

Maple Performance Gel

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Abstract

Maple syrup is a beloved household staple for many across North America, but does not have very many product variations. Syrup for waffles, small confectionaries and other slight variants or its original form are the majority of what exists on the market today. Value-added maple products give the maple industry not only more exposure, but outward expansion into other markets. Consisting of mostly sucrose, with some additional minerals, maple syrup is an ideal foundation for performance gels, and can satisfy a real need within the endurance running communities. We found that adding a thickening agent to maple, with the addition of flavoring and electrolytes, was the most ideal formula for nutritional benefits and consumer ease. A thorough processing step, clean and sterile packaging measures, and correct fill instructions are all vital in the shelf life and safety of these novel products. Targeting events that will attract our endurance runner demographic, effective marketing materials and a clear explanation of the many nutritional benefits will be the key for the success of a maple energy gel and will hopefully add new levels and variation to the maple syrup market.

Introduction

Aaron Wightman, an Extension Associate with the Cornell Maple Program, tasked us with formulating and marketing a new performance gel made with their maple syrup. With over 7,000 tapped maple trees in a 150 acre sugarbush, their facilities can produce thousands of gallons per year, weather permitting.

In past years, many new technologies have been created to improve the efficiency of maple production, in turn increasing yield. Utilizing reverse osmosis systems, the maple extension team is able to drastically reduce the time it takes for them to reduce their sap into syrup. With their ability to process thousands of gallons of maple each season, they have more syrup than they know what to do with and have looked to other industries for new markets. Creating value-added products is not a new concept; the maple industry has a long history of producing value-added products, stretching back to the 1800's. There are many products that use pure maple syrup including cotton candy, cream, and granulated sugar. Our challenge was to expand the number of value-added products to relieve the potential negative price pressure exerted by an increased maple syrup supply. Outside of maple candies, there are not many other products that use authentic maple syrup, and the Cornell Maple Extension, as well as our team, hope to change that.

Performance gels are carbohydrate-based gels that provide energy and promote recovery. They are meant to be consumed while moving, and are therefore packaged in small portable containers that are built for convenience and ease of use. Performance gels are very popular amongst the endurance running community because energy stores need to be replenished after about an hour of exercise. Performance gels replenish calories and give immediate energy by using sugar as their base ingredient. Some offer benefits beyond calorie replenishment by including additional ingredients like electrolytes, caffeine, and amino acids. Traditionally, performance gels are composed of artificial ingredients and have very off-putting textures and often metallic tastes. Recent consumer trends suggest there is a strong movement towards more "natural" options and formulations that digest better during exercise. The desire for a natural performance gel that tastes good is a hole in the current market that a maple syrup-based performance gel could fill.

After aligning the product with the preferences of our target market, it will be important to market the gel effectively. Specifically, product branding, advertising, and pricing will be critical to the success of the product. Branding will help communicate the competitive advantage of the maple gel, while advertising will help increase brand awareness. Many top-selling products do not boast superior value but are able to control the market with powerful advertising. An example of this is Bud Light. The market for energy gels is significantly smaller than the market for a product like beer which will make it especially important to advertise successfully. Lastly, cost and pricing will be important to monitor to make sure the product is profitable.

Maple performance gels have the potential to give consumers exactly what they want; a clean label, natural performance gel that can compete with current market prices while providing the same benefits as larger brands. The maple industry has revolutionized their technologies and drastically improved their annual yield. Being able to produce a value-added product like performance gels allows maple producers to break out of confectionaries and into the world of health and wellness.

Section 1: Problem Solving Approach

1.a. Preliminary Market Research: Product Evaluation

In order to gain an understanding of the market for performance gels, the team visited Wegmans and the Finger Lakes Running Company to purchase products to test. No one on the team is a user of this product category so it was very important to help us learn about the market.

We found only the CLIF brand at Wegmans, which leads us to believe that most of these products are sold either online or at specialty retailers like the Finger Lakes Running Company. After purchasing the samples, the team met in The Commons and tasted each of them. The main attributes that were evaluated were taste, flavor, size, viscosity, granularity, aftertaste, price, ingredient statement, and nutritional benefits.

