibly minimise the feeling of disgust and aversion (Lemke et al., 2021), making the association with organs less confronting (Fokkinga & Desmet, 2013).

Gut health imagery could possibly be used on kombucha packaging to convey its health benefit. This research will explore whether realistic or abstract gut health imagery can shape consumers' perceptions of health and naturalness.

2.4.2.3 Ingredient imagery

Kombucha is often fruit and herb flavoured, which in the Dutch kombucha market is communicated, if visualised, on the packaging with cute, cartoonish illustrations. Cute packaging design increases the perceived tastiness and decreases the perceived healthfulness, increasing the purchase intention of vice products, decreasing the purchase intention for relative virtue products (Schnurr, 2019). Unrealistic illustrations are a popular way to present images for vice food that is avoided due to health reasons, such as Nutella. Decreasing consumers' perceived unhealthiness and boosting sales compared to realistic photographs (Kim et al., 2019). Kim et al. (2019) suggest that for new-to-the-market food products, unrealistic imagery can have a negative effect because it looks tasteless, lowering the purchase intention. Photography is also found to be more appealing on chocolate packaging than illustrations, evoking important feelings of reliability through realism (Kovač et al., 2019).

When communicating flavour, Smith et al. (2015) have found that using a photograph of strawberries instead of solely the word strawberry on the packaging sets consumers' expectations that the flavour comes from the real ingredient instead of artificial flavouring.

The majority of kombucha packaging sold in Dutch supermarkets uses abstract decorative elements such as paint swirls, seemingly having no implicit meaning. A study on chocolate packaging found that concrete patterns relevant to what is packaged are more appealing than abstract patterns because they communicate information about the product and its contents (Kovač et al., 2019). The shape of patterns also influences taste expectations. Rounded patterns are linked to an expectation of sweetness, and angular patterns are associated with an expectation of sourness. When the taste expectations are influenced by both pattern and colour, colour has a stronger impact than pattern (Matthews et al., 2019)

The findings from these studies are important for understanding how to design kombucha packaging that conveys both the health benefits and the tasty, natural appeal of the product. This research will explore which types of ingredient imagery, whether realistic or abstract, resonate most with consumers in shaping their perceptions of health, naturalness and taste.

2.4.2.4 Shape

The shape of packaging is one of the two most important packaging elements that influences consumers' purchase decisions (Hassan et al., 2012). Specifically, shape of cans can positively influence perceived healthiness and shelf recognition. Studies have shown that packaging resembling a slim human body shape increases health perceptions compared to wider shapes, particularly when consumers have a health-focused shopping goal (Van Ooijen et al., 2016; Yarar et al., 2019).

While packaging shape did not significantly affect expected taste intensity in the case of slim vs. wide shapes (Van Ooijen et al., 2016), other studies suggest that shape can influence taste perception. A study on coffee packaging found that packaging with more complex angular shapes, such as hexagonal, was perceived to have a high taste intensity (Poslon et al., 2021). Angular packaging, opposed to rounded packaging, was also possibly associated with heightened perceptions of taste intensity of yoghurt (Becker et al., 2011). Rounded drinks packaging shapes and textures can raise the perceived sweetness in comparison to angular packaging (Fenko, 2018). Whereas another study found that angular packaging over rounded packaging evoked sweeter taste associations (Da Rosa et al., 2018).

Kombucha brands first used glass bottles when entering the Dutch market, however, today almost all use cans. The kombucha industry introduced canned packaging to reduce the price, product portability, sustainability and recyclability (Kim & Adhikari, 2020). Despite this, one Phd dissertation research with 300 kombucha drinkers in the United States found that people showed a strong preference for kombucha in glass bottles, while their opinions on non-glass containers (such as plastic/PET bottles and aluminium cans) were largely neutral (Kim, 2020). For younger consumers, however, convenience is key (Kellershohn, 2021).

These insights highlight that the packaging vessel is not only a functional aspect of kombucha, but that the shape can communicate healthfulness and taste. This study researches whether the slim vs wide vessel shape of kombucha packaging influences perceptions of healthfulness.

2.5 Conclusion

This literature review has explored how packaging design elements colour, imagery, verbal claims, and packaging shape can influence consumer perceptions of kombucha's perceived health benefits, naturalness and tastiness. Current kombucha packaging, especially in the Dutch market, often uses

vibrant colours and cartoon imagery that appeal to taste but may conflict with the health benefits of kombucha. Research suggests that lighter, warmer colours and more realistic imagery may better communicate both taste and naturalness, while more abstract visuals could reduce feelings of disgust when conveying health. Potentially, kombucha's natural fermentation process can be used to convey health. While verbal health and taste claims are commonly used on packaging, literature reveals mixed effects. Taste claims can either enhance perceived tastiness or evoke negative feelings. Health claims may not communicate health benefits more effectively than graphic design elements and may even reduce perceived naturalness. Additionally, packaging shape plays a role in health perception; slimmer shapes of packaging are perceived to be healthier.

This study will qualitatively and quantitatively explore the following research question: *How do colours, imagery, shape, and verbal claims on kombucha packaging influence consumer perceptions of healthiness and taste, and to what extent is this relationship mediated by perceived naturalness?*

These elements are critical because they directly influence consumer perception; however, literature shows varying results both across product categories and more generally. Clear communication of product benefits remains essential but is not yet fully understood, particularly regarding gut health messaging in the rapidly growing kombucha market. To address this, the study first explores consumer perceptions of current kombucha packaging through qualitative research. Based on these insights and the findings from the literature review, new packaging design stimuli will be developed. These designs will then be evaluated quantitatively to gain a deeper understanding of how effective they communicate kombucha's dual positioning as a healthy and tasty drink whilst being natural.

3. Study 1: Qualitative research

3.1 Method

3.1.1 Data collection

A focus group interview with five participants was conducted to explore consumers' perceptions of kombucha packaging. This qualitative approach was chosen as an initial step to gain insights into how consumers interpret packaging elements in a real-world context. These exploratory findings helped identify themes and consumer reactions that informed the development of ecologically valid hypotheses and stimuli for the subsequent quantitative study.

A semi-structured interview format was used, allowing for flexibility while ensuring key topics were covered. The questions were built upon findings of the literature review and guided by the research question, see Appendix A1. The discussion followed this structure: 1. Introduction, 2. Awareness, purchase motivation, and knowledge of kombucha, during which images of SCOBY were shown (Appendix A2, Figure 2) 3. Branding and packaging perception. In this last stage, participants discussed their perceptions of five physical kombucha cans from different brands available at the Dutch supermarket Albert Heijn (Appendix A2, Figure 3). To ensure consistency, berry flavours were chosen for comparison, with yuzu as a substitute for the brand without berry options. The common flavour of ginger was intentionally excluded, as it is strongly associated with health, which could influence participants' perceptions. The 1.5-hour focus group session was conducted in person, audio-recorded, and subsequently transcribed anonymously. Prior to participation, all participants provided informed consent.

Participants were recruited through convenience sampling, and a homogeneous group of design students (age 23–26) was formed: four women and one man from diverse cultural backgrounds, three Chinese and two Dutch. While participants were not selected based on prior kombucha consumption or probiotic interest, their age group aligns with the target demographic for kombucha, as the 18–34 age range shows the highest general interest in probiotic beverages (Kellershohn, 2021).

3.1.2 Analysis

Using a thematic analysis in Atlas, 95 codes were extracted and placed into 16 themes. The themes are divided into the four packaging cue categories: Claims, imagery, colour and shape.

3.2 Results & Discussion

3.2.1 Explicit cues

Claims: Participants did not initially notice the probiotic claims on the packaging, possibly because the design was perceived as overwhelming due to an overload of verbal information. When asked about the probiotic claims, they found terms like “Live cultures” and “gut friendly” confusing and scary. Someone misunderstood “cultures,” associating it with human cultures rather than probiotics, with one participant suggesting that this confusion might be due to a language barrier. The claim “gut friendly” even evoked negative reactions, with one participant mentioning lactation and others questioning the credibility of the term, arguing that anyone could claim to be “friendly.” Additionally, the wording seemed to imply that other drinks were not gut-friendly, leading participants to suggest that “gut improving” might be more appropriate. These insights suggest that not only imagery of bacteria, as found by Schifferstein et al. (2021), but also certain probiotic-related verbal claims can evoke disgust and fear.

Contrary to literature that indicates that health claims are essential on health-positioned food packaging (Festila & Chrysochou, 2018; Lähteenmäki, 2012), this focus group indicates that it might be negative to include some health claims as they evoke too much disgust and fear, besides literature finding that it can harm the perceived naturalness (Lähteenmäki et al., 2010). Moreover, participants did not associate these claims with increased healthfulness, supporting Oliveira et al.’s (2015) finding that graphic design has a stronger influence on health perception than verbal health claims.

Labels such as “biologic” and “organic” were not actively sought out, although two participants noted they liked seeing them, as they were associated with health. In contrast, the nutritional claim “Zero sugar” was frequently noticed and considered important when selecting drinks.

Regarding taste, participants generally ignored explicit taste claims (‘Delicious taste & Great taste’), instead relying on flavour names and ingredient descriptions to form expectations. This supports Jurafsky's (2014) idea that vague claims such as ‘delicious’ function as linguistic filler, offering little informative value and failing to evoke a meaningful response from consumers.

3.2.2 Implicit cues

Imagery: Participants preferred realistic illustrations or photographic imagery of ingredients over cartoon-style illustrations. Realistic visuals were perceived as more real and not artificial flavour. In contrast, cartoon imagery was more likely to evoke negative taste perceptions by implying syrup or artificial chemicals rather than real fruit ingredients. These findings align with previous research showing that photographic images, compared to illustrations, enhance product appeal and realism, thereby increasing perceptions of reliability (Kovač et al., 2019). Similarly, Smith et al. (2015) found that showing a photograph of a strawberry instead of just the word “strawberry” was found to set expectations for real ingredients rather than artificial ingredients. These results are consistent with Kim et al. (2019), who reported that cartoon illustrations may reduce perceived taste. However, they contrast with Schnurr (2019), who found that cute cartoon imagery can actually enhance perceived tastiness for food primarily chosen for taste.

Participants favoured packaging with ingredient imagery for its clarity in communicating what the drink contains. In contrast, unrelated visuals, such as mountains or oversized logos, were considered confusing and unhelpful. These findings echo Kovač et al. (2019), who found that concrete and content-relevant visuals are more appealing than abstract patterns because they convey meaningful information about the product.

After being shown pictures of SCOBY and learning how kombucha is made, some participants found the concept unappealing, describing the bacteria and yeast as making them imagine "tiny walking things". While another participant mentioned that the reuse of the SCOBY in multiple batches was off-putting and detracted from the drink's appeal. These reactions reflect similar findings from Schifferstein et al. (2021), who noted that imagery suggesting bacteria can evoke fear and disgust. Unlike Janich (2017), however, no associations were made with scientific innovation or experimentation when viewing bacterial imagery.

Colour: The focus group results, where neon, vibrant and flashy colours are perceived as less healthy, align with existing literature, which found this for vibrant, high saturated colours (Mead & Richerson, 2017). Participants noted that these colours gave an impression of artificial taste and associations with energy drinks, which are perceived to be unhealthy and which they found unattractive. Natural, as opposed to artificial, is perceived as healthier by the participants. This aligns with findings that artificial colours of nutrition labels were associated with artificial additives and thus perceived as unhealthy (Vila-López & Küster-Boluda, 2017). The focus group suggested that brighter colours may be perceived as tasty and attractive, they were not linked to artificial taste, however, with sweetness and, therefore, were not seen as healthy. Notably, the brighter colour was pink, which is a hue often connected to sweetness (Matthews et al., 2019).
Literature suggests that muted, less saturated, lighter colours increase the health perception of food (Festila & Chrysochou, 2018). However, this wasn't universally true for all light colours in the focus group. Light grey and light beige were also perceived as artificial and unattractive, similarly to findings of literature where yellow kombucha labels were seen as less appealing than green labels (Jiang et al, 2022). Nevertheless, no disgust was evoked by yellow, like that study suggested. On the other hand, light pastel colours were seen as attractive and healthier by some participants, reinforcing the idea that light colours can have positive associations with health.

