1

SUSTAINABLE PACKAGING OPTION FOR DIETARY SUPPLEMENT

CALIFORNIA POLYTECHNIC STATE UNIVERSITY
TECHNICAL ASSOCIATION OF THE GRAPHIC ARTS

ARTICLE 1

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Alex Chen

The increasing preference for sustainability have significantly transformed consumption patterns, particularly within the packaging industry. Businesses have recognized this shift as an opportunity to align their operations with more sustainable practices, simultaneously attracting conscientious consumers and contributing to environmental conservation.

This project study focuses on the packaging option offered within K1 Packaging Group, a printing and sourcing company in Southern California to Everest Formulation, a dietary supplement contract manufacturer under K1 Packaging Group, and how it could utilize green marketing strategies to create and leverage business opportunities in the packaging printing sector for its supplement customers.

PROBLEM STATEMENT

The burgeoning global awareness of environmental consequences associated with packaging materials has been a significant catalyst for a marked shift in consumer preferences and regulatory frameworks worldwide. This change is particularly pronounced in product packaging, necessitating the packaging industry's response in offering sustainable options to brands and consumers (PR Newswire, 2023 & Packaging Europe, 2022).

While large corporations frequently hold considerable market share and production capacity, small to mid-sized companies within the packaging industry grapple with the rising trend of sustainable packaging. The article "Using world making to understand the role of design in the sustainability agenda" discussed these businesses, smaller organizations particularly, are compelled to undertake exhaustive research before investing in specific machinery or materials due to their relative financial limitations (Ritch, E., & Brennan, C., 2010).

Navigating the abundant options for sustainable packaging solutions proves to be challenging for businesses operating with limited resources. The pivotal question, then, is which area should such a small business prioritize? This project is designed to deliver a near-term solution for K1 Packaging Group, a family-owned enterprise specializing in the provision of primary and secondary printed packaging, encompassing paper, plastic, and glass materials.

The objective is to guide strategic investment of resources to cater to both present and future generations of buyers. In doing so, we aim to gain a deeper understanding and stay ahead of prevailing industry trends.

PURPOSE OF STUDY

This project was initiated to understand the following key questions:

1. What are the feasible sustainable packaging options that K1 Packaging Group could employ?
2. Do consumers for sustainable options vary across different materials?
3. What are the regulations around sustainable packaging?
4. What are the prevailing sustainable-related logos and organizations?

HYPOTHESIS CONSIDERATIONS

H1: Consumers, especially Gen Z, show a readiness to transition towards more sustainable packaging options, even if it entails a modest price increase.

H2: Among the current sustainable packaging materials available in the market, consumers tend to favor bio-based packaging more than fiber-based or glass alternatives, with polymer-based packaging being their least preferred choice.

H3: Consumers are likely unfamiliar with existing sustainable certification logos and make decisions based on the accompanying text information.

H4: When it comes to dietary supplement products, consumers tend to lean towards traditional packaging styles, such as bottles (whether glass or plastic), rather than alternative styles like plastic pouches or paper tubes.

CURRENT EVEREST FORMULATION CAPABILITY

K1 Packaging offers a broad spectrum of packaging solutions to cater to a diverse range of customer sectors. However, Everest Formulation's expertise is distinctly positioned in providing comprehensive, turnkey solutions tailored for supplement products for various brands. As of 2023, the company manages a broad product format portfolio, including encapsulation, powders, tablets, and liquid-based items.

Predominantly, Everest Formulation employs plastic containers with plastic caps for packaging, which is primarily due to their extensive acceptance and prevalent use. However, the company's versatility in packaging capabilities is evident in their advanced machinery that supports co-packing of products into a variety of formats, such as stand-up pouches, three-side sealed pouches, and stick packs. Moreover, Everest Formulation operates a specialized production line specifically for blister packaging, which adds another layer of diversity to their packaging options.

Nonetheless, it should be noted that several of these packing options may still be semi-automatic. Competitors or specific packaging offerings, such as stand-up pouches, are more commonly provided via fully automated in-line machinery. This project will also serve to inform K1 Packaging Group about popular sustainable packaging forms and the appropriate machinery to invest in for future developments.

SUSTAINABLE OPTIONS FOR SUPPLEMENT INDUSTRY

What material counts as sustainable and can be provided? Sustainability has swiftly ascended to prominence, cementing its place as a fundamental cornerstone in the packaging business models of an increasing number of supplement brands (Euromonitor International. 2021). With mounting concerns over environmental degradation and a palpable shift in consumer behavior, brands have found themselves needing to reorient their operational practices towards a more sustainable model. Based on the research "Packaging in a circular economy: Sustainable packaging insights" from McKinsey & Company in 2020, this has led to brands focusing their sustainability efforts on both e-commerce and retail channels, which each come with their own unique sets of challenges and opportunities (McKinsey & Company, 2020).

Before looking at what K1 Packaging Group should be investing in, it is important to understand what sustainable packaging options are currently available on the market and the material within K1's supply chain:

Recycled Plastic Packaging: This form of packaging leverages plastic, which, after thorough cleaning and reprocessing, is repurposed into new packaging materials. This strategy significantly reduces the demand for virgin materials and curtails the volume of waste destined for landfills. Commonly referred to as PCR (Post-Consumer Recycled) plastic, this option is recognized for its role in diminishing the carbon footprint associated with the production of virgin plastic (Euromonitor International, 2021).