We tasted products from 5 different brands and evaluated them in an expanded version of Table 1. One aspect to note was the “I could finish this” column, which was a metric to show how much we liked the product. Overall, we found that most of the products were not desirable to us, which showed that these products were mainly being consumed for their functional benefits, with taste being less important.

We also noticed a large range of viscosities in the gels, ranging from so thin that it was dripping out of the package, to very thick, which forced it to be squeezed out of the pouch. On its own, maple syrup is fairly thin so we wanted to find a way to thicken it with a “natural” additive. Our favorite product was the Hüma gel, which uses chia as a gelling agent. It had a consistency thin enough that it could be easily squeezed out while running, but thick enough so that it would not pour out and spill on the consumer.

Another observation was that the larger brands, such as GU and CLIF, had a more artificial taste, which was only masked when paired with a strong flavor such as chocolate. On the other hand, the products marketed to be more “natural” generally tasted better and had less of a chemical aftertaste. Since maple is more delicate than chocolate, we wanted to avoid any artificial tasting additives, as it would disguise the star of our product. After tasting all of these products, we had a better idea of what the market was like, but we still did not understand our target consumer as well as we would have liked, which was resolved in our next meeting with Ian Golden.

1.a.1. Preliminary Market Research: Insights from Ian Golden

The team met with Ian Golden per Aaron Wightman’s recommendation. Ian Golden is the owner of Finger Lakes Running Company (the running store located in The Ithaca Commons) and is a professional runner. The primary goal of this meeting was to learn about sports gel market trends and what athletes look for in a sports gel. The overarching takeaway from this meeting was that there is an emerging trend towards more natural and less synthetic products. Currently, GU is the market leader, however, Mr. Golden sees their product as synthetic and hard to digest and is trying to phase it out of his store. He also mentioned Hammer as another industry standard as an example of a synthetic, hard to eat, and harder to digest brand that he phased out of his store. As far as emerging natural brands, Honey Stinger, Hüma, and Spring were discussed as recent additions to the market that were growing in popularity due to their cleaner label, better taste, and better digestibility.

Aside from reviewing current brands on the market, Mr. Golden also went through what he and other athletes look for in a gel. He said that the primary concern was calories and where they came from and that electrolytes, amino acids, and protein were additions that varied based on the type of gel: pre- versus post-workout. He recommended that we formulate a “during” workout gel for around \$2.50 with 100 calories and emphasize sucrose as the main sugar source. He made these recommendations based on the most popular trends in the market and the ease of digestibility of sucrose versus fructose. After this meeting, the team was able to compile a list of ingredients for the gel and determined the claims that the gel was going to provide. It was decided that the gel should be a “during” workout gel with as clean a label as possible to comply

with the market trend towards more natural products. Therefore, maple syrup would be the base of the gel with chia as a clean label gelling ingredient and added electrolytes.

1.b. Product Parameters as Determined by Industry Partner

Next, the team went to the Maple Facilities to meet with Aaron Wightman to see how maple syrup was processed and to get a better idea about what the partners desired from the product in terms of composition and processing. While there, the desire for a clean label product was confirmed and the partners had no objections to the ingredients decided on above. To aid in the process, Mr. Wightman gave the team the sports salt he had been experimenting with in formulations, along with a filler, and empty gel packages- both screw cap and tear off. Aside from a clean label, there was also an emphasis placed on simple processing that a maple producer could potentially accomplish on their own as a side venture. This resulted in a preference being shown for the screw cap packages, as those are easier to fill. Finally, the industry partners gave the team an example of what they desired from our marketing plans, essentially wanting an informational brochure or pamphlet about the merits of maple syrup in relation to athletic performance. At the end of this meeting, it was concluded that the maple gel should be as simple as possible both in terms of formulation and processing and that there should be an informational aspect to the marketing plan.

Section 2: Product Formulation

2.a. Nutrition

The main nutrient contents we focused on when formulating were total carbohydrate and electrolyte content, including sodium, calcium, potassium, phosphorus, and magnesium. For total carbohydrate, we are looking to deliver between 20-30g per packet, which is standard among energy gel products. In addition, the product aims to deliver electrolytes to help rehydrate users during and after exercise, and thus, delivering sufficient amounts of electrolytes was key to the formulation of the product. In order to achieve these nutritional goals, we looked for ingredients that naturally contain a high carbohydrate content and electrolytes. For the carbohydrate, maple syrup was the perfect base for the product as it supplies sugars in the form of sucrose, glucose, and fructose. Furthermore, maple syrup is also a source of electrolytes such as potassium, calcium, and magnesium. Another great source of electrolytes is the chia seed powder. In addition to its thickening and gelling properties, chia seed powder also provides magnesium, phosphorus, and potassium, among other electrolytes.