Shape*:* Slim and wide cans were generally perceived as unhealthy by participants, who frequently associated them with products like alcohol, beer, energy drinks, cocktails, and lemonade. One participant remarked, "If it's in a can, it won't be healthy," and several participants noted that drinking from a can in the morning, when one might seek gut health benefits, felt unusual and inappropriate.

These results suggest that the vessel type (metal can) might evoke stronger unhealthy associations, regardless of whether it is slim or wide. This contrasts with previous findings by Van Ooijen et al. (2016) and Yarar et al. (2019), who found that slimmer, human-like package shapes are perceived as healthier. An alternative explanation could be that, because cans are rounded, they may be subconsciously associated with sweetness, as Fenko (2018) found that rounded packaging shapes can heighten the perception of sweetness.

Overall, these findings suggest that the choice of vessel needs to be carefully reconsidered for health-positioned products, as metal cans currently evoke associations opposite to healthfulness.

3.3 Conclusion

The focus group results show that consumers' perceptions of naturalness, health, and taste in kombucha are influenced by multiple cues.

Health perception was not strengthened by health claims. Instead, these claims often evoked confusion, skepticism, and even disgust. Likewise realistic imagery of the natural production process with SCOBY also evoked disgust. Healthier impressions were more effectively supported by the explicit nutritional claim 'Zero Sugar' and by the implicit cue of lighter, muted, pastel colours. Vessel shape also impacted health perception, although negatively; Slim and wide cans were linked to unhealthy product categories like alcohol and energy drinks, undermining the intended health positioning. This suggests that packaging category associations may outweigh the effects of shape alone.

Taste expectations were mainly influenced by implicit cues of colour and imagery, rather than by shape or explicit taste claims. Although "Delicious taste" is an explicit taste claim because it directly states a positive attribute of the product's taste, participants ignored vague claims like this. Instead, they formed their taste expectations based on implicit cues like flavour names, naturalistic ingredient imagery, and colour. Specifically, natural, realistic ingredient imagery and pastel, not overly vibrant colours helped create positive taste expectations. In contrast, grey, flashy, or neon colours reduced appeal by suggesting an artificial, chemical taste.

Naturalness was strongly associated with realistic ingredient imagery and colours. Participants perceived photographic depictions of ingredients as more natural compared to cartoon-style illustrations, which were linked to artificiality. Similarly, lighter, muted, pastel colours enhanced the perception of naturalness, while grey, neon, flashy colours were seen as artificial and unnatural. As naturalness was linked in participants' minds to both health and taste appeal, preserving a natural image was crucial to the product's overall attractiveness.

Overall, these results underscore that for kombucha, effective health, taste and naturalness communication relies more on implicit design elements, such as natural-looking imagery, lighter pastel colours, avoiding can-based packaging and explicit nutritional claims about sugar content, than on explicit health or taste claims, which may be perceived as vague or uninformative. Packaging perceived as healthier was not associated with poorer taste expectations, largely because natural-looking colours were linked to both healthiness and a more natural taste. To positively influence consumer purchase decisions, packaging design should strategically balance taste appeal, health perception, and natural cues.

4 Hypotheses

To answer the research question: How *do colours, imagery, shape, and verbal claims on kombucha packaging influence consumer perceptions of healthiness and taste, and to what extent is this relationship mediated by perceived naturalness?* The following hypotheses were developed. These hypotheses are based on a combination of insights from the literature review and findings from the exploratory qualitative study.

H1 (colour):

- H1a: Light, muted, and less saturated colours lead to higher perceived health compared to vibrant, saturated colours.
- H1b: Light, muted, and less saturated colours lead to higher perceived taste compared to vibrant, saturated colours.

H2 (abstract health imagery):

- H2a: Abstract probiotic imagery increases perceived health.
- H2b: Abstract probiotic imagery decreases perceived naturalness.

H3 (ingredient imagery):

- H3a: Realistic ingredient imagery increases perceived health.
- H3b: Realistic ingredient imagery increases perceived naturalness.
- H3c: Realistic ingredient imagery increases perceived taste.

H4 (health claim types):

- H4a: Scientific health claims lead to higher perceived health than loophole health claims or no health claims.
- H4b: Scientific health claims lead to lower perceived naturalness than loophole health claims or no health claims.
- H4c: Scientific health claims lead to lower perceived taste than loophole health claims or no health claims.

H5 (taste claims):

- H5a Indulgent taste claims increase the perceived tastiness of kombucha compared to no taste claim.
- H5b Indulgent taste claims increase the purchase intention of kombucha compared to no taste claim.

H6 (shape): Slim cans are perceived to be healthier than wide cans.

H7 (implicit design elements) (exploratory):

- H7a: Implicit design elements have a stronger influence on perceived health than explicit claims.
- H7b: Implicit design elements have a stronger influence on perceived taste than explicit claims.

H8 (naturalness mediation):

- H8a The relationship between kombucha packaging design features and perceived healthiness is mediated by perceived naturalness.
- H8b: The relationship between kombucha packaging design features and perceived taste is mediated by perceived naturalness.

Control variables

Visual attractiveness and familiarity are included as control variables because they can independently influence consumers' perceptions and evaluations of a product, potentially confounding the effects of the main experimental manipulations. Visual attractiveness is not a focus of this study, but it is important to control for, as appealing or unappealing designs could bias participants' evaluations of the packaging (Mehta et al., 2023). Familiarity captures consumers' prior exposure or experience with kombucha, which may similarly shape their perceptions and choices independently of the manipulations. Controlling for these factors ensures that the observed effects on taste, health, and

purchase intention can be more confidently attributed to the manipulated packaging features and perceived naturalness.

Research model

The resulting research model is presented in Figure 1. The independent variables are colour, imagery, shape and verbal claims. The mediating variable is perceived naturalness.The dependent variables are taste perception, health perception and purchase intention. Visual attractiveness and familiarity were measured and tested separately to check for potential confounding effects. They are shown with dashed arrows to indicate that they were examined in robustness checks rather than included as covariates in the main analyses.

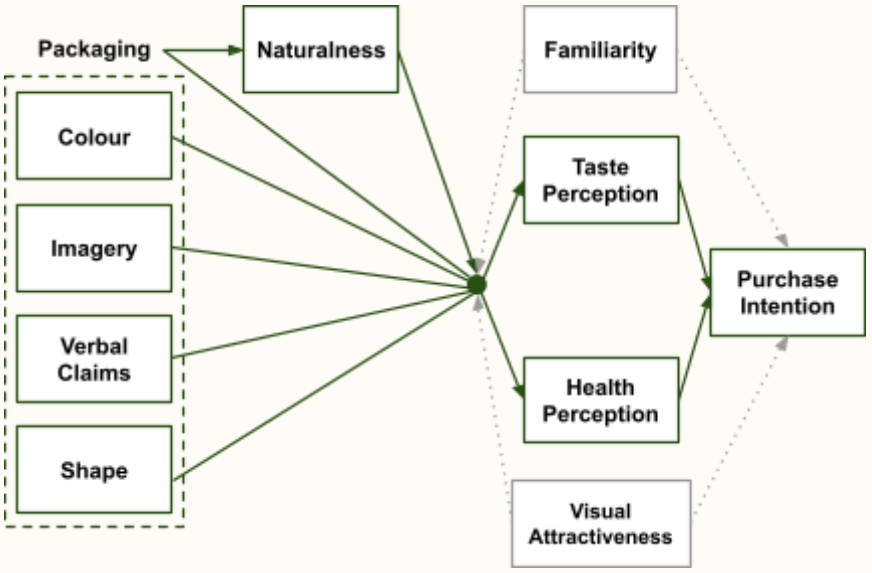

Figure 1: Research Model

5. Study 2: Quantitative research

5.1.1 Method

To build on the exploratory insights from the qualitative Study 1, Study 2 used a quantitative approach to test specific packaging design features in a more controlled and generalizable manner. This study employed a within-subjects experimental design using an online questionnaire distributed via Qualtrics (see Appendix C). The design tested the influence of explicit packaging cues, namely verbal health and taste claims, and implicit cues, specifically colour, shape and (health and ingredient) imagery on consumer perceptions of kombucha. A within-subjects approach was chosen because it allows for greater statistical power with a smaller sample size and reduces between-subject variability, making it easier to detect differences between conditions. Given the limited possible reach through informal recruitment, a between-subjects design (which would have required approximately 400 participants for sufficient power across all conditions) was not feasible.

5.1.2 Pretest

A pretest was conducted to evaluate the clarity of the questionnaire items and estimate the time required to complete the survey. Five participants were selected, all of whom were non-design students, as this group was considered less sensitive to design manipulations and more representative of a general consumer population.

Manipulation checks were included to determine whether participants noticed key visual elements, such as the fruit imagery and the presence of a health-related claim on the can. Three out of five participants correctly identified the difference in fruit imagery. While this was not universal, the manipulation was still considered sufficiently noticeable for the purposes of the study, especially since the study aimed to simulate realistic consumer impressions where not all elements are consciously processed. Therefore, no changes were made to the imagery manipulations. All participants were able to recall the presence of a health claim. These checks confirmed that the manipulations were generally perceived as intended.

However, two participants indicated that the taste-related questions felt repetitive and confusing. Given that the overall survey was already relatively long, and to minimize participant fatigue and improve clarity, the original three taste items from Schnurr (2019) were reduced to a single representative item: “I expect this product to be very tasty.” The removed items were “I think this product looks very delicious” and “I think this product tastes good.” This adjustment ensured the questionnaire remained concise while still capturing participants' perceptions of tastiness.

5.2 Main study procedure

Participants were asked to give their informed consent prior to starting the study. After giving consent, participants were presented with eight different kombucha packaging designs, each representing a unique combination of packaging features. For each design, they rated the kombucha on perceived healthiness, tastiness, naturalness, visual attractiveness, and purchase intention. The order of stimulus presentation and questions was randomized to control for potential order effects. After rating the packaging stimuli, participants answered a question about their familiarity with kombucha, allowing for the exploration of whether prior exposure influenced their perceptions. Finally, participants provided demographic information, including age group and gender.

5.3 Participants

Participants were recruited using convenience sampling, primarily through personal networks (e.g., friends, family, university and housing group chats, and private social media). In addition, snowball sampling occurred as some participants further shared the survey within their own networks. A total of 50 participants took part in the study, all residing in the Netherlands. Most participants were aged between 18 and 24 years (48%), followed by 25–34 (30%), 55–64 (12%), and 35–44 (10%). The sample consisted of 33 women (66%) and 17 men (34%).

5.4 Stimuli

5.4.1 Stimuli design rationale

The design vision for the kombucha packaging stimuli was developed based on insights from both the literature and Study 1. When the health benefits of kombucha, particularly its probiotic effects, are scientifically proven, the packaging should clearly and accurately communicate these benefits to consumers. This helps build trust and ensures consumers understand the product's unique value. Accordingly, the following vision was formulated: *The packaging should communicate kombucha as a probiotic beverage that supports gut health through natural, traditional Chinese fermentation.* Its time-tested health benefit, rooted in probiotic content, should be emphasised as the main differentiator, rather than focusing solely on being a low-calorie option. While taste is not the central message, the packaging should strike a balance between communicating health benefits and maintaining taste appeal. To counter the common perception that healthier products are less tasty, the design should still make the drink appear refreshing and pleasant, ensuring it remains approachable and appealing to a broader audience.

Guided by this vision and insights of the Study 1, eight kombucha packaging stimuli were developed to test how specific packaging elements influence consumer perceptions. An example of how insights from Study 1 were applied to enhance realism and relevance is the decision to avoid using the phrase 'live cultures' as a loophole health claim, as participants perceived it as unclear and unsettling. Two mood boards (Appendix B1, Figure 4 & 5) were created to guide the visual direction of a base design that aligned with the vision. Based on this design, eight different manipulations were made to balance realism with the need to isolate key variables for testing. Each manipulation reflected a specific design variable (e.g., colour, shape, health claim) intended to test its influence on consumer perception. The manipulated packaging features (independent variables) and their levels were:

- **Health claim (3 levels)**:
  - No health claim
  - Scientific product-category health claim ("Probiotic" + "with good bacteria")
  - Loophole health claim ("Gut loving" + "Unleash gut strength")
- **Taste claim (2 levels)**:
  - No taste claim
  - Indulgent taste claim ("Mouthwatering treat")
- **Health imagery (2 levels)**:
  - Abstract probiotic health imagery (gut visual)
  - No health imagery
- **Ingredient imagery (2 levels)**:
  - Cartoon fruit imagery
  - Photographic fruit imagery
- **Shape (2 levels)**:
  - Slim can
  - Wide can
- **Colour (2 levels)**:
  - Light muted colour palette
  - Vibrant highly saturated colour palette

5.4.2 Design considerations and challenges in balancing health and taste

During the design process, several key considerations and challenges emerged in balancing the communication of health and taste, which influenced the development of the packaging stimuli. The subsections below outline the primary considerations and challenges encountered during the design process.