Biodegradable or Plant-Based Plastics: These represent the current sustainable alternatives that are engineered to substitute traditional plastic. Derived from entirely natural plant materials such as corn oil, starch, orange peels, and various plants, these materials decompose faster than conventional plastic when discarded (Rujnic-Sokele, M., & Pilipovic, A., 2017). Within K1 Packaging's supply chain, biodegradable plastics like Polylactic Acid (PLA) can be converted into film products. However, it's worth noting that the barrier characteristics of these products aren't as robust as those of traditional plastic pouches (Wu, Misra, M., & Mohanty, A. K., 2021). This restricts their application, particularly liquid or lotion products. The table below (Figure 1) depicts the typical barrier features (oxygen transfer rate and moisture vapor transfer rate) of PLA film, which is approximately ten times higher compared to PET/PE plastic film.

Properties	Units	Typical Values	Test Method
Thickness	gauge µm	80 20	WW17-445
Basis Weight	in^2/lb m^2/kg	28,350 40.3	WW17-445
Yield	lbs/ream	15.23	ASTM D646
Tensile Strength	lb/in^2 N/m^2	9,000 - 15,000 62 - 103	ASTM D882
Gloss (45°)	Units	75	ASTM D2457
Haze	%	≤ 2	ASTM D1003
COF	treat/treat untreat/untreat	0.05	ASTM D1894
MVTR 100°(38°C), 100% RH	g/100 in^2/24 hr g/m^2/24 hr	30 490	ASTM F1249
OTR 73°(23°C), 0% RH	cc/100 in^2/24 hr cc/m^2/24 hr	92 1425	ASTM 1434-66

Table 1 Barrier feature data of current biodegradable plastic film

Glass Packaging: Glass, being non-toxic and 100% recyclable, can be reused an indefinite number of times (Moustakas, K., Loizidou, M., & Rovolis, A., 2020). This eco-friendly alternative is gaining traction among K1 Packaging and Everest Formulation's client base, mainly as a primary packaging solution.

Compostable Packaging: This packaging variant can be decomposed into its natural constituents within a composting environment, without leaving any harmful residues in the soil. The majority of the fiber-based packaging options fall under this category. While it's not typically used as a primary packaging that comes into direct contact with supplement products, it is widely employed as a secondary packaging, most commonly in the form of folding cartons (Twede, D., Selke, S. E. M., & Shires, D., 2014).

It's important to note that there are other sustainable packaging solutions, such as metal or tin packaging and mushroom pulp packaging. However, these fall outside the purview of what K1 Packaging can currently offer. By comprehending the above-mentioned options that K1 Packaging can provide, we can delineate the scope of offerings by posting the project's analysis.

CURRENT SUPPLEMENT BRANDS BUSINESS MODEL

Prior to the pandemic, supplement packaging was pretty simple. The majority of business came from retail or the placement of products on retail shelves. This means most of the packaging is restricted by the retailer's rule, and often the product is provided in a secondary folding carton with a plastic primary packaging and with a label. However, during the pandemic, e-commerce has totally changed the landscape. According to the journal "E-commerce and e-business. In Strategic E-Business: Strategic Thinking and Practice," the requirements of the packaging have also been altered. Below we will touch on the two sales channels and the packaging requirements:

E-commerce: The digital revolution and the subsequent meteoric rise of online shopping have ushered in a new era for packaging practices, especially after the pandemic. Packaging now needs to cater to the nuances of e-commerce, and this comes with an array of considerations. Products need to be encased in such a manner that their integrity and quality are preserved during transit, reducing the risk of damage or spoilage. This necessitates robust packaging that can withstand the rigors of transport and delivery (Chaffey, D., 2020).

Accompanying the escalation in e-commerce is a surge in packaging waste, a problem that urgently requires addressing. Therefore, brands are tasked with the challenge of minimizing packaging waste without compromising product safety. This calls for creative and innovative solutions, such as using modular designs or developing minimalist packaging that uses fewer materials but maintains the desired level of protection.

Consider the case of Roman Health, a client of K1 Packaging that primarily conducts its business via e-commerce. Their packaging requirements underline the high priority accorded to transit protection. Since the retail environment doesn't need to be factored into their considerations, they are more inclined to use glass jars, which aren't as susceptible to damage during shelf stacking. Directly printing artwork on the glass jars with a minimalistic design is a common strategy adopted by the company. This is because there's no need to vie for attention against other competitors on a retail shelf.

Retail: In the retail sector, sustainable packaging is crucial not only from an environmental viewpoint but also as a decisive factor in customer purchasing decisions.

Packaging serves as a silent salesperson, and research indicates that customers are more likely to purchase eco-friendly products. Consequently, packaging becomes a critical medium to communicate a brand's sustainability commitment (Rokka, J., & Uusitalo, L., 2020).

Brands must use their packaging to visually express their environmental ethos, which could be achieved through eco-labels, recycling instructions, or even the choice of packaging design and materials. Green colors, earthy tones, and natural imagery can subtly signal a brand's environmental commitment (Luchs, M. G., & Kumar, M., 2017).

Additionally, for retail products, packaging sustainability extends beyond the product itself to secondary and tertiary packaging like shelf-ready packaging and display units. Brands must consider the full lifecycle of their packaging materials, from production to disposal, aiming for sustainability at each stage.

