

Article

Assessing Consumer Acceptance and Willingness to Pay for Novel Value-Added Products Made from Breadfruit in the Hawaiian Islands

Marin Lysák ^{1,*} , Christian Ritz ²  and Christian Bugge Henriksen ¹

¹ Department of Plant and Environmental Sciences (PLEN), Crop Sciences, Climate and Food Security, Faculty of Science, University of Copenhagen, Højbakkegård Allé 30, DK-2630 Taastrup, Denmark; cbh@plen.ku.dk

² Department of Nutrition, Exercise and Sports, University of Copenhagen, Rolighedsvej 25, DK-1958 Frederiksberg C, Denmark; ritz@nexs.ku.dk

* Correspondence: marinrr@plen.ku.dk

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Abstract: Breadfruit is a high yielding tree crop with a long history in the Pacific Islands, with the potential to improve food security under climate change. Traditionally, it has been grown and used extensively as a food source in Hawaii, but in the past decades, it has been neglected, underutilized, and supplanted by imported staple foods. Revitalization of breadfruit is central for reducing dependency on food imports and increasing food resiliency and self-sufficiency in Hawaii. Such a process could potentially be strengthened by the development of novel value-added products. This empirical study investigates consumer acceptance and willingness to pay in two scenarios: with and without detailed product information about breadfruit and its cultural significance, nutritional benefits and potential contribution to increase local food security. A total of 440 consumers participated in the study. Participants receiving descriptive information had a higher level of acceptance and were willing to pay a higher price compared with participants who were not informed that the product was made from breadfruit: 1.33 ± 0.15 acceptance on the hedonic scale and 1.26 ± 0.23 USD (both $p < 0.0001$). In conclusion, repeated exposure and building a positive narrative around breadfruit products may increase consumer acceptability.

Keywords: descriptive information; cultural significance; food security; local foods; liking; consumers

1. Introduction

Breadfruit is a well-known staple crop through Oceania, and has been valued for centuries [1–3]. It has been theorized that breadfruit was brought to the Hawaiian Islands as early as 900–1000CE, but this most likely occurred after the 1300s by way of Pacific explorers [3,4]. Historically, breadfruit grew in large groves and home gardens throughout the Hawaiian Islands as a food source, although it also served multiple other purposes [5–8]. Over the last decade, significant efforts have been made to revitalize the use and consumption of breadfruit (*Artocarpus altilis*) in the Hawaiian Islands [8,9]. Today, breadfruit has widespread dissemination beyond the Pacific, and it can be found in tropical regions in over 80 countries worldwide [1,10,11].

The breadfruit tree is fast-growing and produces an abundance of nutritious starchy fruit [10–12]. These trees are reported to produce $6 \text{ t}\cdot\text{ha}^{-1}$ of fruit that is rich in carbohydrates, amino acids, fiber, vitamins, and minerals, including micronutrients such as iron and potassium, especially when compared to other tropical staple starch crops such as cassava, sweet potato and banana [2,10,13–17]; however, exact fruit yield estimations are variable due to seasonality, cropping systems, cultivar and environment [11]. A study by Liu et al. reported that, on average, between 24 breadfruit cultivars,

269 fruits per year were produced, with each fruit weighing an average of 1.2 kg [17]. Therefore, it is evident that breadfruit has the potential to target issues surrounding food and nutrition security if specific cultivars and growing conditions are optimized [13,17–19].

Breadfruit in Hawaii

The Hawaiian Islands are one of the most geographically isolated areas of the world, and are highly dependent on food imports, with approximately 85% of the food being imported [20–22]. Although it has also been said that it would be impossible and impractical for Hawaii to become fully self-sustainable, as it would impose too high of a cost on society, food self-sufficiency is still seen as an important public policy goal that could have multiple benefits for society [21,23]. Based on the food security and food self-sufficiency strategy from 2012 [23], a food resiliency bill was proposed in 2017 with the aim of increasing both demand, production and access to locally produced food [24]. More specifically, a bill relating to breadfruit has been proposed in 2018 [25]. One obvious benefit of more local food production in Hawaii would be to increase food security by reducing dependency on imported food and becoming less vulnerable to conditions beyond its coasts. This will be even more important with exacerbating climate change and more extreme weather events that have already been observed to reduce yield and cause higher food prices [26]. In a study by Lobell et al., increases in food prices of up to 19% have been attributed to climate change, and with a high dependency on imported food, Hawaii would be very vulnerable to such increases [27].