5.4.2.1 Familiarity and packaging shape

During the design process, manipulating packaging shapes presented a challenge. When using novel or unconventional glass bottle shapes, participants expressed confusion regarding the product category, uncertain whether the item was a beverage at all. While these glass bottle shapes conveyed a more premium or niche health-oriented image (Appendix B2, Figure 6), they also risked reinforcing the common tension between health and taste, distancing the product from the mainstream appeal expected in supermarket settings. In contrast, cans were considered more appropriate for the Dutch kombucha market due to their familiarity, realism and taste appeal. However, they are also associated with less healthy beverages, which complicates the communication of kombucha's health benefits.

Additionally, visual elements needed to balance recognisability and authenticity. Specifically, design cues associated with traditional Chinese aesthetics had to be adapted to appear familiar and approachable to a Western audience. Highly authentic or ornate elements were avoided to prevent alienation or confusion. Instead, Chinese elements were enlarged and simplified to a more minimalist layout. When combined with a familiar, modern vessel, a can, this approach enabled the design to communicate this modern and traditional mix while remaining fresh and accessible (Appendix B2, Figure 7).

5.4.2.2 Communicating gut health

Integrating the theme of gut health with cues of Chinese origin proved challenging, as it required merging traditional visual language with modern, scientifically informed health symbolism in a coherent and familiar way. Following negative perceptions in Study 1, images of SCOBY were deliberately excluded. Initial design iterations using anatomical health imagery (e.g., illustrations of organs) were perceived as unappealing and overly clinical. Abstracting these visuals into simplified or symbolic graphics improved visual appeal (Appendix B3, Figure 8). However, using health imagery alone without other decorative elements appeared too much 'in your face' and unattractive. Additionally, when health imagery was used in isolation, without verbal clarification, consumers often misunderstood the intended message. To address this, verbal claims, most notably the word "probiotic", were added alongside visuals, which improved consumer understanding of the product's purpose a lot compared to vague gut-related descriptions or no explanation, which left consumers guessing the meaning of the imagery. Brand names associated with wellness also helped to strengthen the health message without overwhelming the aesthetic.

Other products and brands often rely solely on technical or Latin-based terms (e.g., lactobacillus) without visuals, which can give a scientific and medicinal impression but tends to undermine perceptions of naturalness and taste. Therefore, careful considerations were made to avoid a clinical look, which also risked making the product seem less like a beverage and less attractive.

Successfully integrating gut health, fruit flavor, and Chinese origin in one cohesive packaging design required careful attention to visual hierarchy. Overcrowding the design with too many cues risked confusing consumers or diluting the central message.

5.4.2.3 Colour choices

Kombucha brands typically offer a variety of fruit flavors, which strongly influence the packaging colour choices. Distinguishing flavors through colour is common, for example, raspberry is often represented by pink, while ginger is associated with yellow. However, the bright pink used for raspberry can sometimes weaken the product's health perception due to its sweet, sugary connotations. Adjusting the pink to a softer, muted tone mixed with beige created a more natural and healthier appearance. While achieving a natural look is important, the design must avoid appearing overly "hippy" or stereotypical of niche health food stores, by for example only using beige. As too healthy is connected to less tasty by consumers, limiting the product's broader market appeal. In addition, beige and soft colours can also blend into the background on crowded supermarket shelves. Therefore careful considerations need to be made when selecting the colour palette to sufficiently stand out. Which sometimes requires balancing eye-catching, tastier-looking colours with those that convey healthfulness, which is challenging since vibrant, attention-grabbing colours can conflict with the softer tones typically associated with "healthy" products. Additionally, it's essential to ensure flexibility across different flavors while maintaining consistency.

Using unrelated colours, such as blue, can confuse consumers by evoking other product categories (e.g., dairy) and failing to clearly communicate the flavor. The final colour palette was carefully curated to support the possibility of different flavour associations (Appendix B4, Figure 9), align with health cues, and maintain enough visual distinctiveness and attractiveness (see Appendix B4, Figure 10 for a comparison between prototypes and a few real kombucha packages found in stores).

5.4.2.4 Manipulations

Since the experiment required detecting effects from packaging changes, the manipulations had to be sufficiently salient but not overly exaggerated/unrealistic. Striking this balance proved difficult: changes needed to remain subtle enough to preserve a consistent visual hierarchy of the intended benefits, yet clear enough to serve as isolated variables for statistical comparison. It was important that the only difference between conditions was the intended manipulation (e.g., taste claim sticker, imagery, colour) without inadvertently altering for example perceived premium quality, tasteiness, healthfulness, if not intended. While the goal was to isolate individual design features (e.g., removal of health imagery), complete control of certain visual variables, such as layout, was not always feasible without undermining the overall realism of the packaging. To preserve ecological validity, inconsistencies are present in some of the stimuli. These limitations should be taken into account when interpreting the results.

5.4.3 Stimuli design testing

Throughout the design process, preliminary versions of the packaging were informally tested with approximately six individuals to gather quick feedback on recognizability, appeal, and clarity of key design elements. In the nearly final state some prototypes were made to test visual distinctiveness, readability and attractiveness (Appendix B4, Figure 10). Informal testing helped identify potential misunderstandings and refine choices before finalizing the stimuli. An overview of the eight stimuli used in the survey is presented in Figure 11.

Figure 11. Eight kombucha packaging stimuli

5.5 Measurements

To assess **perceived naturalness**, participants rated each packaging design using a 7-point Likert scale (1 = *Strongly Disagree*, 7 = *Strongly Agree*). The scale was based on the naturalness judgment framework by Román et al. (2017), specifically focusing on production-related naturalness (e.g., ingredients and processing), while excluding factors related to growing conditions (e.g., organic, local) and final product attributes (e.g., eco-friendliness, healthiness). The following three items were used: (1) I think this product is made with natural ingredients. (2) I believe this product is minimally processed, (3) I believe this product is made using traditional or artisanal methods.

Perceived healthiness was measured using an adapted version of a semantic differential scale from Schnurr (2019), converted to a 7-point Likert-type agreement scale for consistency across multiple product perception dimensions (e.g., healthiness, taste, naturalness). The three items were: (1) I think this product is very healthy. (2) I believe this product would be a very important part of a healthy diet. (3) I think this product is good for my health.

Perceived Tastiness was assessed using one item adapted from Schnurr (2019): “I expect this product to be very tasty.”. Participants responded on a 7-point Likert agreement scale.

Familiarity with kombucha was measured using three self-developed items: (1) I am very familiar with kombucha. (2) I drink kombucha often. (3) I see kombucha frequently when shopping. Participants responded on a 7-point Likert agreement scale. These items were included to explore whether prior exposure influenced perceptions.

5.6 Statistical assumption checks

5.6.1 Reliability analysis

The three items measuring perceived naturalness showed good internal consistency, Cronbach's α = .845. Corrected item–total correlations ranged from .608 to .781, indicating that all items contributed positively to the overall scale. Removing the item "I believe this product is made using traditional or artisanal methods" would slightly increase α to .885, however, the item was retained to preserve theoretical coverage of the construct.

The three items measuring health perception showed acceptable internal consistency, Cronbach's α = .745. Corrected item–total correlations ranged from .401 to .678, indicating moderate to strong associations with the overall scale. Removing the item "I believe this product would be a very important part of a healthy diet" would increase α to .846, however, the item was retained to preserve theoretical coverage of the construct.

The three items measuring familiarity of kombucha showed acceptable internal consistency, Cronbach's α = .787. Corrected item–total correlations ranged from .562 to .686, indicating that all items contributed positively to the overall scale. Although α increased slightly to .797 if the item "I see kombucha frequently when shopping" was deleted, all items were retained to preserve the conceptual breadth of the familiarity construct.

5.6.2 Normal Distribution Check

The assumption of normality was tested for all dependent variables using the Shapiro–Wilk test.

- Naturalness perception was normally distributed ($p > .05$)
- Health perception was normally distributed ($p > .05$)
- Taste perception deviated from normality ($p < .05$), with significant moderate negative skewness (–0.56, SE= 0.34, $|z| > 1.96$. However, given the within-subjects design with sufficient sample size (N= 50) and the robustness of repeated-measures ANOVA to such violations, no transformations were applied and results were cross-validated using a non-parametric Friedman test.
- Visual attractiveness ratings deviated from normality ($p < .05$), with significant moderate negative skewness (-0.97, SE= 0.34, $|z| > 1.96$). Given these violations, a non-parametric Friedman test was conducted as a robustness check to validate the repeated-measures ANOVA results.
- Purchase intention deviated from normality ($p < .05$). The distribution showed slight negative skewness (-0.56, SE= 0.34) and mild platykurtosis (-0.61, SE= 0.66), which suggest approximate normality. Given that normality assumptions were not fully met, a non-parametric Friedman test was conducted as a robustness check to validate the repeated-measures ANOVA results.

6. Results

6.1 Health perception

A repeated-measures ANOVA was conducted to examine whether health perception differed across the eight kombucha stimuli. Mauchly's Test of Sphericity indicated that the assumption of sphericity was met, $\chi^2(27) = 24.563$, $p = .601$. The results showed a significant main effect of stimulus condition, $F(7, 343) = 11.488$, $p < .001$, $\eta^2 = .190$, indicating that responses differed significantly across the eight stimuli. Pairwise comparisons with Bonferroni correction were subsequently performed. Participants generally did not perceive the packaging as particularly healthy, with health ratings ranging from mean = 2.77 to 4.10 on a 7-point scale (3 = "somewhat disagree," 4 = "Neither agree or disagree").

Colour

The packaging with a light, muted, and less saturated pink colour, Stimulus 1 (mean= 3.92), was perceived as significantly healthier than the packaging with a vibrant, saturated pink colour, Stimulus 6 (mean = 2.77, $p < .001$). They were identical in all aspects except colour. Therefore, **H1a can be accepted**: Light, muted, and less saturated colours lead to higher perceived health compared to vibrant, saturated colours.

Health imagery

Stimulus 1 (mean= 3.92), which included gut health imagery, was not perceived as significantly healthier than the packaging which lacked such imagery, Stimulus 7 (mean= 4.10, $p = 1.00$). However, since the removal of gut-related imagery also changed the overall design, it is difficult to isolate the effect of the imagery alone. Differences in prominence of the claim, visual hierarchy, or other design features such as decorative graphics may have influenced perceptions. Therefore, **H2a cannot be rejected with certainty**: abstract probiotic imagery may not increase perceived health compared to no health imagery, but the presence of design confounds limits the strength of this conclusion.

Health claims

Stimulus 1, which contained scientific health claims 'Probiotic Tea + with good bacteria' (mean= 3.92), did not significantly differ in perceived health compared to Stimulus 5, which contained loophole health claims 'Gut loving' + 'Unleash gut strength' (mean= 3.95, $p= 1.00$).

The packaging without any health claims and gut health imagery, Stimulus 2 (mean= 3.41), was significantly perceived as less healthy than the packaging with scientific health claims and also no gut health imagery, Stimulus 7 (mean= 4.10, $p= .041$). However, because these two designs also differed in uncontrolled details (e.g. decorative graphics), the effect of the health claim alone cannot be isolated. Therefore, **H4a can be rejected for loophole claims, but cannot be conclusively accepted for no health claims** due to design confounds. These results suggest that scientific health claims do not lead to higher perceived health than loophole health claims, but possibly do compared to packaging without any health claims.

Shape

There was no significant difference in perceived health between the slim shaped packaging can, Stimulus 4 (mean = 3.65), and the wide shaped packaging can, Stimulus 1 (mean= 3.92, $p = 1.00$). The only difference between these packages was the can shape. Therefore, **H6 is rejected**: Slim cans are not perceived to be healthier than wide cans.