2.b. Claims

In terms of the ingredient list, we wanted to achieve a clean label, a feature that many consumers look for today. Besides clean label, we also targeted other claims when formulating our product. Some of these claims include: vegan/vegetarian, caffeine free, source of electrolytes, and allergen-free. The goal was to align the product with the current market trend as well as making the product available to a larger consumer audience.

2.c. Taste

Flavoring is an important product attribute for energy gels. The most popular energy gel flavors are fruit-based, followed by chocolate and vanilla. For the first product, we wanted to keep the flavor simple, and emphasize the flavor of maple syrup. Initially, we tested out several flavors, including vanilla, lemon, and cinnamon. Based on an internal sensory evaluation, we

found that cinnamon had the best flavor profile among the three. The addition of cinnamon adds complexity to the overall product flavor profile and a little kick to the otherwise overwhelmingly sweet maple syrup. Cinnamon is also known for its anti-inflammatory and antioxidant properties (Baker, Chohan, & Opara, 2013; Thakur, Yadav, & Khadka, 2013), which is crucial for muscle recovery.

2.d. Ingredient Selection

Due to the nature of this project, maple syrup is the primary ingredient in our formulation. Maple syrup delivers carbohydrates, primarily in the form of sucrose, and calories that are needed for an energy gel. In addition, maple syrup is also a source of vitamins and minerals, including potassium, calcium, riboflavin, magnesium, and manganese. Several of these minerals are also electrolytes that gel users are looking for in their product. Besides its nutritional value, maple syrup also offer other health benefits. Studies have found that polyphenolic compounds found in maple syrup, including quebecol and other derivatives, exhibit anti-inflammatory properties (Cardinal and others 2016; Nahar and others 2014). This is important as long-distance runners and cyclists often look for anti-inflammatory ingredients to prevent cell damage and aid in muscle recovery.

The choice of chia as a gelling agent for the maple performance gel was decided on based on the functional and nutritional benefits it can offer. Review of energy gel from Hüma have shown that chia seed delivers desirable texture as the primary gelling agent. Chia is an especially effective gelling agent as it has high water binding properties. The gelling property can be further improved when milled into a fine powder, as the surface area of the seed is greatly increased. Once hydrated as a flour, chia exhibits shear thinning properties (Garcia-Salcedo, Torres-Vargas, Real, Contreras-Jimenez, & Rodriguez-Garcia, 2018). The shear thinning properties of the chia paste causes the gel to have a lower viscosity at higher shear rates. In a performance gel application, the chia-based gel feels firm in the packaging, but is easily consumed as a semi-thick liquid once pressure is applied to squeeze the product out of the packaging. For marathon runners, this allows for easier consumption of the gel as the product is not too thin as to spill or too thick to make for difficult extraction from the packaging. The water-binding ability and shear thinning of the chia flour therefore makes it an ideal gelling agent in a performance gel application. In addition to its gelling property, chia seed is also a good source of plant-based protein, with a high amino acid score. Similar to maple syrup, chia seed also delivers electrolytes in the form of magnesium, calcium, and potassium. The ingredient is also a good source of dietary fiber and omega-3 fatty acids.

2.e. Formulation Testing

Formulation testing began with the testing of chia seed as a gelling agent for maple syrup. Initially, store-bought ground chia seed was used to test for gel consistency. The resulting gel was gritty and paste-like. Therefore, we further grounded the chia seed using a mortar and pestle. The second trial was less gritty, but still remained very pasty. The addition of electrolyte in the next trial further thickened the product. Ground flaxseed was also explored, in combination with chia seed, as a gelling agent for the product. However, it did not offer additional benefit in terms of nutritional value, gelling, or sensory, and therefore was not used in subsequent trials. Due to the consistently thick texture, the percent of chia seed was significantly reduced from over 3% to under 2% of the total formula. In addition, cinnamon was added to the formula for flavor. Trial 5 yielded a product that has close to ideal consistency and great flavor profile. However, the group