Supporting locally grown foods on the Hawaiian Islands is crucial for the success of local farmers and the agricultural economy, reducing invasive pests and decreasing food miles associated with the vast distances food must travel to reach these remote islands [21]. Breadfruit is used in complex agroforestry systems throughout the Pacific, illustrating its potential to realistically and sustainably increase local food production in locations suitable for growing breadfruit in modern day society [8,28]. Breadfruit has an enormous potential to impact food security and food interdependence, and therefore, is included as one of the 35 priority crops listed in the multilateral system of the International Treaty on Plant Genetic Resources for Food and Agriculture [29]. Breadfruit is currently an underutilized fruit tree that has great potential to increase food security on the Hawaiian Islands. With the rise of sugar and pineapple plantations in the 1800s, many of the large breadfruit establishments that once supported the Hawaiians have ceased to exist; however, remnants of them remain [6]. Despite efforts during the 20th century to replenish this resource, many trees continued to be removed for various reasons such as urbanization [8]. In a survey conducted amongst 323 respondents on Hawaii Island, it was found that 46% of the breadfruit grown was not utilized [8]. Although breadfruit trees persist in the landscape, much of the fruit is wasted due to seasonal abundance, short shelf life, harvesting/post-harvest-handling challenges and modern food preferences [12,16]. Ironically, many households across the State have reported that they lack access to affordable and nutritious food [8]. Revitalization efforts targeting the feasibility of increasing the usage of breadfruit are advancing rapidly and the Hawaii 2050 Sustainability Plan prioritizes the production and consumption of local foods as a means to increase Hawaii's food security [8,9,30].

Since breadfruit is underutilized, it is not considered a staple food in the diets of Hawaii's residents today. Breadfruit does not make its way to the shelves of every supermarket, nor is the tree found in vast agroforestry systems throughout the islands as it once was. Therefore, residents and millions of tourists visiting the Hawaiian Islands are not necessarily in contact with this unique resource on a regular basis. However, a 2016 supply and value chain study on the Hawaiian Islands showed that existing supplies of breadfruit are being distributed to consumers by way of growers, chefs, distributors, and entrepreneurs with value being added by chefs, entrepreneurs and distributors [31]. In the same study, it was found that suppliers primarily distribute to restaurants (54%), a newly formed breadfruit co-operative (33%), supermarkets (30%) and farmers markets (25%) [31]. One of the barriers to higher adoption rates of the existing breadfruit supply as a staple food in Hawaii is the rise of convenience foods and modern consumption patterns. Consuming breadfruit requires know-how, i.e., knowing

when to harvest according to desired maturity of the fruit, how to prepare it depending on the stage of maturity, and perhaps even knowing which cultivar (variety) is more desirable for a particular use, all of which make for tough competition against well-known and globally consumed staples such as rice and potatoes.

Looking at new ways of incorporating breadfruit into the diets of residents and tourists in Hawaii requires creativity in modern society. By adding value and creating ready-made convenience products, breadfruit can easily fit into a modern lifestyle. Finished convenience products do not require that consumers need to know how to utilize the raw fruit directly from the tree; however, they are still able to support the local economy and utilize a local food resource. Finding novel and innovative methods to prepare, sell and consume breadfruit, people can discover more diverse ways to enjoy this nutritional and culturally relevant food source in manners diverging from traditional Hawaiian culture. Novel foods can broaden perspectives about an ingredient, perhaps helping to make it appealing to a wider audience. As there are several factors that play a role in the response to acceptance of novel foods, it is important to understand ways in which novel foods can be incorporated as a means to diversify diets and increase nutrition profiles [32].

Consequently, there is a need for empirical data to be used to evaluate the likelihood of success of a novel value-added product primarily made of breadfruit in the Hawaiian Islands. A consumer study would not only explore consumer perception of novel methods of preparing and consuming breadfruit for the modern-day palate; it could also guide product development incentivize product producers to utilize this local resource, and in turn, increase the likelihood of success. Success in this case can mean multiple things, for example, success in utilizing an existing local resource as well as success of a business, whereby both have an impact on increasing food security in the Hawaiian Islands. However, at the time of this study, no consumer study on acceptance and willingness to pay for value-added products made of breadfruit has been conducted in the Hawaiian Islands.