Ingredient imagery

No significant difference in perceived health was found between the packaging with photographic fruit imagery, Stimulus 1 (mean= 3.92), and the packaging with cartoon fruit imagery, Stimulus 8 (mean= 3.82, p= 1.00). However, the cartoon fruit imagery differed in design layer order for two fruits out of six, as they were placed in front rather than behind other elements, which may have influenced

participants' perceptions. Therefore, **H3a is rejected** but without certainty: Realistic ingredient imagery does not increase perceived health compared to cartoon ingredient imagery.

Implicit vs Explicit Design elements

The analysis revealed that colour was the only implicit design element that significantly affected perceived health. The other implicit design elements, shape, health imagery and ingredient imagery, did not show significant effects. One significant effect was found for explicit claims; the packaging with explicit health claims and without health imagery was perceived as healthier than the packing without an explicit health claim and also no health imagery. However, as previously mentioned, due to possible confounds this contrast cannot be attributed solely to the presence of a claim. Moreover, the study did not include a stimulus that combined "no health claim and no health imagery" with a vibrant, saturated colour; such a stimulus would be required to isolate the pure impact of colour under those conditions. **Therefore, H7a cannot be conclusively tested** based on the current stimuli: The implicit design element colour has a stronger influence on perceived health than explicit claims.

Table 2

Mean ratings for the 8 packages on the target dimensions

	Health	Naturalness	Taste	Attractiveness	Purchase intention
1 Scientific claim	3.92 [6]	3.93 [6, 8]	5.04	5.16	4.57 [3, 6]
2 No health Claim & Imagery	3.41 [6, 7]	3.50 [6]	4.96	4.64	4.86
3 Taste Claim	3.54 [6]	3.49 [6]	4.90	4.25	4.31[1]
4 Slim	3.65 [6]	3.57 [6]	4.96	4.28	4.47
5 Loophole Claim	3.95 [6]	3.69 [6]	4.62	4.73	4.73 [6]
6 Bright Colour	2.77 [1-8]	2.78 [1-7]	4.88	4.07	3.90 [1, 5]
7 No Health Imagery	4.10 [2, 6]	3.72 [6]	4.64	4.09	4.47
8 Cartoon Fruit	3.82 [6]	3.38 [1]	4.80	4.78	4.55

(Significant difference found with the stimulus number in subscript)

6.2 Naturalness perception

6.2.1 Naturalness perception across stimuli

A repeated measures ANOVA was conducted to examine whether the eight stimuli differed in perceived naturalness. Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(27) = 41.42$, $p = .038$. Therefore, Greenhouse-Geisser corrected results are reported. There was a significant effect of stimulus on perceived naturalness, $F(5.72, 343) = 8.29$, $p < .001$, partial $\eta^2 = .145$, indicating a large effect size. Subsequently, pairwise comparisons with Bonferroni correction were performed. Participants generally did not perceive the packaging as notably natural, with ratings ranging from mean = 2.78 to 3.93 on a 7-point scale (3 = "somewhat disagree," 4 = "Neither agree or disagree").

Colour
The packaging with a light, muted, and less saturated pink colour, Stimulus 1 (mean= 3.93), was significantly perceived to be more natural than the packaging with a vibrant, saturated pink colour, Stimulus 6 (mean = 2.78, p= < .001). As colour was the only differing feature between the two, **H1b can be accepted:** Light, muted, and less saturated colours lead to higher perceived naturalness compared to vibrant, saturated colours.

Health imagery
Stimulus 1, which featured abstracted gut imagery (mean= 3.93), was not significantly perceived to be less natural than the packaging without such imagery, Stimulus 7 (mean= 3.72, p= 1.00). However, as previously stated, the lack of the imagery could have caused differences in prominence of the claim, visual hierarchy, or other design features could have influenced results. Therefore, **H2b is rejected with uncertainty**: abstract probiotic imagery may not decrease perceived naturalness compared to no health imagery.

Ingredient imagery
Stimulus 1, which displayed photographic fruit imagery (mean= 3.93), was perceived as significantly more natural than the packaging with cartoon-style fruit imagery, Stimulus 8 (mean= 3.38, p = 0.02). Nonetheless, as mentioned before, the design layer order for two fruits out of six did differ between the stimuli, which may have influenced participants' perceptions. Therefore, **H3b can be accepted with uncertainty:** Realistic ingredient imagery increases perceived naturalness compared to cartoon ingredient imagery.

Health claims
Stimulus 1 which included scientific health claims ‘Probiotic Tea + with good bacteria’ (mean= 3.93) did not significantly differ in perceived naturalness compared to Stimulus 5, with loophole health claims ‘Gut loving’ + ‘Unleash gut strength’ (mean= 3.69, p= 1.00). Nor did the packaging without any health claims and gut health imagery Stimulus 2 (mean= 3.50) differ from the packaging with the scientific health claim and also no gut health imagery (mean=3.73, p= 1.00). Albeit, these two designs also differed in uncontrolled details (e.g., decorative graphics), therefore, the effect of the health claim alone cannot be isolated. Consequently, **H4b can be rejected for loophole claims, but cannot be conclusively rejected for no health claims** due to design confounds. These results suggest that scientific health claims do not lead to higher perceived naturalness than loophole health claims, and possibly not compared to no health claims either, although this cannot be stated with certainty.

6.2.2 Naturalness mediation

6.2.2.1 Naturalness mediation on health

To explore whether the effect of packaging on perceived health was mediated by perceived naturalness, three paths were examined through a multilevel mediation analysis using Linear Mixed Models (LMM), see Figure 12 for an overview. The multilevel mediation was used to account for the within-subjects design, as traditional mediation methods (eg. PROCESS) assume independent observations. By including random intercepts for participants, the multilevel model accounted for each participant’s baseline level of perceived health, properly separating within- and between-participant variability. To ensure comparability across variables and facilitate interpretation of coefficients, all perception variables were standardized (Z-scores) for the mediation analyses, while raw scores were used in all other analyses.

Results showed a significant direct effect of stimuli on naturalness (path a: $F(7, 392) = 4.39$, $p < .001$) and of stimuli on perceived health (path c: $F(7, 392) = 5.40$, $p < .001$). When naturalness was included in the model, it significantly predicted perceived health with a strong effect size (path b: $\beta = 0.69$, $F(1, 391) = 373.25$, p <.001), while the direct effect of stimuli on perceived health remained significant but was reduced (path c’: $F(7, 391) = 2.91$, p = .006). Because naturalness is a continuous variable, this

path is expressed with a regression coefficient (β), whereas the effects of stimuli are categorical and cannot be summarized with a single slope. The pattern suggests **partial mediation**: perceived naturalness explains part of the relationship between packaging features and perceived health, but packaging features also have a direct effect on health perceptions beyond naturalness. Therefore **H8a is partially supported**: The relationship between kombucha packaging design features and perceived healthiness is partially mediated by perceived naturalness.

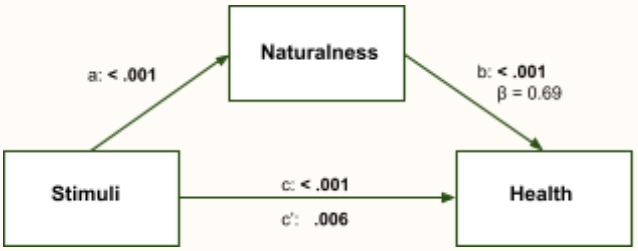

Figure 12: Stimuli mediation of naturalness on health

6.2.2.2 Naturalness mediation on taste

Another multilevel mediation analysis using LMM was conducted to examine whether the effect of packaging on perceived taste was mediated by perceived naturalness (see Figure 13). Results showed no direct effect of stimuli on taste (path c: F(7, 392) = 0.64, p = .720), thus mediation is not supported. Therefore, hypothesis **H8b is rejected**: perceived naturalness does **not mediate** the relationship between kombucha packaging features and perceived taste.

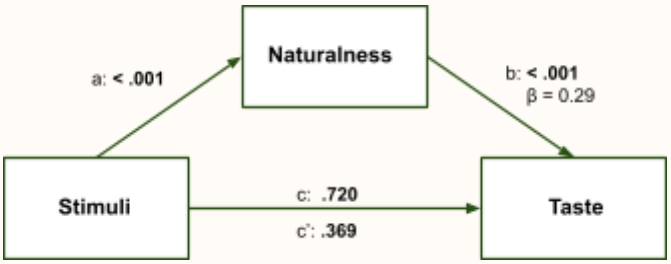

Figure 13: Stimuli mediation of naturalness on taste

6.3 Taste perception

A repeated-measures ANOVA tested whether taste perception varied between the eight kombucha stimuli. Mauchly's test indicated a violation of sphericity, $\chi^2(27) = 75.84$, $p < .001$; therefore, Greenhouse-Geisser corrections were applied ($\varepsilon = .662$). The analysis revealed no significant effect of stimuli on taste perception, $F(4.63, 227.1) = 1.23$, $p = .299$, partial $\eta^2 = .024$. Taste ratings ranged from neutral to moderately positive (mean = 4.62–5.04 on a 7-point scale). Consistent with the repeated-measures ANOVA, the Friedman test also indicated no significant differences in taste perception across stimuli, $\chi^2(7) = 6.46$, $p = .487$. Therefore **all taste-related hypotheses are rejected.**

- **Colour:**
  H1c is rejected; Light, muted, and less saturated colours do not lead to higher perceived taste compared to vibrant, saturated colours.
- **Ingredient Imagery:**
  H3c is rejected, but with uncertainty due to design confounds: realistic ingredient imagery possibly does not increase perceived taste.
- **Health claims:**

H4c is rejected for loophole health claims, and cannot be conclusively evaluated for no health claims due to design confound**s:** scientific health claims do not lead to lower perceived taste than loophole claims, and possibly also not compared to no health claims

- **Taste claim:**
  H5a is rejected: Indulgent taste claims do not increase the perceived tastiness of kombucha compared to no taste claim
- **Implicit vs Explicit Design elements:**
  H7b is rejected with uncertainty: Implicit design elements may not have a stronger influence on perceived taste than explicit claims.

6.4 Purchase intention

Purchase intention ratings across the eight stimuli were moderate overall, with mean scores ranging from 3.90 to 4.57 on a 7-point scale, indicating participants were generally neutral to slightly open to purchasing the products.

Mauchly's test indicated that the assumption of sphericity was violated for purchase intention ratings, $\chi^2(27)= 52.72$, $p = .002$. Therefore, degrees of freedom were corrected using the Greenhouse-Geisser estimate ($\varepsilon= .771$). A repeated-measures ANOVA revealed a significant effect of stimulus on purchase intention, $F(5.40, 259.05) = 4.13$, $p < .001$, partial $\eta^2 = .079$, indicating that purchase intention ratings differed significantly across the eight stimuli. Consistent with the repeated-measures ANOVA, the non-parametric Friedman test also indicated that participants' purchase intentions differed significantly between the eight stimuli, $\chi^2(7) = 20.654$, $p = .004$.

A series of Wilcoxon signed-rank tests was conducted to compare purchase intent across the eight packaging conditions. Participants were significantly more likely to consider purchasing the kombucha packaging without a taste claim (Stimulus 1) compared to the packaging with a taste claim (Stimulus 3), $Z = -3.35$, $p < .001$. This indicates that the indulgent taste claim reduced purchase intention. Therefore, **H5b is rejected**: Indulgent taste claims do not increase, but decrease, the purchase intention of kombucha compared to no taste claim.
Additionally, the light, muted and less saturated coloured packaging (Stimulus 1) was more likely to be considered for purchase than the vibrant saturated coloured packaging (Stimulus 6), $Z = -3.55$, $p < .001$.

6.5 Control variables (Robustness checks)

6.5.1 Visual attractiveness

A repeated-measures ANOVA was conducted to examine differences in attractiveness ratings across eight stimuli. Mauchly's test indicated that the assumption of sphericity was met, $W(27) = 38.81$, $p = .067$. Results showed no significant effect of stimulus on attractiveness ratings, $F(7, 343) = 1.68$, $p = .112$, partial $\eta^2 = .033$, indicating that attractiveness ratings did not differ significantly across stimuli. Consistent with the repeated-measures ANOVA, the non-parametric Friedman test also indicated no significant differences in visual attractiveness across stimuli, $\chi^2(7) = 12.458$, $p = .086$. The visual attractiveness is therefore unlikely to have acted as a confounding variable in explaining differences in perceived health or taste. With the mean visual attractiveness ratings ranging from 4.07 to 5.16, participants generally rated the packaging as moderately visually attractive.