wanted the product to be less gritty. Therefore, chia seed powder was procured from Benexia. Due to the fine particle size of the new chia seed powder, the percent of chia seed was further lowered to less than 1%. Trial 6 and 7 used the same formulation and produced a product that had a smooth, gel-like consistency and was far less gritty than the previous trials. Trial 6 was hot-filled while Trial 7 was retorted. Minimal differences in terms of thickness and flavor profile were noticed. The percent of ground chia seed was altered in Trials 8 and 9 to test the effects on gel thickness. Trial 8, with 0.51% chia seed, had a very watery consistency. Trial 9, on the other hand, had 1.86% chia seed and a noticeably thicker, gel-like consistency. Based on the trials, we believe Trial 7 is the best formulation. Trial 9 may also appeal to consumers who prefer thicker gels.

Section 3: Process Determination

Initially, hot filling was explored as an alternative kill step for the processing of maple energy gel. The heat treatment is performed at 161°F for 15 sec. To mimic such a process, the ingredients were mixed and cooked on a stove top and manually filled in the packaging. This process was selected because flavors are often well-preserved during hot-filling. However, considering the resources and equipment available to the industry partner, hot filling would require aseptic packaging and filling and may introduce risk of post-processing contamination. In addition, when examining the physicochemical properties of the product, we found that the product has a pH of 6. Because it is considered a low-acid food, retorting is needed as a kill-step to ensure the safety and quality of the product.

In the PD kitchen, retorting was performed by mixing maple syrup and other ingredients, including chia powder, flavoring, and electrolyte powder, and filling into the tear-top packets using the pouch filler provided by the industry partner. The bottom of the packet was heat-sealed using a heat sealer. The filled pouches were then retorted in 185°F water for at least 3 minutes to inactivate microbes and extend the product shelf-life. The product can then be stored in ambient conditions. The complete process flow for manufacturing the energy gel is shown in Figure 1 (Appendix B).

Due to the processing equipment needed for the retort and packaging process, we recommend looking at contract manufacturing for the energy gels, at least before the scheduled renovation of the Cornell Maple Program facility. Some suggestions on potential contract manufacturers are discussed in the Recommendation section of this report.

Section 4: Product Safety and Shelf-life Testing

The shelf life testing of the maple gel monitors the growth of known microbes in maple syrup. From Table 4, the water activity of maple syrup was measured to be 0.801 at 23.7°C, preventing the growth of bacteria (Appendix A). Although maple syrup is pasteurized in production, the final product is susceptible to contamination by yeasts and molds that could lead to spoilage. Several species of *Saccharomyces* and *Zygosaccharomyces* have been isolated from spoiled maple syrup as contaminants (Thompson, 2009). Since only yeasts and molds are of concern for spoilage in the maple gel product formulated, weekly yeast and mold testing was performed to monitor microbial growth. In addition, a weekly standard plate count (SPC) was performed on the product to confirm the absence of bacteria.

The following shelf life study was completed on the final formulation of the product. Product was held at room temperature (23°C) for 3 weeks with weekly SPC and yeast & mold

tests performed. SPC plates were incubated at 32°C for 48 hours. The yeast and mold plates were incubated at 23°C for 48 hours. All tests were performed in duplicate.

The results of the preliminary shelf life microbial testing in Table 3 confirm that there was no yeast and mold growth in the maple gel after 3 weeks (Appendix A). However, there was growth on the SPC plates. The microbes that grew on the SPC plates were already present in the gel prior to processing. Because the counts on the SPC plates did not increase over the 3 week time period, this shows that the microbes present were not growing. Due to the clear lack of growth, the product demonstrates its long-term storage capabilities in warm and cool environments.

Section 5: Sensory Evaluation

For meaningful sensory evaluation of this product, we needed to users of energy gels. The team reached out to Adrian Durant (akd72@cornell.edu) and Arthur Cameron Smith (acs1@cornell.edu), the head coaches of the Cornell mens and womens cross country and track teams to see if the teams would be willing to perform a sensory evaluation of our product. Unfortunately, it was the peak of track season when we inquired and neither coach was willing to have their team participate. As a result, we were not able to conduct large scale sensory evaluation of our product because we were not able to find another large group of active individuals that used energy gels regularly.