Specifically, the aim of the present study was to explore and compare consumer acceptance and willingness to pay for novel value-added products made from breadfruit in the Hawaiian Islands among consumers receive or not receiving detailed product information. The study tested the hypothesis that consumers who receive product information including: (i) about the product being primarily comprised of breadfruit, (ii) the cultural significance of breadfruit, (iii) nutritional benefits of breadfruit, and (iv) the potential contribution to increase local food security, would have a higher acceptance rating and be willing to pay more for the product. This information was presented simultaneously, and was not tested independently.

2. Methods

2.1. Products

Three different products primarily composed of breadfruit were used in the study. The samples consisted of a flat bread, a pancake (thin pancake resembling a crepe) and a pudding. Both the pudding and flat bread were prepared using fresh fruit and the pancakes were made from breadfruit flour. All products used few additional local ingredients. Both the flat bread and pancakes were sampled on Hawaii Island in Hilo and Kailua-Kona, respectively, and the breadfruit pudding was sampled on Maui (see Figure 1). Products were selected based on the fact that the producer already had a breadfruit-based product on the market and expressed an interest in increasing the consumption of breadfruit throughout Hawaii. There was no promotion of their business or products during the sampling sessions.

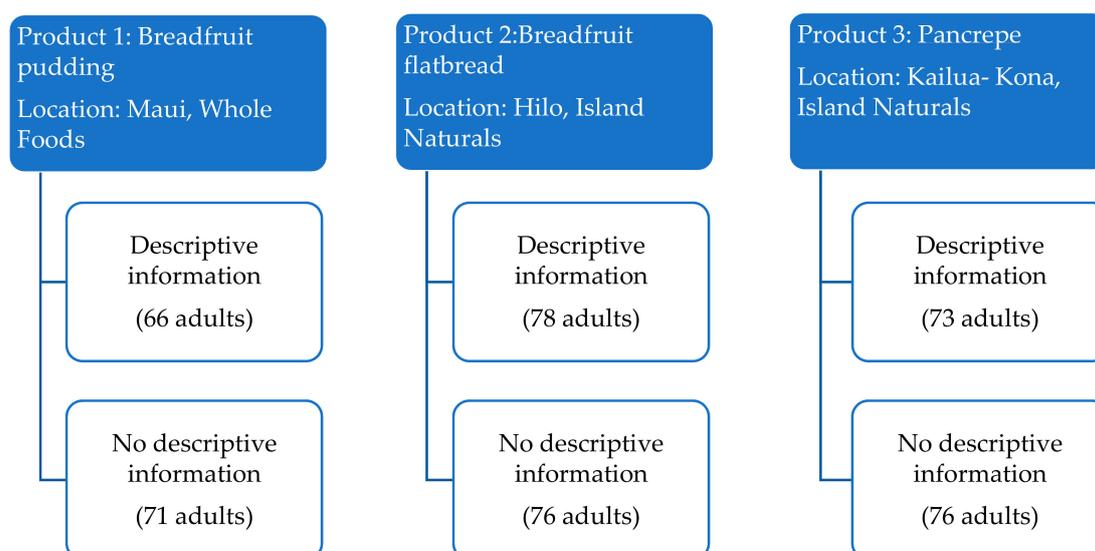


Figure 1. Design of consumer study showing two distinct scenarios per location.

2.2. Participants and Study Location

In order to best capture the consumers who would potentially be exposed to the product being sampled and have the opportunity to purchase it, the study was conducted at three separate popular local natural food stores that already carried breadfruit products. The study took place at Island Naturals supermarket in the towns of Hilo and Kailua-Kona on Hawaii Island and Whole Foods Market in Kahului on Maui. Each session was conducted between 9am and 3pm on two consecutive days during April of 2016.