6.5.2 Familiarity

A mixed-effects linear regression was conducted to examine whether familiarity predicted health perception across all packaging conditions, accounting for the repeated-measures design. Results showed that familiarity did not significantly predict perceived health ($\beta = 0.071$, $p = .099$), suggesting that the main effects were not confounded by prior familiarity with kombucha.

7. Conclusion

This study investigated how specific packaging elements, particularly colour, ingredient and health imagery, verbal claims, and shape, influence consumer perceptions of kombucha's healthiness and taste, and to which extent this relationship is mediated by perceived naturalness. A quantitative study using self designed-kombucha packaging was conducted to explore these effects.

The study shows that certain implicit and explicit packaging cues can influence consumers' health perception of kombucha positively, without compromising taste perceptions. The findings demonstrate that packaging with the implicit cue of light, muted, and less saturated colours was perceived as healthier, more natural, and more likely to be purchased compared to packaging with vibrant, saturated colours. The explicit cue of a scientific health claim may also enhance perceived healthiness. Although packaging did not directly influence taste perceptions, naturalness explains a large part, though not all, of the relationship between packaging and perceived health. Photographic ingredient imagery, another implicit cue, may also increase perceived naturalness compared to cartoon-style imagery. Other cues, such as shape, taste claims, and possibly health imagery, had no effect on health or naturalness.

8. Discussion

For this study a within survey with 50 participants tested how specific packaging elements influence consumer perceptions of kombucha's healthiness and taste, and to which extent this relationship is mediated by perceived naturalness. The results showed different influences on health and naturalness depending on the packaging elements.

8.1 Influence of packaging cues on consumer perceptions

8.1.1 Health perception

The use of microbial claims on kombucha packaging is popular, however the microbial claims do not always reflect actual probiotic content and no human trials support the effectiveness of the claims (Harrison et al., 2023; O'Sullivan & O'Sullivan, 2024). Prior research has shown that consumers do not visually process health claims (Varela et al., 2014), and that graphic design rather than health claims, triggered health associations (Oliveira et al., 2015). Interestingly in this study, the stimulus with only a scientific health claim (and no gut imagery) scored highest in perceived health, and was perceived as more healthy than the packaging without any health claims or imagery. Indicating that the scientific health claim can possibly communicate kombuchas' probiotic health benefit effectively, although this conclusion should be interpreted with caution due to design confounds. This may show that health claims which are more prominently placed like in this study do have effect on health perception. As Oliveira et al. (2015) suggested that lower information density, factors improve attention to claims. While no firm conclusion can be drawn, this aligns with prior research suggesting that health claims can help communicate health benefits (Lähteenmäki, 2012), and avoid misleading consumers through implicit cues alone (Festila & Chrysochou, 2018). It also highlights the importance of accurate, evidence-based communication and the need for stronger regulation, given that the scientific health claim used in this study is not recognized as such under Dutch regulations, yet may still increase health perception.

Surprisingly, abstract probiotic imagery did not increase perceived health, indicating it may not be effective to communicate the probiotic health benefit, however design confounds limit this conclusion. This contrasts with Festila & Chrysochou (2018), who found that health imagery can enhance health perception, and with Schifferstein et al. (2021), who suggested it may have the opposite effect. One possible explanation is that the imagery used was too abstract. During the design phase, participants perceived packaging designs that only depicted the gut and bacteria in an abstracted and cartoonish manner as too confronting, despite claims by Fokkinga & Desmet (2013) that abstraction can reduce discomfort. Instead, designs with lower realism, such as merging gut symbolism into a mythical figure

like a dragon, were perceived as less confronting and more appealing. This suggests that not just abstraction, but the degree of realism, shapes emotional responses to organ-related imagery. In line with this, the study found no difference in attractiveness between packaging with or without gut health imagery, contrasting Schifferstein et al. 's (2021) findings that even slightly abstracted bacteria images can lower aesthetic appeal due to disgust. These results suggest that highly abstract, low-realism imagery may help communicate health-related content without reducing visual appeal or perceived health. Future research should explore how the degree of realism of bodily imagery affects consumer emotion and acceptance (Schifferstein et al., 2021; Lemke et al., 2021), however also how this influences health perception.

Finally, while naturalness explains part of the relationship between packaging and health, packaging also has a direct effect on health perceptions, suggesting additional pathways beyond naturalness. This partially aligns with the consumer belief that ‘natural equals healthy’ (Wang et al., 2022) and is supported by previous research linking naturalness to health-related product appeal (Binninger, 2015; Rozin, 2005). Additionally, consumers tend to prefer naturally occurring functional components in products like kombucha over artificially added ones (Kraus, 2014; Teratanavat & Hooker, 2006), reinforcing the relevance of naturalness in health perception, even if it is not the sole factor.

8.1.2 Taste

Though believed that healthier food is perceived to be less tasty (Raghunathan et al., 2006), this study shows it is not always the case. As surprisingly, light, muted, and less saturated colours did not lead to higher perceived taste compared to vibrant, saturated colours, nor did it lower perceived taste, despite being perceived as healthier. Contradicting findings by Fenko (2018) who found that colour is a large influential cue on people's perceptions and expectations of flavour. Light, muted and less saturated colours were described as having less of an artificial taste in Study 1. Whereas vibrant, saturated colours were perceived as sweeter in research by Tijssen et al. (2017). Possibly the no influence can be explained, like Tijssen et al. (2017) found taste intensity expectations are influenced by a combination of colour factors rather than by the single element; highly saturated colours together with red.

Designers may try to make packaging more tasty by making the packaging look more natural, in line with the consumer belief that “natural equals tasty” (Wang et al., 2022). However this study found no evidence for mediation of perceived naturalness in the relationship between packaging and perceived taste. It showed that packaging did not directly influence taste ratings even though perceived naturalness was a moderate predictor of taste. This suggests that factors beyond packaging, such as consumers’ prior beliefs, intrinsic product qualities, or other contextual cues, may shape perceptions of naturalness, which in turn influence taste evaluations. This may explain why unexpectedly, the realistic ingredient imagery possibly does not significantly increase perceived taste compared to cartoon ingredient imagery, even if possibly perceived to be more natural. It is possible that a lower level of perceived naturalness of ingredients does not necessarily diminish taste expectations. Despite Study 1 indicating realistic ingredient imagery helped set positive taste expectations because they thought the ingredient to be natural instead of artificial. It also diverges from previous research: Kim et al. (2019) found that cartoon illustrations of food compared to photographs lowers perceived tastiness for new-to-the-market food products, while Schnurr (2019) found that that packaging with cute cartoon illustrations, increases the perceived tastiness. Future research should explore the sources of naturalness perceptions to better understand how they affect taste expectations in kombucha.

A way currently some kombucha brands try to increase taste perception is by including taste claims on their packaging. However this study shows that this does not have an effect on taste perception and actually reduces purchase intention. One possible explanation for the findings, is offered by Schifferstein et al. (2021), who suggest that easily verifiable claims through tasting may actually undermine confidence in the brand. Though in the case of Garaus et al. (2023) and Turnwald and

Crum (2018) both found that taste claims can enhance purchase intention and taste perception of healthy foods when compared to health claims. This research supports Garaus et al. 's (2023) findings that using a taste claim may only be effective and increase purchase intention of healthy food in comparison to health claims, not with the absence of claims. Balancing taste and health of healthy food through taste claims as Turnwald and Crum (2018) suggests may not always be effective.

8.1.3 Naturalness

Conveying naturalness of food is important as consumers prefer natural food (Rozin, 2005). As anticipated this study found that boosting the perceived naturalness can be done by using light, muted, and less saturated colours and possibly photographic ingredient imagery on packaging. This aligns with findings from Study 1, where participants perceived photographic depictions of ingredients and light, muted, less saturated colours as more natural, whereas cartoon imagery and vibrant, saturated colours were associated with artificial taste. This study shows that cartoon imagery may not add to verbal flavour indication to set natural flavour expectations unlike photographs which were found by Smith et al. (2015) to set natural flavouring rather than artificial flavouring when only using the verbal flavour indication. Interestingly, the packaging with cartoon fruit did not differ from perceived naturalness with vibrant, saturated packaging. Even though no controlled manipulation was made to directly test this, it may suggest that cartoon-style ingredient imagery, in this case, fruit, could reduce perceived naturalness in a way similar to the effect of vibrant, saturated colours.

When conveying health through imagery of bacteria or with health claims studies found that it can lower perceived naturalness. However this study shows that that may not be the case. This study found that abstract probiotic imagery may not decrease perceived naturalness compared to no health imagery. This is contradicting the study by Janich (2017) that found that images of bacteria possibly counteracts the association of natural food production. This difference may be due to the fact that the abstract probiotic imagery used in the stimuli was created to fit the vision of natural production instead of realistic scientific images. Nor did scientific health claims affect perceived naturalness compared to loophole claims, and possibly not compared to the absence of health claims. This contrasts with previous findings that health claims can reduce perceived naturalness (Lähteenmäki et al., 2010). However further controlled research is needed to disentangle these effects.

8.1.4 Balancing multiple consumer benefits

To effectively promote healthier choices, research emphasizes the need to balance health and taste cues (Li et al., 2024; Turnwald & Crum, 2018). Communication of multiple benefits is therefore needed, though it presents challenges for cohesive packaging design and is rarely tested in the literature (Schifferstein et al., 2021). In study 2, the designed packaging leaned more toward taste than health, with participants rating perceived health lower than taste. Suggesting cues were not optimally selected or positioned in the visual hierarchy.

Understanding and testing the combination and interaction of multiple packaging cues is critical for designers to effectively communicate what is desired. Designers must carefully consider cue strength, placement in the visual hierarchy, and potential trade-offs. For example, using a can, likely high in the hierarchy, may signal taste but reduce health perception, as cans were associated with unhealthy beverages in Study 1. However, cues are not always tradeoffs; e.g. this study showed that colours can enhance health perception without affecting taste. In addition, indirect attributes, such as naturalness, can help enhance perceptions of healthfulness, providing designers with additional levers for cue selection.

Testing in real-life contexts can help designers understand how consumers perceive products in more depth, which connections are made with specific cues, and which cues are actually noticed. This knowledge can help in making more informed decisions to balance multiple benefits effectively.

8.2 Limitations

This study has several limitations that should be considered when interpreting the findings.
First, the stimuli were not always fully controlled in terms of visual layout, making it difficult to draw firm conclusions about the effects of specific design elements.

Secondly, this study used a within-subjects design with eight similar stimuli, resulting in a relatively lengthy and repetitive survey (7–12 minutes). Being exposed to all eight packaging designs may have caused confusion or respondent fatigue, potentially affecting data quality. Future research could consider a between-subjects design with a larger sample to reduce cognitive load and strengthen validity.

Third, the study was conducted outside of a realistic shopping context, limiting ecological validity. Presenting stimuli in a supermarket shelf setting would better reflect how consumers process packaging information in real life and allow for more natural comparisons with competing products. Future research should validate these results through more ecologically valid methods such as field experiments or eye-tracking in retail settings.

Lastly, this study did not assess whether participants had a health-focused shopping goal, which could have influenced perceptions, purchase intention and contributed to differences compared to other studies. If health was perceived as less important in this context, this may have contributed to the relatively low ratings for health perception across the stimuli, thereby limiting the generalisability of the findings to other health-oriented products. Additionally, the use of cans, although realistic for the Dutch kombucha market, may have further lowered health perceptions.

8.3 Implications & Recommendations

Designers and companies can help consumers make healthier choices through design elements of packaging without compromising on taste appeal, as is often believed. To support this, designers must balance health and taste cues, positioning them carefully within the visual hierarchy. Naturalness can serve as a bridge between packaging and health perception. By using light, muted colours, health and natural perceptions of kombucha can be strengthened and even increase purchase intention. Photographic ingredient imagery may further enhance perceived naturalness. However, taste claims should be used cautiously, as they may not be effective and may backfire by lowering purchase intention. Microbial products may benefit from using a probiotic health claim to enhance health perception. Minimalistic, clear layouts that highlight the health claim may enhance its effectiveness.