Instead, a small scale sensory study occurred at Island Health and Fitness. Sixteen to eighteen gram samples of the energy gel were given out to gym members who were asked to fill out a survey that inquired about product texture, sweetness, viscosity, ease of product use, energy gel use frequency, and product marketing. Thirty product samples were given out and nine people filled out the survey. Of the nine that filled out the survey, only two of them currently used energy gels, which was not ideal since energy gels are a niche product that have specific sensory and nutritive attributes that may be unfamiliar to non-consumers. The results from this small scale sensory evaluation were favorable: 56% of respondents found the viscosity and texture to be favorable; 33% of respondents found the sweetness to be just about right, and 78% of respondents liked the product and would pay \$2.50 for it. While these results are promising, the small sample size and the fact that only two individuals from the study were consumers of energy gel means that these results are not conclusive.

Section 6: In-Depth Market/Consumer Research

In order to determine an appropriate and thorough branding and marketing plan, additional market and consumer research on top of the preliminary research done at the beginning of the project was necessary. The in-depth research focuses on three major components: market trends, competitive landscape, and target consumer insight.

According to the Energy Gel Products Market Analysis Report by Future Market Insights (2017), the energy gel market is seeing an increasing trend in awareness-based marketing for energy gel brands. In terms of the product itself, demand for clean label products and combination flavors are growing. Currently, fruit-based flavors will account for the majority of the market share. The top fruit flavors include orange, strawberry, raspberry and lemon. Other popular energy gel flavors include chocolate and vanilla. The increasing growth of the energy gel market is driven by increasing health awareness, rising preference of gels over energy drinks, and improved retailing. For retailing, specialty stores remain the largest distribution channel for

energy gel, followed by supermarkets. However, e-commerce may see the largest growth in the future.

Research on the typical energy gel user was also conducted. According to data from the Sports and Fitness survey conducted by Statista (2016) that included 1075 U.S. respondents between the ages of 18-69, the typical consumers of energy gels are millennials and Gen X (24-50 yo) with mid to high income (>\$75,000/yr). Consumers are primarily male, college-educated, and work out at least once a month. Millennials, the primary consumer age group for the energy gel market, exhibit unique behavior when making purchases. Research from Mintel (2015) reveals that 43% of U.S. Millennials do not trust large food manufacturers compared to 18% for non-millennials. Another study from Mintel (2018) found that 61% of Millennials would switch to a brand/company that supports a cause that they believe in. The results from the two studies echoes the increasing trend of awareness marketing for energy gel brands. Based on the consumer research, we understood the importance of building a socially-conscious, awareness-based brand that appeals to millennial shoppers.

The current energy gel market landscape is dominated by several major players. When analyzing the competitors, we chose a few attributes to differentiate them: premium vs cheap and artificial vs natural. Based on these characteristics, we positioned the competitors accordingly, as shown in Figure 2. Many of the major players on the market, including GU, CLIF, and Gatorade, offer cheap products that include various artificial ingredients. This indicates that products similar to these brands would face fierce competition. Maurten Sport Gel is also formulated with artificial ingredients but positions itself as a premium product due to the gel's functionality and strong brand perception built on endorsement from elite athletics. On the natural side, Carb Boom! and Honey Stinger offer cheaper, more natural energy gel products. Both products offer little in terms of nutrition aside from calories and are smaller players on the market. Lastly, Spring and Hüma are major players in the natural energy gel market that offer products at a premium price point. Based on the competitive landscape, we were able to identify the ideal brand position, which is to compete with Spring and Hüma by offering both a natural and premium product.

Section 7: Recommendations

7.a. Product Formulation

The final formulation for the maple gel is shown in Table 5. This formulation was determined to have the most ideal consistency, flavor, and sweetness. The amount of ground chia seed and SynerplexSports electrolyte powder used achieved an ideal gel consistency that was neither too runny nor too thick. The cinnamon level in the gel contributed a desirable flavor, as demonstrated by the preliminary sensory test results. In addition, the nutrition label for the final product formulation mimicked those of gels currently on the market and aligned with consumer preferences, as shown in Figure 3.