Take HUM Nutrition, another K1 Packaging customer. As they primarily operate in the retail channel, they ensure maximum product protection during shelving and customer interaction by heavily using plastic containers. Labeling is also significant; while it may not be sustainable, it's necessary due to regulations requiring certain messages to be displayed.

SUSTAINABLE REQUIREMENT

Given the varying sustainability regulations across different regions, companies must pay close attention to the standards set in their primary markets. As K1 Packaging's customer base is mainly in Europe and North America (particularly California), the sustainable packaging options will need to align with these regions' regulations.

USA: In the United States, a market characterized by its massive size and diversity, a variety of sustainability standards and guidelines have been put forth, often on a voluntary basis. One such notable standard is the Sustainable Packaging Coalition's (SPC) guidelines. These guidelines serve as a comprehensive resource for companies seeking to incorporate sustainability into their packaging practices (Sustainable Packaging Coalition., 2021).

The SPC's guidelines lay particular emphasis on three major elements: recyclability, composability, and the reduction of packaging materials. Recyclability is a cornerstone of the guidelines, encouraging companies to use materials that can be effectively

collected, sorted, and reprocessed into new packaging or other products. This encourages a circular economy approach, with materials constantly being reprocessed and reused, reducing the demand for virgin materials.

Composability is another key aspect, focusing on the use of materials that can decompose under specific conditions into nutrient-rich compost, further promoting the concept of the circular economy and reducing the amount of waste that ends up in landfills (Narodoslawsky, M., & Shazad, K., 2020).

Finally, the SPC guidelines stress the reduction of packaging materials. Companies are urged to rethink their packaging designs to minimize material usage, without compromising the functionality and integrity of the packaging. This concept, often referred to as 'source reduction', reduces both material costs and environmental impacts associated with packaging (Sustainable Packaging Coalition., 2021). On the other hand, since K1 Packaging is located in California, and known for its progressive environmental policies, California has been a pioneer in the USA in terms of limiting plastic waste. The state has enacted a number of laws aimed at reducing the use of single-use plastics:

Assembly Bill 1884 (2018): This law prohibits full-service restaurants from automatically providing plastic straws with beverages, allowing them only upon customer request (California Assembly, 2018).

Senate Bill 270 (2014): This law banned single-use plastic carryout bags at certain locations like grocery stores and pharmacies (California Senate, 2018).

Assembly Bill 341 (2011): This law established a policy goal of diverting 75% of solid waste away from landfills by recycling, composting, or source reduction, which includes plastic waste (California Assembly, 2011).

In 2020, California attempted to pass a broader bill, the California Circular Economy and Plastic Pollution Reduction Act (Senate Bills 54 and AB 1080), which would have required a significant reduction in single-use packaging and product waste, but the bill did not pass.

Several California cities have also enacted their own restrictions on single-use plastics. For instance, San Francisco banned single-use plastic bags as early as 2007, and has

since banned plastic straws and other single-use plastic items (City of San Francisco Environmental Department, 2020).

Europe: In Europe, a region well-known for its strong commitment to environmental concerns, regulations regarding sustainable packaging tend to be stricter. The European Packaging and Packaging Waste Directive provides a regulatory framework aimed at preventing the production of packaging waste and promoting its reuse, recycling, and other recovery forms.

The Single-Use Plastics Directive (EU) 2019/904, which came into effect in July 2019, specifically targets the ten single-use plastic products most often found on Europe's beaches and seas (European Commission, 2019).

The directive has several key elements:

- Certain products will be banned in the EU markets from 2021, including single use plastic cutlery (forks, knives, spoons, and chopsticks), plastic plates, straws, and sticks for balloons.
- For products without straight-forward alternatives, the goal is to limit their use through a national reduction in consumption. This includes single-use burger boxes, sandwich boxes, or food containers for fruits, vegetables, desserts, or ice creams.
- Producers will help cover the costs of waste management and clean-up, as well as awareness-raising measures for food containers, packets, and wrappers (such as for crisps and sweets), drinks containers and cups, tobacco products with filters (such as cigarette butts), wet wipes, balloons, and lightweight plastic bags.
- Certain products will require a clear and standardized labeling which indicates how waste should be disposed of, the negative environmental impact of the product, and the presence of plastics in the products.
- The directive also sets a target to incorporate 25% of recycled plastic in PET bottles from 2025 and 30% in all plastic bottles from 2030.

The directive imposes strict rules on packaging waste, seeking to minimize its environmental impact. This involves setting stringent targets for the recovery and recycling of packaging materials. It also encourages companies to reduce their packaging waste at the source, similar to the SPC guidelines in the US.

Material usage is another crucial aspect regulated by the directive. Companies are encouraged to optimize their use of packaging material, focusing on the principle of 'doing more with less'. This principle encourages innovation and creative thinking in packaging design to minimize material usage.

The directive also sets mandatory recycling targets for member countries, which companies need to take into account when designing and choosing packaging materials. This drives the use of materials that are easily recyclable, thus promoting the development of a circular economy within the packaging industry.