2.3. Experimental Procedures

Consumers were informed of the purpose of this study and were voluntarily able to choose whether they wanted to participate in the study. Two different scenarios with different participants were conducted with each product, targeting 80 consumers per scenario. In one scenario, no product information was presented before sampling the product, and they were therefore assumed to be completely uninformed about the sample they would taste. When participants approached the sampling table during the first scenario, they were made aware that, due to the study, they would not be given any information about the product prior to tasting the bite-size sample. In the other scenario, participants had access to written information about the product, and were able to freely inquire about the product. When product information was intended to be presented prior to the tasting of the sample, participants were specifically asked to read basic information about breadfruit, which was printed in font size 16 with the most important words emphasized in bold and underlined format. In addition, the information sheet contained a large image of a breadfruit and corresponding leaves as a visual indicator to ensure that it was clear to participants that the sample being tasted was made of breadfruit (see Supplementary Materials). Written information included the following points:

- The product you are sampling today is made with **breadfruit**.
- Breadfruit has been **an important staple crop in the Pacific** for more than 3000 years.
- Breadfruit **contains all essential amino acids** making **its protein high quality**. It is high in carbohydrates and a good source of dietary fiber, potassium, calcium, and magnesium with small amounts of thiamin, riboflavin, niacin and iron.
- Breadfruit has **great potential to increase food security** throughout the tropics/sub-tropics, where it can grow.

After reading the laminated information sheet, they were presented with a bite-size sample and asked to taste the sample and fill out the paper questionnaire (see Supplementary Materials). In addition, other printed informational resources from the Breadfruit Institute about breadfruit were available on the table.

The two scenarios were separated in space or time to ensure that consumers would not influence one another. Each scenario started off with two different sampling tables set up at the location. One table was set up inside the store and another outside the store to ensure that participants could not hear or see the different scenarios being conducted. Participants were asked if they have previously participated in the study to minimize duplicate answers, which would alter data collection. If 80 participants for a scenario did not occur within a 6 h period, the scenario was resumed on the following day using the same protocols.

The main author and an assistant served all samples where participants did not receive product information prior to sampling the product. The product producers served some of the breadfruit pudding and the breadfruit flat bread samples that were served as part of the scenario where participants were provided with product information before sampling the product.

2.4. Questionnaire

All participants were asked to taste a small sample of the product and immediately fill out a paper questionnaire (see Supplementary Materials). All questionnaires were anonymous and coded according to the date and whether or not the participant received information about the product while tasting or not. The questionnaire asked the participant the following information: age, gender, place of residence (Country or State), their acceptance (liking) of the product and their willingness to pay for a single serving size of the product. Serving size was determined by the product producer and was visually shown or verbally described to participants during the time of the study.

Product acceptance was based on a 9-point hedonic scale illustrated by nine different “smiley” faces accompanied by matching text [33]. Willingness to pay (WTP) was based on \$0.49 USD or \$0.99 USD increments, based on an extended range that surrounded the actual value the product producer felt was reasonable for how much they would anticipate selling the product. The breadfruit pudding WTP scale was based on a 4 oz (113.4 g) single serving size with pre-defined increments of \$0.99 USD ranging from nothing to \$7.99 USD. Willingness to pay scale for the breadfruit flat bread was based on a 5 oz (141.7 g) portion with pre-defined increments of \$0.49 USD ranging from nothing to \$10.00 USD. The WTP for the pancrepe was based on 6 oz (184.3 g) of product mix with pre-defined values of \$0.99 USD ranging from nothing to \$10.00 USD. The pancrepe samples were prepared according to package instructions as a means to expose consumers of what can be made with the dry breadfruit flour mix.

2.5. Statistical Analysis

The difference in liking between the two groups receiving or not receiving product information was estimated by means of linear mixed models. Statistical analyses were carried out using the statistical environment R with the extension packages “lme4” and “survival” [34]. A significance level of 0.05 was used. Locations were included as random effects to capture differences between the chosen stores. Three linear mixed models were considered: (1) an unadjusted model only including the factor corresponding to the two groups receiving, or not receiving, product information (2) one with additional adjustment for age and gender, and (3) one with further adjustment for place of residence (Hawaii or other). Models were fitted using restricted maximum likelihood estimation. Estimated mean acceptance per group and estimated mean differences in liking based on the three models were obtained with corresponding standard errors and *p*-values.

The difference in willingness to pay between groups was evaluated using censored regression models, which could adequately handle the fact that willingness to pay data were obtained as intervals of acceptable prices. The unobserved willingness to pay levels were assumed to be normally distributed.

Again, three models were considered: the unadjusted model, the model adjusted for age and gender, and the model adjusted for age, gender, location, and place of residence. Estimated mean willingness to pay per group, as well as estimated mean differences in willingness to pay between groups, were obtained together with corresponding standard errors and *p*-values. The relationship between willingness to pay and acceptance was also evaluated using a censored regression model including liking as a predictor, while adjusting for age, gender, and place of residence.