7.b. Product Packaging & Processing

As of now, the tear-off pouches used for product formulation hold a maximum of 18g of maple gel. The suggested serving size of 39g suggests that a larger tear-off pouch would be necessary to hold this amount of product. In addition, the current process used to fill and retort the pouches is laborious and time-consuming. In order to increase efficiency, it is suggested that

a co-packer be used to fill and retort the maple gel. The use of a co-packer would also increase consistency among finished products. The current packaging process yields samples that vary within 3g of each other. A co-packer would ensure uniformity within all pouches produced with limited weight variability.

7.c. Product Shelf Life

To confirm product safety, the shelf life study should be continued to verify a 1 year product shelf life. As yeasts and molds are the most probable cause of spoilage for the maple gel, these are the microorganisms of most concern in relation to the product's one year shelf life. If the maple gel samples produced do not have any traces of yeast or mold after one month of weekly testing, microbial tests should then be performed on a monthly basis. After one complete year of microbial testing on room temperature stored maple gels, the shelf life of the product should be verified; if no yeast or mold is found within the samples after one year the product shelf life can be confirmed as one year.

7.d. Sensory

To confirm the results obtained in the small scale sensory study conducted during this project, a large scale sensory evaluation with regular consumers of energy gels should be carried out. To accomplish this, the survey from the small scale sensory study could be used. Possible subjects for a large scale sensory evaluation include the Cornell track and cross country teams, during a less important part of their season, the Finger Lakes Running Club, or race participants in marathons, triathlons, ultra-marathons, etc.

7.e. Marketing Plan: Pricing

In order to make a profit on the product, a marketing plan is needed. There are a few elements that are critical to this. One of these is the target retail price, which we believe should be set at \$2.50. The maple gel is made with premium ingredients, and the other premium and "natural" products, such as Hüma, are also \$2.50. Our cost of ingredients is \$0.81/unit. There are other factors that should be accounted for, like manufacturing costs, labor costs and markup of retailers. These factors are uncertain because production has not been tested on a larger scale. After all of these factors are determined, we expect that a retail price of \$2.50 will be sufficient to cover all costs and maintain a profit.

7.e.1. Name and Branding

Another aspect of the marketing plan is the product name, as well as product packaging/branding. Our proposed name is "Untapped Potential" and a proposed logo can be found in Figure 4 (Appendix B).

Based on our in-depth market and consumer research, we understand that the main consideration for branding is building a socially-conscious brand that would appeal to the target consumers, who are high income millennial and gen X runners (24-50 years old). We believe this can be achieved by building the brand purpose around supporting local communities and advocating for NYS agricultural products. The brand can communicate its brand purpose by supporting New York State (NYS) initiatives such as the Farm-to-School program (2019) that help connect the students and schools with local farmers to bring awareness to regional food systems and student health and nutrition. The brand can also support NGOs like America Farmland Trust (2019) that work to protect and conserve farmland. From a product standpoint,

our energy gel is built on an agricultural product in maple syrup that is unique to NYS. We believe that incorporating fruit purees made from top NYS agricultural products, such as apples, grapes, tart cherry, and strawberries, in future line extension products would further demonstrate the brand purpose. Not only does it align with the market trend of fruit-flavored energy gels, but it would also appeal to consumers who support socially-conscious brands.

7.e.2. Retail and Advertising

Based on the existing distribution channels for energy gel products, the product would be sold primarily at specialty running stores, since that is the main platform that they are sold. We would also suggest offering it on Amazon, since all of the main competitors are sold there as well. Retailing both in-store and online would help reach more consumers and further expand the brand presence.

The last key component of the marketing plan is advertising. In order to increase brand awareness, the product needs to be exposed to the target market. One way this could be done is by promoting the product at a running event, such as a 5k. Product samples could be distributed to participants and banners could be posted. Alternatively, if the budget were a little larger, the brand could sponsor the event. Another way the product could be promoted is by promoting it online. Specifically, the YouTube running channels would be ideal to sponsor. Similarly, Instagram influencers that focus on running would be another opportunity for advertising. It would be best if these channels and influences are based in New York state. However, if this is not possible, it is critical that the product be available on Amazon.