Given the current sustainable packaging regulations in the EU and USA, it's evident that K1 Packaging must adapt to new materials and acquire machinery capable of processing these materials. This adaptation is crucial to keeping up with trends and ensuring future business continuity. With a clear understanding of the regional regulatory requirements, sustainable material options, and unique packaging requirements for both retail and e-commerce setups, the next step would be to conduct a feasibility survey study. This study would help identify the most suitable sustainable materials and technologies that align with K1 Packaging's operations, customers' needs, and regional regulations. Following this, K1 Packaging could consider investing in the necessary machinery and training its workforce to handle the new materials and technologies. Additionally, engaging with suppliers who already adhere to these sustainability practices could be beneficial. Building robust relationships with these suppliers would help ensure a smooth transition to more sustainable practices.

OBJECTIVE - POOL OF OPTIONS

PRODUCT OPTIONS

Given K1 Packaging Group's extensive in-house capabilities, it's beneficial to understand the main types of packaging currently utilized by their customers and to propose a range of sustainable alternatives within those categories. The bulk of K1 Packaging and Everest Formulation's supplement fulfillment services, comprising about 77%, are for powder-based products, followed by liquid formulations. Tablets and encapsulated products constitute approximately 8% and 5%, respectively (Figure 1).

Among the powder-based products, which constitute the majority, most are packaged in plastic containers and sachets. This focus helps narrow down the potential

sustainable alternatives that need exploration. Presently, most of the packaging is done in plastic containers with secondary labels or directly filled into multi-layered plastic pouches in stand-up or sachet formats.

It's evident that the dietary supplement business segment relies heavily on polymer-based packaging (Zhang, Y., et al., 2020). This dependency presents a significant opportunity for introducing sustainable solutions, especially considering the industry-wide push towards reducing single-use plastic and regulatory efforts to curb plastic waste.

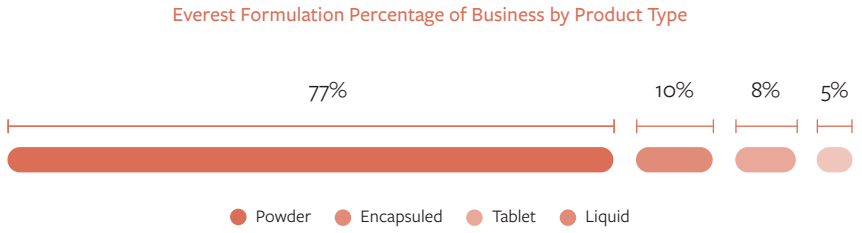

Figure 1 Percentage of business based on product type from Everest Formulation

SUSTAINABLE MATERIAL OPTIONS

Chapter 2 outlined a variety of potential options to replace the current polymer-based packaging. Firstly, bio-based packaging offers a viable alternative as it is derived from biological sources instead of fossil-based materials (Rujnic-Sokele, M., & Pilipovic, A., 2017). Secondly, biodegradable and compostable packaging, designed to break down and degrade naturally in the environment, presents another promising solution. Thirdly, recyclable packaging made from materials readily processed by our recycling systems can be considered. Lastly, post-consumer recycled (PCR) packaging, which is manufactured from recycled content, could be another viable choice. These types of packaging are the principal sustainable options that can be considered for K1 Packaging's dietary supplement business.

TYPES OF PACKAGING

To maximize the impact of sustainable alternatives within the highest proportion of K1 Packaging's operations, we need to focus on four frequently used types of packaging. Firstly, the stand-up pouch is a widely adopted format. Secondly, glass containers, known for their recyclability and reuse potential, are also common.

Thirdly, plastic containers currently constitute a significant portion of packaging types, but they offer substantial room for sustainable improvements. Lastly, fiber-based tubes, which can be both biodegradable and compostable, are also in regular use. These four packaging formats represent the primary targets for integrating more sustainable material options.

SURVEY, METHODOLOGIES, AND FINDINGS

To gather insights about readily available sustainable packaging options within K1 Packaging's supply chain, a choice-based survey was deployed. This survey was meticulously segmented into sections that align with specific factors, such as material selection and marketing strategies.

We received valuable feedback from 140 participants spread across North America and Asia, providing a comprehensive understanding of the most viable and advantageous sustainable packaging options. Any participants that are under the age of 18, or repeated entry, as well as unfinished surveys have been eliminated from the counting (Figure 2).

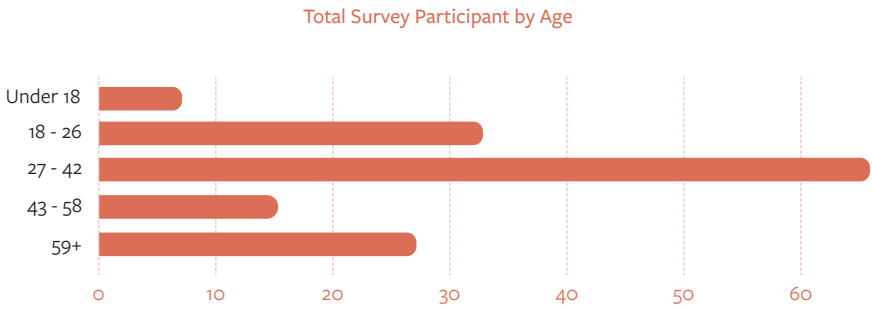

Figure 2 Survey participation by age group

Moreover, the survey was stratified according to distinct age demographics, focusing on current buyers of K1 Packaging Group and Everest Formulation (Gen X to Baby Boomers, aged 43 and above in 2023) and future buyers or young professionals (Gen Z to Millennials, aged 18 to 42 in 2023).