3. Results

A total of 440 adult consumers participated in the study. There were 238 females, 128 males, 2 who reported 'other' and 72 people who did not specify gender. The age of consumers ranged from 18 to 86 years. Baseline characteristics per location and group are reported in Table 1. There were no marked differences between the three locations.

Table 1. Demographic distribution for testing conditions of three consumer food studies based on breadfruit products.

	Product 1 (Hilo)		Product 2 (Kona)		Product 3 (Maui)		Total
	Without Information	With Information	Without Information	With Information	Without Information	With Information	
Sex							
Female	46	47	43	34	34	34	238
Male	25	20	24	24	22	13	128
Other	0	0	0	0	1	0	1
Not specified	5	11	9	14	15	19	73
Residence							
Hawaii	67	72	69	61	49	54	372
Other	7	4	6	11	22	11	61
Not specified	2	2	1	1	0	1	7
Age							
Average	48 (19, 81)	44 (18, 79)	47 (21, 79)	44 (21, 69)	40 (18, 68)	48 (18,86)	45

The results for acceptance are shown in Figure 2, and the results for willingness to pay are shown in Figure 3. In Figure 3, it is evident by the dashed line that more consumer participants had a higher acceptance of the products when provided with the descriptive information. There was a significant increase of 1.33 ± 0.15 ($p < 0.0001$) in acceptance (on the hedonic scale) due to receiving product information. Adjusting for age, gender, and residence resulted in very similar results (results not shown). Similarly, a significant increase of 1.26 ± 0.23 USD ($p < 0.0001$) in willingness to pay was found for the group that received product information, as compared to the group not receiving any information; again, adjustments did not change the results noticeably (results not shown). There was a strong positive relationship between willingness to pay and acceptance, corresponding to an increase of 0.59 (0.07) USD per one unit increase in the hedonic scale ($p < 0.0001$).

In summary, acceptance of all breadfruit products sampled increased by more than 1 point on the hedonic scale when participants were presented with additional information about the product and participants were willing to pay more for the product if they had received the descriptive information. In the following section the results will be further explored within the context of other value-added products comprised of breadfruit sold in Hawaii.

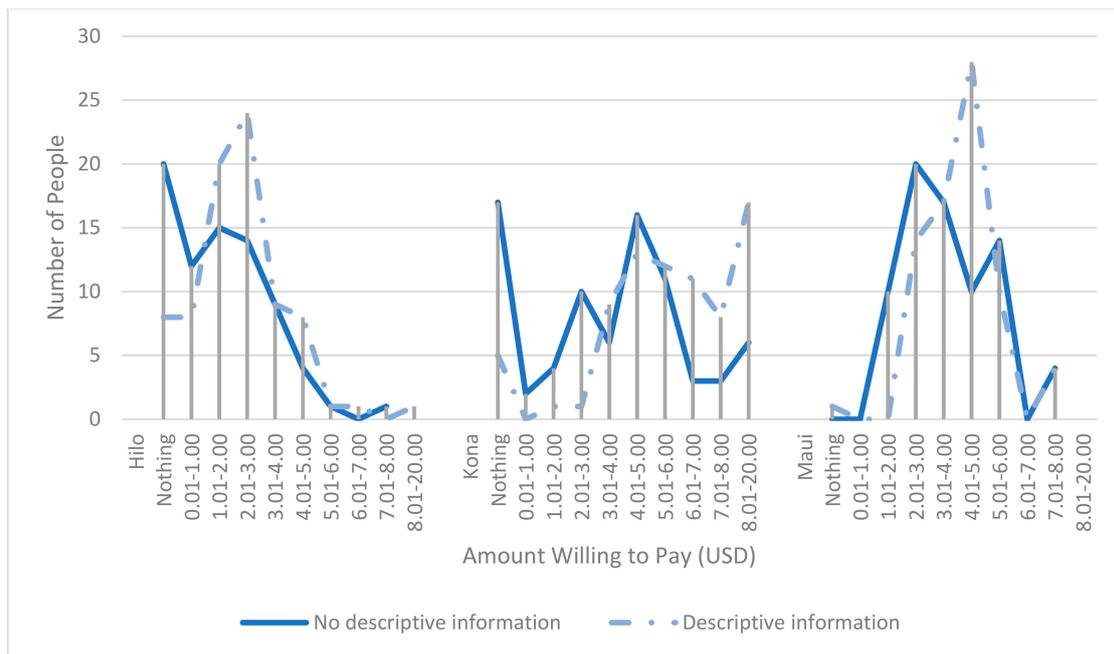


Figure 2. Participants stated willingness to pay for three different breadfruit food products with and without receiving product information.