Section 7: Conclusions

Based on all of the work that has been done with this product, the following conclusions can be drawn. Our gel is similar to products currently on the market, but it is unique in that it is the only maple syrup gel in the U.S. market with added benefits. Energy gels are not sold at a large variety of retailers which shows that there is space in the market for a new product, meaning the brand could be successful. The sensory data collected confirm that consumers find the maple gel flavor, consistency, and price favorable. The proposed price-point and choice of retailers will allow this maple gel to be competitive in the market. Additionally, people will be inclined to purchase this product since it is made locally, which is important to current consumers. Overall, this maple gel can be successful in local markets because of its desirable sensory attributes, nutrition claims, and competitive marketing plan.

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Appendices

Appendix A. Tables

Table 1. Sensory analysis of existing performance gels.

Name	Flavor	Texture	Taste	“I could finish this”
GU	Tri-Berry	Thick, chalky, artificial	Chemical, artificial, sweet	0/5

GU- Roctane	Lemonade	Medium thickness	Artificial, metallic, umami, lemonade powder	0/5
CLIF	Strawberry	Thick mouthfeel, no grit	Gentle, notes of artificial strawberry, honey	2/5
CLIF	Chocolate	Grittiness, chocolate sauce consistency	Brownie batter, chocolate frosting	4/5
CLIF	Mocha	Chalky, gritty	Very strong coffee, lighter chocolate	2/5
Honey Stinger	Gold	Smooth, thin, liquidy	Honey, very sweet	1/5
Spring	Peanut Butter	Thick	Bananas, PB2, sour, acidic	0/5
Hüma	Lemonade	Smooth	Arnold Palmer	5/5
Hüma Chia energy plus	Berries and Pom	Grainy	Fig newton, raisin	0/5

Table 2. Trial formulation and description for maple energy gel development.

Trial ¹	% Formula (w/w)					Description
	Maple Syrup	Ground Chia Seed ^{1,2}	Electrolyte Powder	Cinnamon	Milled Flaxseed ¹	
1	96.15	3.85	-	-	-	Grittier, paste-like consistency
2	96.15	3.85	-	-	-	Gritty, thick, paste-like consistency
3	93.17	3.73	3.11	-	-	Gritty, thicker, paste-like consistency
4	96.46	0.96	1.61	-	0.96	Gritty, thinner, gel-like consistency

5	93.46	1.87	3.12	1.56	-	Great flavor profile with cinnamon, desirable consistency
6	94.34	0.94	3.14	1.56	-	Less gritty texture; good flavor intensity from cinnamon; smooth, desirable consistency
7	94.35	0.94	3.14	1.57	-	Desirable consistency and flavor profile
8	94.76	0.51	3.16	1.58	-	Liquidy consistency but holds shape
	93.47	1.86	3.11	1.56	-	Thicker, gel-like consistency

*Chia Seed and/or Flaxseed used in Trial 2-5 were store-bought and grounded using mortar and pestle.

*Chia seed used in Trial 6-8 were in the form of a fine powder supplied by Benexia.

*Samples were heat treated (161F for 15sec) and hot filled for Trial 1-6 and retorted (185F for 3min) for Trial 7-8.

Table 3. Maple gel shelf life study test results.

Week	SPC (CFU/mL)	Yeast and mold (CFU/mL)
1	1200, 1300	0, 0
2	800, 900	0, 0
3	600, 1200	0, 0

Table 4. pH and water activity of final gel formulation.

Attribute	Value
pH	6.0
Water activity	0.801 at 23.7°C

Table 5. Product formulation and cost breakdown.

Ingredient	Formula %	g/unit	Cost/lb	Cost/unit	Supplier
Maple Syrup	94.35%	36.80	\$2.21	\$0.18	n/a

Ground Chia Seed	0.94%	0.37	\$2.73	\$0.00	Benexia
Synerplex Sports Electrolytes	3.14%	1.22	\$136.36	\$0.37	Amazon
Cinnamon	1.57%	0.61	\$7.98	\$0.01	Walmart
Package	n/a	n/a	n/a	\$0.25	IMPAK Corp
Total	100%	39	n/a	\$0.81	n/a