This approach allowed for capturing a nuanced understanding of the differing perspectives and preferences across generations.Survey questions primarily revolved

around three core categories: Price, Material, and Marketing considerations. The following sections provide a detailed overview of the survey questionnaire and the corresponding findings.

PRICE SENSITIVITY

Based on K1 Packaging Group's sale feedback, one of the most critical considerations for any packaging provider is whether the unit price aligns with the buyer's budget. Therefore, understanding the acceptable price range for both buyers and end consumers is crucial. Questions in this section aimed to pinpoint the optimal pricing 'sweet spot' that delivers value without compromising affordability.

The inaugural question posed to the survey participants was, "Would you be willing to pay a premium of 1-5% extra for a product packaged sustainably?" Out of the 140 participants, 39 indicated they would not be inclined to pay more for sustainably packaged products (Figure 3).

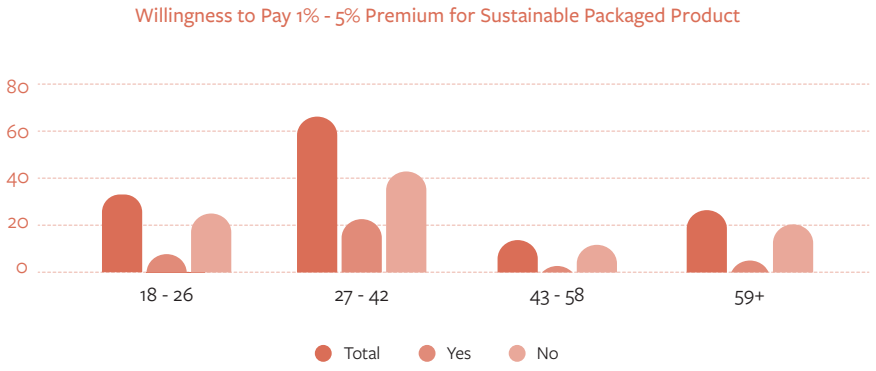

Figure 3 Chart of willingness to pay a premium for sustainable packaging, by generation

An intriguing detail emerges when the data is scrutinized further, splitting it among generational lines. Contrary to popular marketing research "New data reveals consumers increasingly choose products in sustainable packaging globally, despite rising prices" suggesting that Gen Z, born between the mid-1990s and the early 2010s, are the most eco-conscious, 32% of participants from this demographic were not amenable to paying a premium (PR Newswire, 2023). Conversely, Gen X (born between the early 1960s and the early 1980s) emerged as the group most willing to bear an additional cost for sustainability, with a mere 17% not willing to pay more.

To ascertain whether cost was the solitary inhibiting factor, a follow-up question was asked to the 39 individuals who initially declined. They were presented with a hypothetical situation where two versions of a product existed—one packaged with virgin material, the other with sustainable packaging—with both retailing at the same price. They were then asked which one they would prefer to purchase. The results demonstrated that 21 out of the 39 respondents leaned towards the sustainable option, with the majority (19 individuals) belonging to the Gen X to Millennial demographic.

MATERIAL PREFERENCES

With reference to the sustainable packaging options that K1 Packaging currently has access to, this part of the survey delved into preferences regarding the choice of packaging materials. It was further divided into primary and secondary packaging, exploring distinct choices for each. These insights help in comprehending which sustainable materials are more favored and are likely to be more widely accepted.

PRIMARY PACKAGING PREFERENCES

Figure 4 Primary packaging preferences

The survey offered four material options for primary packaging, inquiring which was most appealing to participants when purchasing dietary supplements. Glass jars and paper tubes emerged as top choices, each securing 30% of the votes. Many respondents selected these options due to their sustainability. Surprisingly, 25% of participants still preferred the stand-up pouch option. Despite awareness of its non-recyclability, respondents who favored this option cited its convenient storage and space-saving attributes as compelling reasons for their choice (figure 4).

When presented with variations of the stand-up pouch post-consumer waste (non-recyclable), bio-based film from renewable raw material, and biodegradable material an overwhelming 65% of participants preferred the biodegradable material. This was followed by 22% favoring the post-consumer waste material and a mere 13% opting for the bio-based material, assuming equal protective capabilities across the options.

Percentage of Generation That Are Not Willing to Pay Premium

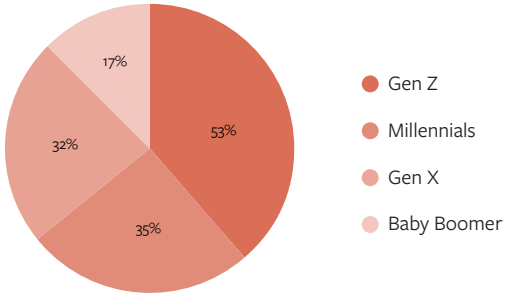

Figure 5 Chart of percentage that each generation is not willing to pay premium

Willingness to Choose Sustainable Packaging if No Change in Price of Product

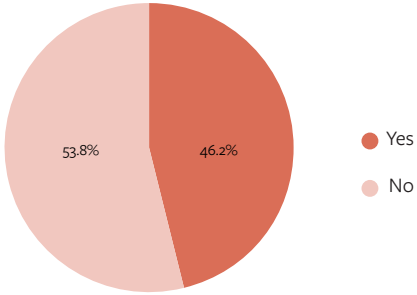

Figure 6 If the price is unchanged, willingness to pick a more sustainable packaging