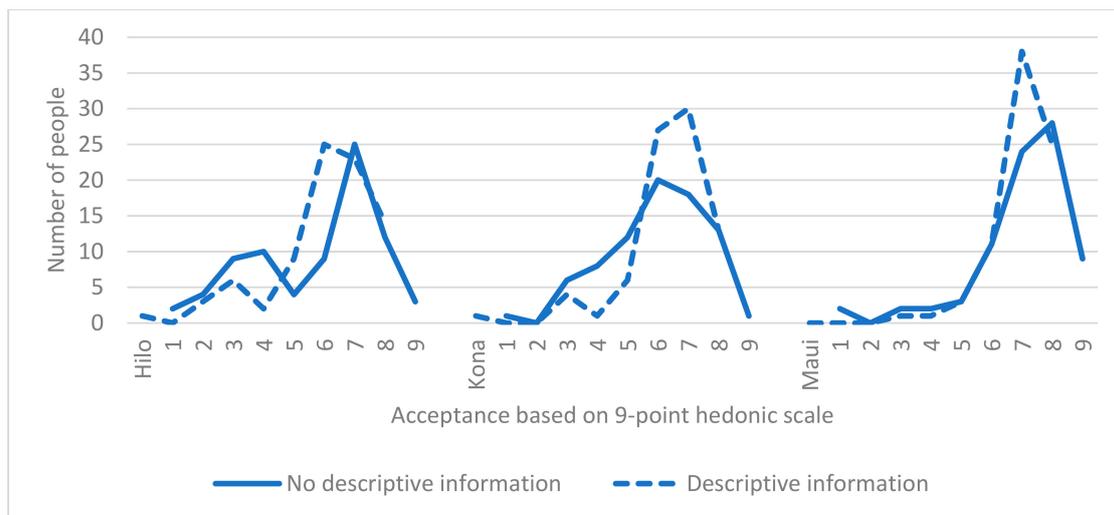


Figure 3. Acceptance of three different breadfruit food products with and without receiving product information.

4. Discussion

There is currently a limited selection of commercially-available breadfruit products on the Hawaiian Islands. Thus, investigating consumer acceptance of products made with breadfruit is crucial in the development of new novel products to increase utilization and ensure the successful future impact of breadfruit as a significant food source. By investigating whether product information would impact a consumer’s acceptance and willingness to pay for a novel food product based on breadfruit, an understanding of how product information can impact a consumer’s choice to buy and consume breadfruit can be obtained. Typically, more than 90% of newly developed food and beverages on the market fail highlighting a compelling need for consumer research when creating novel food products to ensure progress in revitalizing breadfruit [35].

4.1. Socio-Economic Considerations in Hawaii and Willingness to Pay

The Hawaiian Islands are inhabited by over 1.4 million people, representing fourteen different racial groups; 23.7% of the population is considered multi-racial [36]. More than half of the population living in Hawaii during 2011–2015 were born in Hawaii (53.8%) [36]. When looking at the total populations of each race, native Hawaiians have the largest native-born populations [36]. The median age is 38 years old with 50.5% males and 49.5% females [36]. People 18–64 years old make up 62.5% of the total population and people 65 years and older represent 15.6% of the total population [37]. The median household income amongst the prime working age group (18–64 years old) in Hawaii was \$69,515 during 2011–2015 [36]. Per capita the average income across the state is \$29,822, higher than the United States average per capita income [36]. This is of particular relevance when considering the higher cost of living in the Hawaiian Islands. Of the five largest race groups in Hawaii, Filipinos had the highest household income and Native Hawaiians had the lowest. According to the 2018 USDA thrifty food plan, it is reported that a family of four (two adults and two children between 6–11 years old) in Hawaii spends \$270 US dollars a week on food in contrast to the \$149 US dollar average spent on food in the mainland United States [36]. An individual is estimated to spend between \$38–85 US dollars per week depending on if they have a thrifty or liberal food plan respectively [36]. The Hawaii foodbank reported that one in five residents received regular food assistance in 2017 and 12% of households were considered food insecure between 2014–2016 [38]. When compared to a 2016 study conducted by Lysák and Henriksen in 2016, it was found that all but two breadfruit-based products being sold in stores were being sold within the range that consumers who participated in this study declared they would be willing to pay [31]. Most consumers sampling all three products in both scenarios said they would pay between \$2.00–5.00 US dollars for a single serving of the product. As shown in Table 2, only the bagel and pie fell within this range. Considering the above weekly spending budget of residents of Hawaii, it makes sense that they report not being willing to pay more on these value-added products. This is a crucial consideration when determining the affordability of a product and the target consumer group; however, it is equally important to consider the producer and cost of making the product to ensure fair and appropriate wages.