Appendix B. Figures

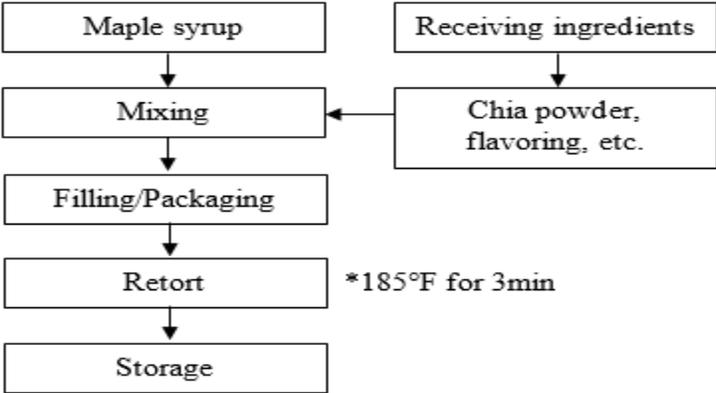


Figure 1. Process flow diagram for manufacturing of maple energy gel.

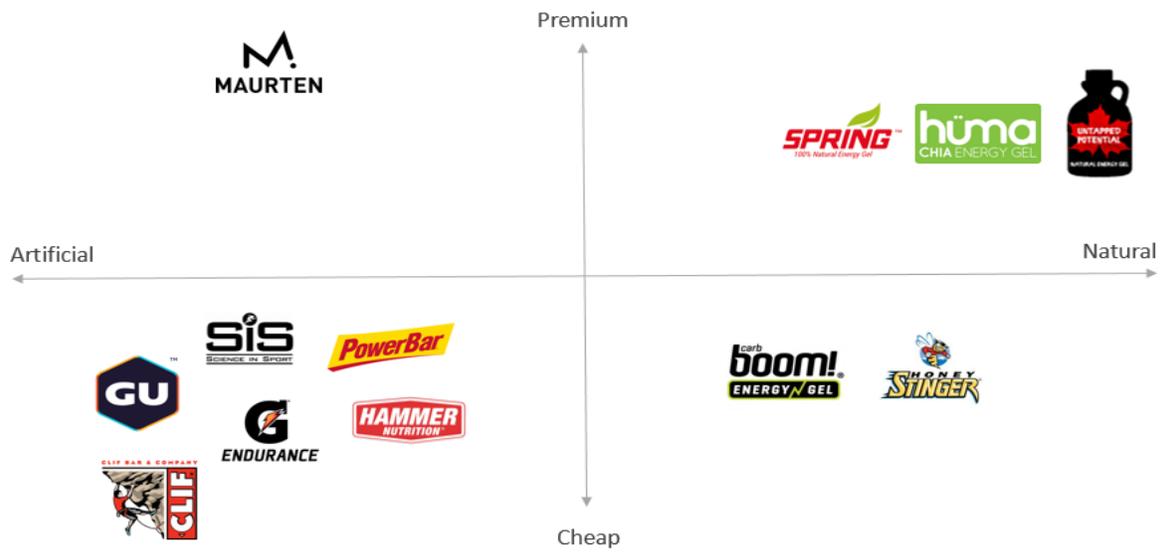


Figure 2. Competitive landscape of current energy gel market.

Maple Energy Gel

Nutrition Facts	
Serving Size: 1 (39g)	
Amount Per Serving	
Calories 100	Calories from Fat 0
% Daily Value*	
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 115mg	5%
Potassium 310mg	9%
Total Carbohydrate 25g	8%
Dietary Fiber 0g	0%
Sugars 22g	
Protein 0g	
Vitamin A 0%	Vitamin C 0%
Calcium 4%	Iron 0%
Riboflavin 25%	Phosphorus 15%
Magnesium 6%	
* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:	
	Calories: 2,000 2,500
Total Fat	Less than 65g 80g
Sat Fat	Less than 20g 25g
Cholesterol	Less than 300mg 300mg
Sodium	Less than 2,400mg 2,400mg
Potassium	Less than 3,500mg 3,500mg
Total Carbohydrate	300g 375g
Dietary Fiber	25g 30g

INGREDIENTS: MAPLE SYRUP, ELECTROLYTE, CINNAMON, CHIA SEED POWDER

Figure 3. Nutrition label for maple energy gel.



Figure 4. Potential product logo