Percentage of Sustainable Packaging Options

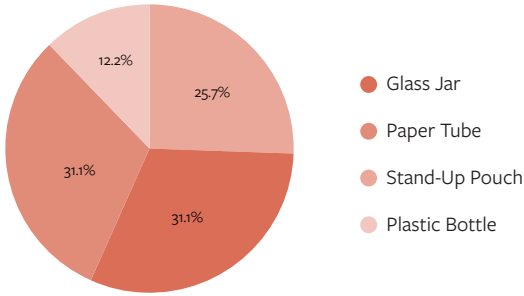

Figure 7 Data regarding 4 sustainable packaging options

Material Options for Stand-Up Pouch

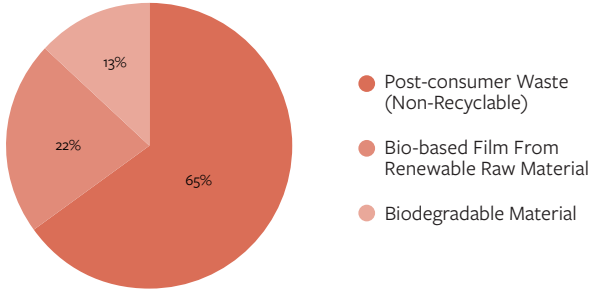

Figure 8 Most popular material option for stand-up pouch

SECONDARY PACKAGING PREFERENCES

The dietary supplement industry commonly utilizes standard folding cartons for secondary packaging, providing a simpler and more streamlined choice compared to primary packaging. This practice applies to various business models, including both e-commerce-based and retail-based operations.

Given the ubiquity of fiber-based materials in secondary packaging, our survey focused on the type of paper suitable for forming the carton. Options included kraft paper board, FSC certified paper board, and post-consumer recycled paper board (Figure 9).

Figure 9 Secondary option provided to the survey. Left to Right – FSC certified paper, kraft paper, 100% recycled paper

Secondary Packaging Result Based on Figure 9

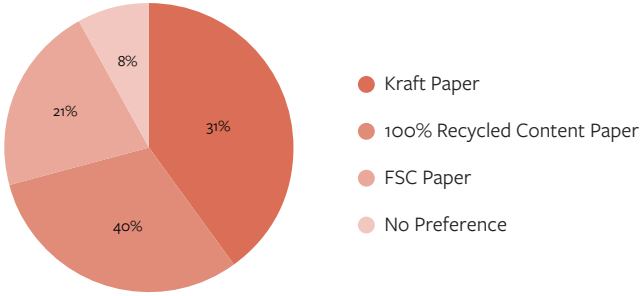

Figure 10 Secondary packaging results based on sustainability preferences

The results suggested a strong bias towards Kraft materials, with 40% of participants opting for this. This was followed by 31% preferring recycled paperboard. Interestingly, despite the Forest Stewardship Council (FSC) being a leading organization in chain of custody certification, FSC certified paper was the least favored option, garnering only 8% of votes (Figure 10). These insights could potentially guide K1 Packaging's future decisions, ensuring they align with the sustainability preferences of their target market.

MARKETING CHOICES

This section of the survey delved into marketing aspects related to packaging. These aspects included certification logos signifying sustainability, preferred color schemes, and the use of environmentally conscious messages. Understanding these preferences is crucial since packaging serves as a potent tool to convey a brand's ethos and identity to its consumers.

SUSTAINABLE RELATED LOGO

The survey first focused on discerning participant familiarity and perception of common logos printed on packaging, ones that K1 Packaging often encounters with its clientele. Based on Figure 11, the recycle symbol (Figure 11.1) is widely recognized and indicates that the packaging can be recycled. The Biodegradable Products Institute Compostable logo (Figure 11.2) signifies that the packaging is compostable and can break down into natural elements in a composting environment, and certified packaging or product meet ASTM D6400 testing standards in the US. The Seedling logo (Figure 11.3) represents certified compostable packaging materials that are offered by German certifier DIN CERTCO. Forest Stewardship Council certification (Figure 11.4) indicates that the packaging materials come from responsibly managed forests. TUV OK Biodegradable logo (Figure 11.5) indicates that the packaging material will break down naturally over time. TUV OK Biobased logo (Figure 11.6) indicates that the packaging material is derived from renewable raw materials. These logos help consumers make informed choices and support brands' sustainability efforts.

The survey findings revealed that 98% of respondents recognized the universally familiar recycling logo. In contrast, only 20% were aware of the FSC certification logo. Knowledge of other logos was even lower: 7% for the BPI Certificate, 5% for the TUV logo, and a mere 3% for the compostable seed logo. However, when asked which logo would increase their likelihood to purchase a product, the dynamics shifted

significantly. The BPI Certificate saw a jump from 7% to 40% in positive responses, the TUV logo increased from 5% to 38%, and the compostable seed logo saw an uptick from 3% to 25%. Interestingly, the FSC logo saw a decline from 20% to 15%.