Table 2. Cost of breadfruit-based food products sold in stores or farmer’s markets in Hawaii [31].

Product	Cost per Location (USD)		
	Wholesale	Store	Farmers Market/Event
Bagel		\$1.36	
Flour (8oz)	\$8.00	\$9.50	
Frozen processed (per pound)	\$3.00–\$3.25		
Frozen steamed processed (7oz)	\$3.75	\$6.20	\$5.00
Hummus (10oz)	\$5.50	\$6.50	
Hummus (8oz)	\$3.00–\$4.00	\$5.99	
Pancrepe mix (6.5oz)		\$11.49	
Pie (serves 8–12 people)		\$38.00	
Savory pie (single serving)			\$11.00
Soup (single serving)		\$9.50	
Sweet pie (single serving)		\$5.50	
Sweet treats (single serving)			\$1.00–\$4.00

An estimated 11.2% of all people in Hawaii lived in poverty, and more than 42,000 Hawaiian residents were unemployed during the 2011–2015 period [36]. However, it should be noted that poverty rates across Hawaii vary significantly between race groups [37]. Considering white, Japanese, and Okinawans are the only races that have higher average household and per capita income than the other represented races it could be said that they would be most likely to pay a premium price for value-added products of interest. In contrast, native Hawaiian’s who have the lowest reported household income may be least likely to purchase a value-added product due to socio-economic

constraints. While this study did not ask participants about their race, birthplace or income, future consumer studies investigating socio-economic factors could identify acceptance and willingness to pay for breadfruit value-added products in light of these realities.

4.2. Consumer Acceptance

Consumers' overall assessment depends on three factors (1) the availability of information from their memory—where regular consumers typically rate a food differently than someone tasting a food for the first time, (2) the diagnosis of information presented—where a participant decides how pertinent, positive, or negative the information is, and (3) the relative accessibility of the information available—how recently the information has been known or the importance of the information and frequency of use [39,40]. All of these factors can be said to have a major role in this study, since it can be clearly seen that the product information about the product created a positive reaction and influenced the participant's assessment resulting in a higher acceptance rating.

Similar to the findings in this study, Tuorila et al. also found that additional product and label information improved acceptance scores and the likelihood a consumer would consume the product in comparison to consumers who were not provided with product information [32]. In a study conducted by Stolzenbach et al., it was found that the degree of product information available determines the value that is associated with the liking of local apple juices [41]. Correspondingly, Danner et al. found that descriptions influence expectations, liking, emotions and willingness to pay for Australian white wines [42]. Not surprisingly, this effect has been well studied in terms of the role that marketing and advertising have on the expectations and value consumers place on products [43,44]. Since breadfruit food products are not regularly seen for sale, consumers do not often come into contact with the information they were presented with in this study simultaneously while consuming breadfruit, highlighting the impact and importance product information will have for the future sale and creation of novel breadfruit products.

Studies conducted by Wansink et al. and Mielby and Frøst found the type of information given when presenting food affects not only the liking of the food but also their expectation of what they are tasting [45,46]. If a participant was informed that they were eating a dish made of breadfruit and had positive associations of breadfruit they would rate the sample with a higher acceptance. Interestingly enough, during the sampling process of this study several participants expressed pleasant surprise while tasting an unfamiliar preparation of a breadfruit product which exceeded their expectations which were previously quite low. Boutrolle and Delarue, say that a complex psychological process between sensory inputs, identification of the food and integration of previous memories of the food actually determine the willingness a person has to eat a food, and in turn determine their attitude about the food [47]. So, while positive associations often have a significant impact on a consumer preference, novel foods have the potential to positively change perceptions. Although, as stated in the study by Wansink et al. it is suggested that more 'evocative' and 'product' information could have increased participants liking even more [45]. This is a crucial consideration for future studies addressing additional factors which may affect acceptance of breadfruit products.