Regulatory bodies, on the other hand, should address the current lack of oversight around microbial health claims for functional food that contain probiotics, such as kombucha. In particular, regulators should be careful allowing ‘probiotics’ to be considered as just a category classifier, consumers may interpret it as a health claim. Yet by regulation, companies are not allowed to clarify the specific effects of probiotic content, which may reduce trust in accurate communication and create an uneven playing field compared to commonly used unregulated “loophole” claims such as “gut-friendly” or “live cultures”. To prevent consumer misinformation, clearer definitions and stricter standards are needed for probiotic-related claims. If probiotic effects are substantiated, there should be more flexibility for companies to communicate them transparently. This would support honest communication, reduce reliance on potentially misleading terms, and allow consumers to make better-informed choices.

Further studies should explore the effects of packaging cues in more ecologically valid contexts, such as in-store or on-shelf settings. Finally, research should also examine how visual hierarchy and consumer goals (e.g., health vs. taste interest) influence perception and purchase intentions.

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Appendix A Focus group

A1. Focus group Questions

Drink preferences and health interests

- What drinks do you typically buy?
- What do you look for when picking a drink in the supermarket?
- When you're making choices about food or drinks, how much does health play a role?

Awareness, purchase motivation & knowledge of Kombucha

- What have you heard about kombucha?
    - Why do you drink it, if you do?
    - How does drinking kombucha make you feel?
- Can you explain how kombucha is made based on what you know?
- Explain how kombucha is made and show a picture of SCOBY
- How does knowing how kombucha is made influence your decision to buy it?
- How do you feel about trying new drinks like kombucha, or do you prefer to stick to what you know?

Branding and Packaging Perceptions

- Can you please write down any Kombucha brands you can think of?

Participants are shown packages of kombucha brands sold at AH.

- Do you recognise any kombucha brands?
    - If yes, what associations or thoughts come to mind when you think of that brand?
- What do you think about the different kombucha packaging designs?
- Do you think they communicate well what are the characteristics of kombucha? Or do you miss anything?
- Which of these kombucha brands would you be most likely to purchase, and why?
- What do you think of the illustrations on the kombucha packaging?
- What role do the colours of the kombucha packaging play in your decision-making process?
- Could you please rank how important the following things are for you?

Shape of the package – Taste appearance – Health appearance – Natural look

    - Can you explain your ranking?
- What do you find positive, negative and interesting about the packaging and why?
- What claims and labels do you typically look for on drink packaging?
- Is there anything about kombucha that hasn't been discussed that you'd like to mention?

A2. Focus group Stimuli

Figure 2: The SCOBY Images shown in the focus group (Abell, 2022; Bucha Brewers, 2019; Yabrooo, 2025)

Figure 3: The five kombucha cans (physically there) discussed (Albert Heijn, 2025)

Appendix B Packaging design

B1. Mood boards

Figure 4: Chinese heritage gut health mood board

Figure 5: Gut health mood board

B2. First iteration designs

Figure 6: First iteration packaging in novel bottle shapes

Figure 7: First iteration packaging designs in more familiar vessel shapes

B3. Second iteration designs

Figure 8: Packaging designs to convey gut health more clearly

B4. Colour testing

Figure 9: Packaging designs testing different flavour compatibility of design

Figure 10: Prototype testing of standout and attractiveness in comparison to existing packaging and testing label readability

Appendix C Survey

Figure 11: Eight kombucha packaging stimuli

The eight packaging stimuli were presented one at a time in random order. After each image, participants answered the same set of questions to assess their perceptions. The full set of questions is listed below:

Please indicate how much you agree with the following statements

How healthy do you perceive this product to be?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I think this product is very healthy	O	O	O	O	O	O	O
I believe this product would be a very important part of a healthy diet	O	O	O	O	O	O	O
I think this product is good for my health	O	O	O	O	O	O	O

How tasty do you perceive this product to be?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I expect this product to be very tasty	O	O	O	O	O	O	O

How natural do you perceive this product to be?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
This product appears to be made with natural ingredients	O	O	O	O	O	O	O
I believe this product is minimally processed	O	O	O	O	O	O	O
I believe this product is made	O	O	O	O	O	O	O

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
using traditional or artisanal methods							

How attractive do you think this packaging is?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
This packaging is visually attractive	○	○	○	○	○	○	○

Would you consider buying this product?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I would consider buying this product	○	○	○	○	○	○	○

Lastly, familiarity and demographic questions were asked.

Kombucha familiarity

How familiar are you with kombucha?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I am very familiar with kombucha	○	○	○	○	○	○	○
I drink kombucha often	○	○	○	○	○	○	○
I see kombucha frequently when shopping	○	○	○	○	○	○	○

Demographics

How old are you?

- ○ 18 - 24
- ○ 25 - 34
- ○ 35 - 44
- ○ 45 - 54
- ○ 55 - 64
- ○ 65 - 74
- ○ 75 - 84
- ○ 85 or older

What is your gender?

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ Prefer not to say

Appendix D Results

D1 Health perception

D.1.1 Reliability analysis Health Perception

Reliability Statistics

Cronbach's Alpha	N of Items
.745	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
How healthy do you perceive this product to be? - I think this product is very healthy	7.12	5.718	.678	.531
How healthy do you perceive this product to be? - I believe this product would be a very important part of a healthy diet	7.65	7.320	.401	.846
How healthy do you perceive this product to be? - I think this product is good for my health	7.10	5.875	.658	.557

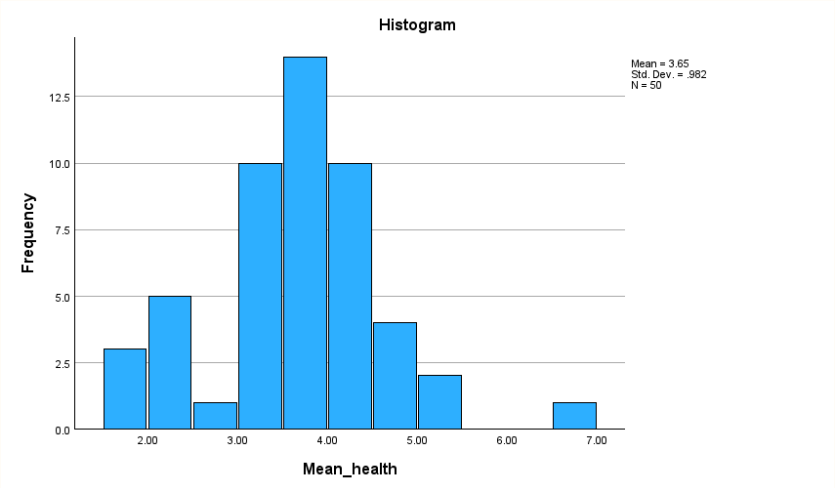
D.1.2 Normal Check Health Perception

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Mean_health	.089	50	.200*	.963	50	.120

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction



D.1.3 Repeated Measures Anova Health Perception

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Epsilon[b] Huynh-Feldt	Epsilon[b] Lower-bound
Health	.589	24.563	27	.601	.877	1.000	.143

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept
Within Subjects Design: Health

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Estimates

Measure: MEASURE_1

Health	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	3.920	.183	3.553	4.287
2	3.407	.178	3.048	3.765
3	3.540	.187	3.165	3.915
4	3.647	.190	3.265	4.028
5	3.953	.185	3.582	4.325
6	2.773	.170	2.431	3.116
7	4.100	.191	3.717	4.483
8	3.820	.161	3.496	4.144

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Health	Sphericity Assumed	61.799	7	8.828	11.488	<.001	.190
	Greenhouse-Geisser	61.799	6.138	10.068	11.488	<.001	.190
	Huynh-Feldt	61.799	7.000	8.828	11.488	<.001	.190
	Lower-bound	61.799	1.000	61.799	11.488	.001	.190
Error(Health)	Sphericity Assumed	263.590	343	.768			
	Greenhouse-Geisser	263.590	300.764	.876			
	Huynh-Feldt	263.590	343.000	.768			
	Lower-bound	263.590	49.000	5.379			

Pairwise Comparisons

Measure: MEASURE_1

(I) Health	(J) Health	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	95% Confidence Interval for Difference[b] Upper Bound
1	2	.513	.181	.187	-.086	1.112
	3	.380	.178	1.000	-.207	.967
	4	.273	.132	1.000	-.162	.709
	5	-.033	.160	1.000	-.563	.496
	6	1.147*	.173	<.001	.577	1.717
	7	-.180	.158	1.000	-.701	.341
	8	.100	.149	1.000	-.391	.591
2	1	-.513	.181	.187	-1.112	.086
	3	-.133	.202	1.000	-.802	.536
	4	-.240	.202	1.000	-.907	.427
	5	-.547	.180	.109	-1.143	.049
	6	.633*	.184	.032	.027	1.240
	7	-.693*	.206	.041	-1.373	-.013
	8	-.413	.187	.890	-1.031	.205
3	1	-.380	.178	1.000	-.967	.207
	2	.133	.202	1.000	-.536	.802
	4	-.107	.174	1.000	-.683	.470
	5	-.413	.165	.444	-.960	.133
	6	.767*	.185	.004	.154	1.379
	7	-.560	.195	.170	-1.205	.085
	8	-.280	.153	1.000	-.786	.226
4	1	-.273	.132	1.000	-.709	.162
	2	.240	.202	1.000	-.427	.907
	3	.107	.174	1.000	-.470	.683
	5	-.307	.160	1.000	-.836	.223
	6	.873*	.178	<.001	.284	1.463
	7	-.453	.170	.290	-1.015	.108
	8	-.173	.167	1.000	-.724	.377
5	1	.033	.160	1.000	-.496	.563
	2	.547	.180	.109	-.049	1.143
	3	.413	.165	.444	-.133	.960
	4	.307	.160	1.000	-.223	.836
	6	1.180*	.173	<.001	.607	1.753
	7	-.147	.198	1.000	-.801	.508
	8	.133	.167	1.000	-.419	.686
6	1	-1.147*	.173	<.001	-1.717	-.577
	2	-.633*	.184	.032	-1.240	-.027
	3	-.767*	.185	.004	-1.379	-.154
	4	-.873*	.178	<.001	-1.463	-.284
	5	-1.180*	.173	<.001	-1.753	-.607
	7	-1.327*	.173	<.001	-1.900	-.754
	8	-1.047*	.167	<.001	-1.598	-.495
7	1	.180	.158	1.000	-.341	.701
	2	.693*	.206	.041	.013	1.373
	3	.560	.195	.170	-.085	1.205
	4	.453	.170	.290	-.108	1.015
	5	.147	.198	1.000	-.508	.801
	6	1.327*	.173	<.001	.754	1.900
	8	.280	.168	1.000	-.275	.835
8	1	-.100	.149	1.000	-.591	.391
	2	.413	.187	.890	-.205	1.031
	3	.280	.153	1.000	-.226	.786
	4	.173	.167	1.000	-.377	.724
	5	-.133	.167	1.000	-.686	.419
	6	1.047*	.167	<.001	.495	1.598
	7	-.280	.168	1.000	-.835	.275

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

D2 Naturalness perception

D2.1 Reliability analysis Naturalness

Reliability Statistics

Cronbach's Alpha	N of Items
.845	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
How natural do you perceive this product to be? - This product appears to be made with natural ingredients	6.86	5.601	.760	.737
How natural do you perceive this product to be? - I believe this product is minimally processed	7.16	6.056	.781	.724
How natural do you perceive this product to be? - I believe this product is made using traditional or artisanal methods	7.02	6.371	.608	.885

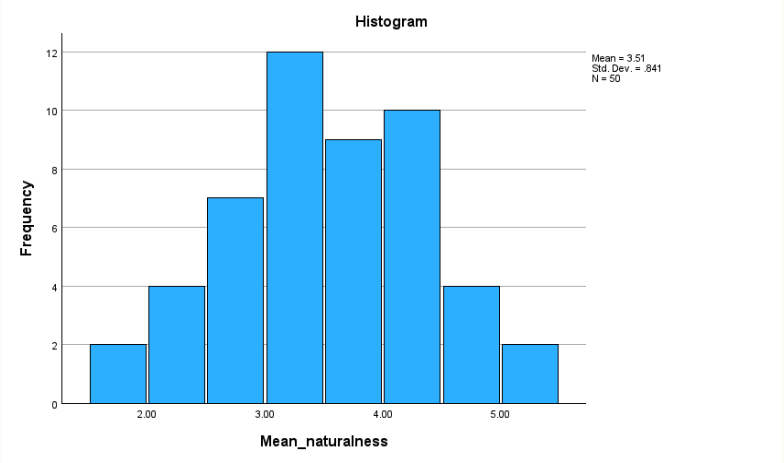
D2.2 Normality Check Naturalness

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Mean_naturalness	.065	50	.200*	.981	50	.600