Figure 11.1
Recycle Symbol

Figure 11.2
Biodegradable Products Institute

Figure 11.3
Seedling

Figure 11.4
Forest Stewardship Council

Figure 11.5
TUV OK Biodegradable SOIL

Figure 11.6
TUV OK Biobased

COLOR PREFERENCES

When participants were asked about their color preferences associated with sustainable packaging, 42% chose green, indicating a strong association between the color and sustainability. 13% opted for blue, 7% chose brown, and 2% selected red. Intriguingly, about one-third of the participants did not believe color would affect their purchasing decisions regarding sustainable packaging. This result matches the article "Persuasive packaging? The impact of packaging color and claims". (Hallez, Vansteenbeeck, H., Boen, F., & Smits, T, 2023).

Figure 12 Color options given

ENVIRONMENTAL MESSAGING PREFERENCES

Given the current trend of incorporating sustainability messages on packaging, participants were asked about their preferences for three common environmental slogans:

- "Keep waste away from landfill" - generally associated with materials made from post-consumer waste recycling.
- "Lower the carbon footprint" - typically related to packaging that is lighter or smaller than previous versions or packaging produced without using virgin materials.
- "Reduce greenhouse gas emission" - commonly linked to recyclable and bio-based products, or products that help decrease plastic usage.

Among the respondents, 76% felt that any of these messages were important. However, an additional 17% expressed more concern about reducing the carbon footprint and greenhouse gas emissions, both of which tie in closely with polymer-based packaging.

It's important to briefly address the issue of sustainability messaging and material specificity in packaging labels. A prevalent practice involves labeling on bottles, a method that inadvertently compromises the recyclability of the bottle by creating a non-mono material. This means that the bottle can't be recycled unless the label is peeled off— a step often overlooked by consumers, leading to the bottle's eventual disposal in a landfill. To counter this, K1 Packaging offers a specific label featuring a unique adhesive; though the label itself isn't recyclable or compostable, it facilitates a higher bottle recycling rate within the current U.S. recycling system. A diagram explaining this system is provided for user understanding. In the conducted survey, a significant majority (83%) of respondents indicated a willingness to buy containers utilizing this specific label once they comprehended the recycling infrastructure and the label's sustainability message.

By thoroughly examining the survey responses across these critical areas, a more profound and multifaceted understanding of sustainable packaging preferences among key consumer demographics is gained. This in-depth knowledge can subsequently guide K1 Packaging's strategic decisions moving forward in a world increasingly concerned with sustainability.

ANALYSIS AND CONCLUSION

ANALYSIS

Upon analyzing the survey data, numerous intriguing points emerged, diverging significantly from my initial hypotheses. Nevertheless, a predominant theme that surfaced from the survey responses and feedback was the confusion surrounding sustainable materials.

Based on the article "Factors influencing consumer purchase intentions of sustainable products", purchasers and consumers are voicing a demand for clarity and transparency (González-Prida, V. M., Torres-Ruiz, F. J., & Barba-Sánchez, V., 2021). As new sustainability initiatives emerge, there are no established norms, and different organizations are setting their own benchmarks or standards. There's a clear need for a unified set of rules and standards, as well as precise guidelines to help end-users understand each material and its relationship to sustainability.

In addition, the globally varying labeling systems intensify the uncertainty surrounding sustainable disposal instructions. One survey respondent remarked, "I don't understand the concept of biodegradability, but as long as it's labeled with this term, it must be good for the environment". However, this isn't necessarily true. Many commonly used biodegradable materials require specific environmental conditions to degrade effectively and designated drop-off locations to be collected correctly (Manimaran, S., & Kannan, G., 2018). Aligning sustainable material infrastructures, providing clear labeling, and offering comprehensive education about sustainable materials are all crucial factors that could drive consumer engagement in sustainable packaging waste disposal.

The conclusions drawn from the hypothesis in this research are contingent on the limited data available from this specific survey. The majority of participants were primarily from Taiwan, New York, and California, locations where there might be a more profound understanding of sustainable options due to the nature of the local state or national legislation. It's crucial to note that these findings may not necessarily apply on a global scale, and further research, as well as more comprehensive surveys, are necessary to gain a broader perspective on this subject. However, for the immediate and near-future needs of K1 Packaging, this survey offers valuable insights into the preferences and demands of their current and potential future buyers.

CONCLUSION

Conclusions from the hypotheses made at the beginning of this report are as follows:

H1: Consumers, especially those from Gen Z compared to Gen X, show a readiness to transition towards more sustainable packaging options, even if it entails a modest price increase.

At the beginning of this project, based on the research of gen Z has a strong commitment to sustainability and with high percentage expressing concern about the state of the planet (PR Newswire, 2023 & Packaging Europe, 2022), I would assume the younger generation (Gen X) would be more willing to use sustainable packaging with a slight of price increase in the overall product.

However, based on the data, it shows 50% of both Gen X are not willing to pay a premium. While 53% of Gen X are willing to pick a sustainable packaging if the unit cost remains the same, this percentage is not what I expected.

H2: Among the current sustainable packaging materials available in the market, consumers tend to favor bio-based packaging, more than fiber-based or glass alternatives, with polymer-based packaging being their least preferred choice based on this survey.

Based on the findings from the survey, it appears that the hypothesis H2 holds up to a certain extent. The survey responses demonstrated that consumers show an inclination towards more sustainable options, including bio-based and fiber-based packaging, over traditional polymer-based options.