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction



D2.3 Repeated Measures Anova Naturalness

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Epsilon[b] Huynh-Feldt	Epsilon[b] Lower-bound
Naturalaness	.410	41.418	27	.038	.816	.937	.143

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept
Within Subjects Design: Naturalaness

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Naturalaness	Sphericity Assumed	40.404	7	5.772	8.292	<.001	.145
	Greenhouse-Geisser	40.404	5.715	7.070	8.292	<.001	.145
	Huynh-Feldt	40.404	6.556	6.163	8.292	<.001	.145
	Lower-bound	40.404	1.000	40.404	8.292	.006	.145
Error(Naturalaness)	Sphericity Assumed	238.762	343	.696			
	Greenhouse-Geisser	238.762	280.048	.853			
	Huynh-Feldt	238.762	321.231	.743			
	Lower-bound	238.762	49.000	4.873			

Descriptive Statistics

	Mean	Std. Deviation	N
Probiotic_Bacteria_Naturalness_Perception	3.9333	1.18570	50
No_claim_imagery_Naturalness_Perception	3.5000	1.13938	50
Taste_Claim_Naturalness_Perception	3.4867	1.22003	50
Slim_Naturalness_Perception	3.5667	1.23305	50
Loophole_Claim_Naturalness_Perception	3.6867	1.13171	50
Bright_Colour_Naturalness_Perception	2.7800	1.09547	50
No_Health_Imagery_Naturalness_Perception	3.7200	1.12760	50
Cartoon_Naturalness_Perception	3.3800	1.03238	50

Pairwise Comparisons

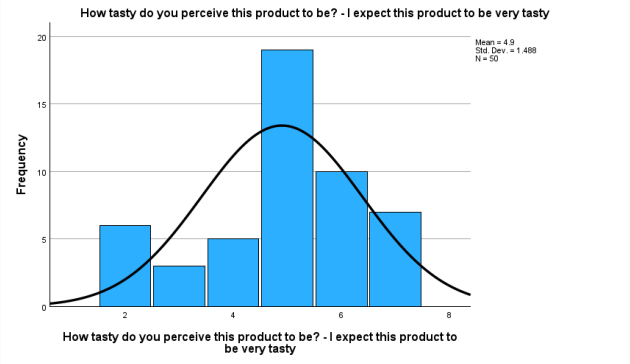
Measure: MEASURE_1

(I) Naturalaness	(J) Naturalaness	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1	2	.433	.146	.132	-.050	.917
	3	.447	.141	.075	-.020	.913
	4	.367	.162	.786	-.169	.902
	5	.247	.115	1.000	-.133	.627
	6	1.153*	.185	<.001	.541	1.766
	7	.213	.177	1.000	-.371	.798
	8	.553*	.152	.018	.051	1.055
2	1	-.433	.146	.132	-.917	.050
	3	.013	.145	1.000	-.465	.492
	4	-.067	.191	1.000	-.697	.563
	5	-.187	.150	1.000	-.682	.309
	6	.720*	.191	.012	.090	1.350
	7	-.220	.161	1.000	-.751	.311
	8	.120	.159	1.000	-.405	.645
3	1	-.447	.141	.075	-.913	.020
	2	-.013	.145	1.000	-.492	.465
	4	-.080	.198	1.000	-.735	.575
	5	-.200	.138	1.000	-.657	.257
	6	.707*	.171	.004	.141	1.272
	7	-.233	.173	1.000	-.806	.339
	8	.107	.155	1.000	-.406	.619
4	1	-.367	.162	.786	-.902	.169
	2	.067	.191	1.000	-.563	.697
	3	.080	.198	1.000	-.575	.735
	5	-.120	.153	1.000	-.625	.385
	6	.787*	.183	.002	.183	1.390
	7	-.153	.195	1.000	-.799	.492
	8	.187	.162	1.000	-.348	.721
5	1	-.247	.115	1.000	-.627	.133
	2	.187	.150	1.000	-.309	.682
	3	.200	.138	1.000	-.257	.657
	4	.120	.153	1.000	-.385	.625
	6	.907*	.179	<.001	.314	1.500
	7	-.033	.169	1.000	-.590	.524
	8	.307	.155	1.000	-.205	.819
6	1	-1.153*	.185	<.001	-1.766	-.541
	2	-.720*	.191	.012	-1.350	-.090
	3	-.707*	.171	.004	-1.272	-.141
	4	-.787*	.183	.002	-1.390	-.183
	5	-.907*	.179	<.001	-1.500	-.314
	7	-.940*	.179	<.001	-1.530	-.350
	8	-.600	.196	.100	-1.248	.048
7	1	-.213	.177	1.000	-.798	.371
	2	.220	.161	1.000	-.311	.751
	3	.233	.173	1.000	-.339	.806
	4	.153	.195	1.000	-.492	.799
	5	.033	.169	1.000	-.524	.590
	6	.940*	.179	<.001	.350	1.530
	8	.340	.158	1.000	-.180	.860
8	1	-.553*	.152	.018	-1.055	-.051
	2	-.120	.159	1.000	-.645	.405
	3	-.107	.155	1.000	-.619	.406
	4	-.187	.162	1.000	-.721	.348
	5	-.307	.155	1.000	-.819	.205
	6	.600	.196	.100	-.048	1.248
	7	-.340	.158	1.000	-.860	.180

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.



D2.4 Naturalness mediation Linear Mixed Models

Path a: Stimuli Effect on Naturalness

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	392.000	.000	1.000
Stimulus	7	392	4.385	<.001

a. Dependent Variable: Zscore(Naturalness).

Path b: Naturalness → Health

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	391.000	.000	1.000
ZNaturalness	1	391	373.247	<.001
Stimulus	7	391	2.909	.006

a. Dependent Variable: Zscore(Health).

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	.206	.098	391.000	2.111	.035	.014	.398
ZNaturalness	.693	.036	391	19.320	<.001	.623	.764
[Stimulus=1]	-.249	.139	391	-1.794	.074	-.523	.024
[Stimulus=2]	-.382	.138	391.000	-2.765	.006	-.653	-.110
[Stimulus=3]	-.274	.138	391.000	-1.981	.048	-.545	-.002
[Stimulus=4]	-.240	.138	391	-1.738	.083	-.512	.031
[Stimulus=5]	-.080	.138	391.000	-.575	.566	-.352	.192
[Stimulus=6]	-.436	.139	391	-3.134	.002	-.710	-.163
[Stimulus=7]	.011	.138	391	.082	.935	-.261	.283
[Stimulus=8]	0[b]	0	.	.	.	.	.

a. Dependent Variable: Zscore(Health).

b. This parameter is set to zero because it is redundant.

Path c: Stimuli direct effect on Health

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	392	.000	1.000
Stimulus	7	392	5.396	<.001

a. Dependent Variable: Zscore(Health).

Path b: Naturalness → Taste

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	391.000	.000	1.000
Stimulus	7	391	1.090	.369
ZNaturalness	1	391	33.950	<.001

a. Dependent Variable: Zscore: Taste.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	-.006	.136	391	-.044	.965	-.274	.262
[Stimulus=1]	.042	.194	391	.217	.829	-.340	.424
[Stimulus=2]	.090	.193	391	.464	.643	-.289	.469
[Stimulus=3]	.048	.193	391	.250	.803	-.331	.427
[Stimulus=4]	.073	.193	391	.379	.705	-.306	.452
[Stimulus=5]	-.210	.193	391.000	-1.087	.278	-.590	.170
[Stimulus=6]	.208	.194	391	1.069	.286	-.174	.590
[Stimulus=7]	-.203	.193	391.000	-1.052	.294	-.583	.177
[Stimulus=8]	0[b]	0	.	.	.	.	.
ZNaturalness	.292	.050	391	5.827	<.001	.193	.390

a. Dependent Variable: Zscore: Taste.

b. This parameter is set to zero because it is redundant.

Path c: Stimuli direct effect on Taste

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	392	.000	1.000
Stimulus	7	392	.643	.720

a. Dependent Variable: Zscore: Taste.

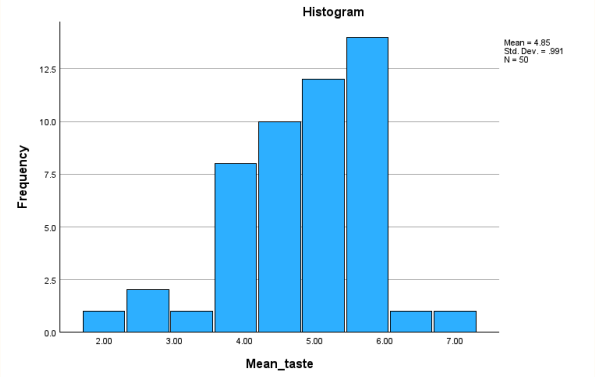
D3 Taste perception

D3.1 Normality Check Taste

Tests of Normality

	Kolmogorov-Smirnov[a] Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Mean_taste	.110	50	.179	.946	50	.023

a. Lilliefors Significance Correction



Descriptives

			Statistic	Std. Error
Mean_taste	Mean		4.8500	.14011
	95% Confidence Interval for Mean	Lower Bound	4.5684	
		Upper Bound	5.1316	
	5% Trimmed Mean		4.9083	
	Median		5.0000	
	Variance		.982	
	Std. Deviation		.99071	
	Minimum		2.00	
	Maximum		6.75	
	Range		4.75	
	Interquartile Range		1.31	
	Skewness		-.871	.337
	Kurtosis		.840	.662

D3.2 Repeated-Measures ANOVA Taste & Friedman

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Taste	.195	75.843	27	<.001	.662	.740	.143

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept
Within Subjects Design: Taste

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Taste	Sphericity Assumed	8.160	7	1.166	1.226	.287	.024
	Greenhouse-Geisser	8.160	4.636	1.760	1.226	.299	.024
	Huynh-Feldt	8.160	5.180	1.575	1.226	.297	.024
	Lower-bound	8.160	1.000	8.160	1.226	.274	.024
Error(Taste)	Sphericity Assumed	326.090	343	.951			
	Greenhouse-Geisser	326.090	227.181	1.435			
	Huynh-Feldt	326.090	253.836	1.285			
	Lower-bound	326.090	49.000	6.655			

Test Statistics[a]

N	50
Chi-Square	6.460
df	7
Asymp. Sig.	.487

a. Friedman Test

Descriptive Statistics

	Mean	Std. Deviation	N
How tasty do you perceive this product to be? - I expect this product to be very tasty	5.04	1.212	50
How tasty do you perceive this product to be? - I expect this product to be very tasty	4.96	1.142	50
How tasty do you perceive this product to be? - I expect this product to be very tasty	4.90	1.488	50
How tasty do you perceive this product to be? - I expect this product to be very tasty	4.96	1.142	50
How tasty do you perceive this product to be? - I expect this product to be very tasty	4.62	1.398	50
How tasty do you perceive this product to be? - I expect this product to be very tasty	4.88	1.586	50
How tasty do you perceive this product to be? - I expect this product to be very tasty	4.64	1.411	50
How tasty do you perceive this product to be? - I expect this product to be very tasty	4.80	1.325	50