However, when it came to specific packaging preferences, respondents showed a balanced preference for glass jars and paper tubes, which each garnered 30% of the vote. This implies that consumers have a clear preference for packaging perceived as more sustainable. However, surprisingly, stand-up pouches (generally non-recyclable) were also chosen by about 25% of respondents due to their ease of storage and space efficiency.

Interestingly, when focusing specifically on stand-up pouches, participants were given the choice to select between pouches made from post-consumer waste, bio-based

film, and biodegradable material. Here, a majority (65%) favored the biodegradable option, 22% chose post-consumer waste, and only 13% chose the bio-based material.

So, while bio-based packaging does hold appeal, consumers seem to prefer biodegradable and fiber-based (paper) packaging options, provided they offer similar protection and functionality as traditional packaging. This reveals a nuanced view on consumers' preference, highlighting that while they are indeed willing to transition towards more sustainable packaging options, factors like functionality and disposal convenience also play a significant role in their choices.

Honorable to mention, the biodegradable plastic infrastructure in the USA is currently in a state of transition, grappling with multiple challenges. While biodegradable plastics present a promising alternative to traditional plastics due to their eco-friendly disposition, the lack of a robust composting infrastructure hinders their widespread adoption (Huerta-Fontela, M., Gómez, M., Martínez, M. A., & Martínez, A., 2020). Furthermore, inconsistencies in regulations and labeling often lead to the incorrect disposal of biodegradable plastics. These materials also cannot be mixed with conventional plastic recycling streams due to their distinct decomposition process. Moreover, the longer decomposition timeline of biodegradable plastics compared to organic waste can pose issues (Sánchez, C., Martínez, M., & Sánchez-Soto, M., 2021). Hence, while biodegradable plastics hold considerable potential in promoting sustainability, the current infrastructure in the US requires significant improvement to harness their full potential.

In conclusion, the hypothesis H2 is partially confirmed. Consumers indeed favor bio-based packaging over polymer-based options, but it seems that biodegradable and fiber-based packaging are more appealing alternatives, given certain conditions.

H3: Consumers are likely unfamiliar with existing sustainable certification logos, and make decisions based on the accompanying text information.

The survey results lend significant support to the hypothesis H3. In terms of familiarity with sustainable certification logos, a staggering 98% of respondents recognized the universal recycling logo. However, the awareness of other sustainability-related logos was comparatively low, with only 20% recognizing the Forest Stewardship Council (FSC) logo, 7% familiar with the Biodegradable Products Institute (BPI) Certificate, 5% recognizing the TUV logo, and 3% knowing about the compostable seed logo.

In spite of this limited awareness, when asked which logo would increase their willingness to purchase a product, the scenario shifted dramatically. Here, the BPI Certificate's influence jumped from 7% to 40%, TUV logo's impact rose from 5% to 38%, and the seeding logo's effect ascended from 3% to 25%. In contrast, the influence of the FSC logo decreased from 20% to 15%. These findings underscore the impact of the accompanying text information in shaping consumer decision-making. For instance, a participant noted not fully understanding the concept of biodegradability but assumed that any packaging labeled with "biodegradable" must be beneficial for the environment.

In conclusion, the survey results confirm the hypothesis H3. While consumers might not recognize sustainable certification logos, the associated text does indeed play a pivotal role in their purchasing decisions. It appears that clear, straightforward messages about the sustainability of a product significantly influence consumers' willingness to purchase.

H4: When it comes to dietary supplement products, consumers in this survey tend to lean towards traditional packaging styles, such as bottles (whether glass or plastic), rather than alternative styles like plastic pouches or paper tubes.

The survey results partially support the hypothesis H4. When participants were asked to select their preferred material for dietary supplement packaging, it was found that 30% chose glass jars and another 30% selected paper tubes. This suggests that a substantial proportion of consumers indeed lean towards traditional packaging styles, such as glass jars (bottles). However, the equal preference for paper tubes, an alternative style, challenges this hypothesis, suggesting that consumers are open to non-traditional, innovative packaging solutions as well.

Moreover, it's interesting to note that about 25% of respondents chose the stand-up pouch option. Despite acknowledging that this option is non-recyclable, participants indicated that the stand-up pouch was easier to store and took up less space during shipment. This points to practical considerations influencing packaging preferences, beyond just the traditional versus alternative dichotomy.

In a follow-up question specifically about stand-up pouches, when given the choice between multilayer pouches made from post-consumer waste (non-recyclable), bio-based film pouches made from renewable raw material, and biodegradable

pouches made from biodegradable material, 65% chose the biodegradable material as their preferred packaging option. This finding indicates that, when it comes to flexible packaging formats like pouches, sustainability is a key determinant of consumer preference.

In conclusion, while some consumers do still gravitate towards traditional packaging styles like bottles for dietary supplements, there is also a significant inclination towards sustainable and practical alternative packaging styles. Hence, the hypothesis H4 is only partially substantiated by these findings.

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ABOUT THE AUTHOR

Alex Chen

Alex Chen, a June 2023 graduate from California Polytechnic State University, San Luis Obispo, earned his M.S. in Packaging Value Chain. His interest in the intersection of marketing decisions and packaging led him to explore innovative, sustainable, and efficient packaging solutions. Outside of his professional and academic life, Alex is a devoted parent to two children, embodying the spirit of perseverance and commitment in both his personal and professional endeavors.