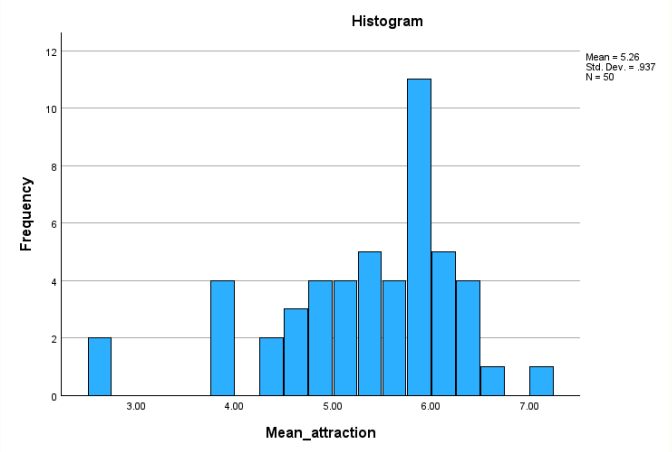
D4 Attractiveness

D4.1 Normality check

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Mean_attraction	.139	50	.018	.930	50	.006

a. Lilliefors Significance Correction



Descriptives

			Statistic	Std. Error
Mean_attraction	Mean		5.2625	.13249
	95% Confidence Interval for Mean	Lower Bound	4.9962	
		Upper Bound	5.5288	
	5% Trimmed Mean		5.3181	
	Median		5.5000	
	Variance		.878	
	Std. Deviation		.93686	
	Minimum		2.63	
	Maximum		7.00	
	Range		4.38	
	Interquartile Range		1.13	
	Skewness		-.972	.337
	Kurtosis		.942	.662

D4.2 Repeated-Measures ANOVA & Friedman

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Stimuli	.434	38.807	27	.067	.805	.922	.143

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept
Within Subjects Design: Stimuli

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Stimuli	Sphericity Assumed	12.458	7	1.780	1.682	.112	.033
	Greenhouse-Geisser	12.458	5.638	2.210	1.682	.130	.033
	Huynh-Feldt	12.458	6.455	1.930	1.682	.119	.033
	Lower-bound	12.458	1.000	12.458	1.682	.201	.033
Error(Stimuli)	Sphericity Assumed	362.917	343	1.058			
	Greenhouse-Geisser	362.917	276.261	1.314			
	Huynh-Feldt	362.917	316.292	1.147			
	Lower-bound	362.917	49.000	7.406			

Ranks

	Mean Rank
This packaging is visually attractive	5.16
This packaging is visually attractive	4.64
This packaging is visually attractive	4.25
This packaging is visually attractive	4.28
This packaging is visually attractive	4.73
This packaging is visually attractive	4.07
This packaging is visually attractive	4.09
This packaging is visually attractive	4.78

Test Statistics[a]

N	50
Chi-Square	12.458
df	7
Asymp. Sig.	.086

a. Friedman Test

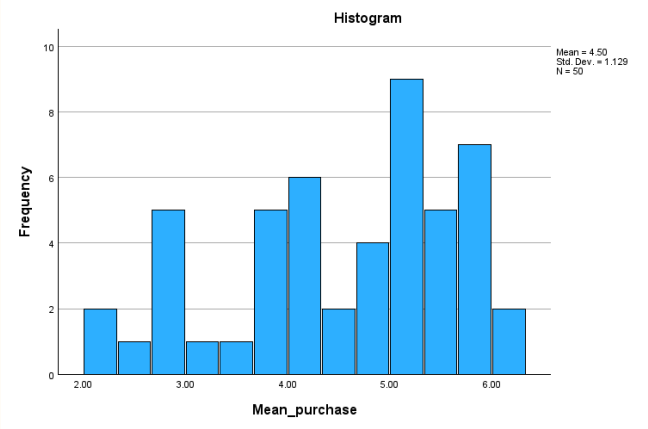
D5. Purchase intention

D5.1 Normality check purchase intention

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Mean_purchase	.170	50	<.001	.941	50	.014

a. Lilliefors Significance Correction



Descriptives

			Statistic	Std. Error
Mean_purchase	Mean		4.5011	.15968
	95% Confidence Interval for Mean	Lower Bound	4.1802	
		Upper Bound	4.8220	
	5% Trimmed Mean		4.5484	
	Median		4.8750	
	Variance		1.275	
	Std. Deviation		1.12913	
	Minimum		2.00	
	Maximum		6.25	
	Range		4.25	
	Interquartile Range		1.63	
	Skewness		-.562	.337
	Kurtosis		-.609	.662

D5.2 Repeated-Measures ANOVA, Friedman & Wilcoxon Signed Ranks test

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Stimuli	.313	52.724	27	.002	.771	.880	.143

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept
Within Subjects Design: Stimuli

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Stimuli	Sphericity Assumed	28.895	7	4.128	4.125	<.001	.079
	Greenhouse-Geisser	28.895	5.397	5.354	4.125	<.001	.079
	Huynh-Feldt	28.895	6.160	4.691	4.125	<.001	.079
	Lower-bound	28.895	1.000	28.895	4.125	.048	.079
Error(Stimuli)	Sphericity Assumed	336.230	336	1.001			
	Greenhouse-Geisser	336.230	259.047	1.298			
	Huynh-Feldt	336.230	295.689	1.137			
	Lower-bound	336.230	48.000	7.005			

Test Statistics[a]

N	49
Chi-Square	20.654
df	7
Asymp. Sig.	.004

a. Friedman Test

Test Statistics[a]

	Buy3 - Buy1
Z	-3.354[b]
Asymp. Sig. (2-tailed)	<.001

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks.

Ranks

		N	Mean Rank	Sum of Ranks
Buy3 - Buy1	Negative Ranks	21[a]	15.43	324.00
	Positive Ranks	6[b]	9.00	54.00
	Ties	23[c]		
	Total	50		

a. Buy3 < Buy1
b. Buy3 > Buy1
c. Buy3 = Buy1

Test Statistics[a]

	Buy6 - Buy1
Z	-3.549[b]
Asymp. Sig. (2-tailed)	<.001

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks.

Ranks

		N	Mean Rank	Sum of Ranks
Buy6 - Buy1	Negative Ranks	23[a]	15.52	357.00
	Positive Ranks	5[b]	9.80	49.00
	Ties	22[c]		
	Total	50		

a. Buy6 < Buy1
b. Buy6 > Buy1
c. Buy6 = Buy1

Test Statistics[a]

	Buy6 - Buy5
Z	-3.435[b]
Asymp. Sig. (2-tailed)	<.001

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks.

Ranks

		N	Mean Rank	Sum of Ranks
Buy6 - Buy5	Negative Ranks	23[a]	18.30	421.00
	Positive Ranks	8[b]	9.38	75.00
	Ties	19[c]		
	Total	50		

a. Buy6 < Buy5
b. Buy6 > Buy5
c. Buy6 = Buy5

D6. Familiarity

D6.1 Reliability analysis familiarity

Reliability Statistics

Cronbach's Alpha	N of Items
.787	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
How familiar are you with kombucha? - I am very familiar with kombucha	5.90	9.765	.657	.678
How familiar are you with kombucha? - I drink kombucha often	7.58	10.861	.686	.666
How familiar are you with kombucha? - I see kombucha frequently when shopping	6.16	9.525	.562	.797

D5.1 Mixed-effects linear regression analysis Familiarity on health perception

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	391.000	492.015	<.001
Stimulus	7	391	5.420	<.001
Familiairity	1	391.000	2.738	.099

a. Dependent Variable: Health.

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	3.588	.228	391	15.708	<.001	3.139	4.037
[Stimulus=1]	.100	.255	391	.392	.695	-.402	.602
[Stimulus=2]	-.413	.255	391	-1.619	.106	-.915	.089
[Stimulus=3]	-.280	.255	391	-1.097	.273	-.782	.222
[Stimulus=4]	-.173	.255	391	-.679	.498	-.675	.329
[Stimulus=5]	.133	.255	391	.522	.602	-.369	.635
[Stimulus=6]	-1.047	.255	391	-4.100	<.001	-1.549	-.545
[Stimulus=7]	.280	.255	391	1.097	.273	-.222	.782
[Stimulus=8]	0[b]	0	.	.	.	.	.
Familiairity	.071	.043	391.000	1.655	.099	-.013	.155

a. Dependent Variable: Health.

b. This parameter is set to zero because it is redundant.

D.7 Demographics

How old are you?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 - 24	24	48.0	48.0	48.0
	25 - 34	15	30.0	30.0	78.0
	35 - 44	5	10.0	10.0	88.0
	55 - 64	6	12.0	12.0	100.0
	Total	50	100.0	100.0	

What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	17	34.0	34.0	34.0
	Female	33	66.0	66.0	100.0
	Total	50	100.0	100.0	

Appendix E Project Brief

TU Delft

Personal Project Brief – IDE Master Graduation Project

Name student Sophie Ngan **Student number** 5,273,501

PROJECTTITLE,INTRODUCTION,PROBLEMDEFINITIONand ASSIGNMENT
Complete all fields, keep information clear, specific and concise

Project title Design of Kombucha packaging to communicate consumer benefits

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

The project takes place in the domain of beverage packaging, specifically kombucha, a fermented drink known for its health benefits. This drink is currently quickly gaining popularity globally as a functional drink, seen as a healthier alternative to sugary soft drinks (Ariff et al., 2023). Traditional soft drinks dominate the market, playing a role in the urgent growing problems of obesity and overweight in the world by being full of sugar. Kombucha contains a low amount of calories and possibly has health benefits from the probiotics inside. However, healthier drinks such as kombucha are often overshadowed by aggressive marketing campaigns promoting high-sugar soft drinks (Prajapati et al., 2024). The main stakeholders in this project include consumers and kombucha brands. Kombucha brands have an interest in differentiating themselves from competitors through packaging design. Clear communication of product benefits with packaging is essential for brands to engage consumers effectively. Consumers seek transparent information to make informed decisions in selecting probiotic drinks (Kellershohn, 2021). The growing market for functional drinks, probiotic drinks, and kombucha gives the opportunity for kombucha brands to use packaging that effectively communicates their unique value propositions and stand out on store shelves. With this project, kombucha brands will better understand the packaging design in line with consumers' preferences. It focuses on how kombucha brands are sold in supermarkets in the Netherlands. Figure 1 shows kombucha packaging sold in a Dutch supermarket.

→ *space available for images / figures on next page*

introduction (continued): space for images

image / figure 1 Different kombucha packaging sold in Dutch supermarket Albert Heijn (Albert Heijn, 2025)

image / figure 2

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

The problem to solve is the lack of attractive packaging and clear communication of kombuchas' taste and health benefits through packaging. In the Dutch market kombucha is still a relatively new concept for many consumers. Kombucha brands sold in supermarkets in the Netherlands need to clearly communicate the benefits on their packaging. In packaging design, there is a conflict between healthier perceived food and taste perception. The purchase intention of healthier-looking vice food is decreased because of the lower taste perception (Schnurr, 2019). The knowledge gap lies in how to combine design elements like verbal claims, colours, imagery, and shapes in a cohesive design (Schifferstein et al., 2021). In a way that ensures consumers perceive kombucha as both healthy and tasty whilst being attractive. This study aims to do this by developing a strategic kombucha packaging design guideline that optimally conveys kombucha benefits focused on the combination of these design elements and possibly leveraging its historic roots and unique production process. Contributing to encouraging consumers to make healthier beverage choices.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format*:*

Design a kombucha packaging guideline to improve the value proposition visibility for consumers in Dutch supermarkets.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

To approach this project I will first conduct a thorough literature review to learn about the kombuchas' origin, production process and how packaging design (elements such as verbal claims, colours, imagery/decorative elements and shapes) influence consumer perceptions of health and taste. I will conduct a focus group to explore consumers' perception on kombucha. Next, I will develop multiple packaging concepts by using findings from the literature and the focus group. Making various combinations and variants of packaging elements such as colour, imagery/decorative elements, verbal claims and shape. These concepts will be tested using qualitative research focus groups to gather insights and preferences. The concepts will be iterated to create a kombucha packaging guideline on what is the most effective way to communicate benefits.

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	26 Feb 2025
Mid-term evaluation	15 Apr 2025
Green light meeting	23 Jun 2025
Graduation ceremony	21 Jul 2025

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	

Comments:
From26th ofmay - 8thofjune I willgo on holiday (2 weeks)

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

After graduation, I would like to work as a brand manager. I enjoy thinking strategically and also being able to use my visualisation skills. This project gives me the opportunity to acquire more knowledge and experience with packaging design, which is often a part of branding. Therefore I would like to conduct research with consumers to develop packaging. I find it motivating and interesting that this project is also about health, being able to help consumers to make healthier choices. This project will enable me to develop a strategic, consumer-oriented approach to packaging design, bridging my academic knowledge with real-world applications in a growing market.