Consumer decision making is a complex process influenced by many factors. Marketing, branding, and packaging blast consumers with information about a product in order to purposely alter their consumption patterns, choices, preferences as highlighted in a quantitative meta-analysis conducted by Verlegh and Steenkamp [48]. Marketing plans are used to motivate consumers to purchase a product, these plans can include addressing store atmosphere, social media influence, corporate social responsibility, brand choice, and perceived value and sales promotion [49–53]. For the purpose of this study, information available to consumers about the product was targeted and it is no surprise that any information about the product to be sampled would have some impact on the consumer's rating of the product. Dichter, however, argued that the products' country of origin may in fact have a large impact on its acceptance [54]. This is of particular interest to this study where consumers were informed that breadfruit has been an important staple crop in the Pacific for more than 3000 years,

making the point that what they are about to sample is a local crop of importance. Thus, it can be seen that the product information presented positively influenced their acceptance of the breadfruit product. Similar observations have been made by Verlegh and Steenkamp and Peterson and Jolibert confirming that when consumers are presented with information relating to the country of origin, there was in fact a measurable medium- to large- effect on consumers' evaluations, especially on the perceived quality of the product [48,55]. Considering that 84% of the consumers who sampled the breadfruit products in this study were residents of Hawaii, it was assumed that they were more familiar with breadfruit as a tree that grows locally and perhaps the product evoked an affective role.

In a study conducted by Stefani et al., it was found that not only does the origin of food products act as a quality cue and impacts the value of the food due to symbolic or affective roles, there is a direct impact on consumers' willingness to pay for a product [56]. The results in this analysis demonstrate that product information has a positive impact on a consumer willingness to pay for a product knowing that the main ingredient is breadfruit and were willing to pay 0.60USD more as their acceptance score increased.

Ultimately, acceptance of novel food product is largely determined by how similar the food product is to a food product that is already consumed in the consumer's regular diet [57]. This finding is particularly relevant in the pure notion of a novel food. Novel food, by definition, is new or unique and therefore not expected to be similar to another food. However, any possible information or sensory cues picked up on by the consumer will inherently elicit an expectation from the consumer [41,58]. Tuorila et al., however, concluded that although marketing and product information are often designed in a way to create positive associations between a consumers expectations and their experience with a novel food, it does not seem to help consumers by guiding them in knowing which existing food to which it should be compared [57]. Schiffmann and Kanuk state that consumers rely on their past experiences, marketing programs and non-commercial information sources to guide their decision-making process [59]. However, in the case of novel breadfruit products, consumers are often so unfamiliar with breadfruit that the comparison is helpful in persuading them to try it in the first place, which can be a hurdle in novel foods gaining popularity. This is particularly relevant when considering future product information and definitions of any novel breadfruit product.

As research by Nelson and Thomson et al. shows, if a person is more familiar with a product it will influence their response to a product since associations are based on life experience [60,61]. In the context of this study, it is assumed that due to previous revitalization efforts described by Ragone et al. over the last decade, as the recent appearance of a select few value-added products for sale as well as the increasing number of prepared dishes available in restaurants with an emphasis on local food, local residents of Hawaii have more familiarity with breadfruit [8]. Additionally, the relevance of breadfruit as an original "canoe crop" in the Hawaiian Islands gives it a long-standing history of a local food source. As stated by Thomson et al., it is not just packaging and marketing material that influences responses to food [61]. The product itself elicited emotional responses and expectations. In future product development, it will be crucial to consider the consumer expectations that stem from their previous perception of breadfruit attributes. Not only is this important in matching positive expectations, but also in the case of changing previously negative associations. As found by Almlı et al. it would then be important to match positive expectations in branding and marketing strategies when attempting to successfully promote a product [62].

Research shows that food products are frequently liked and regularly consumed in certain environments, therefore when performing a consumer study it is crucial to consider the environment in which the study is conducted to ensure that the results represent a scenario which would be most likely [63–65] highlights the notion of 'appropriateness' which states the importance of situational context in order to truly understand what factors influence a consumers acceptance for a product and Meiselman goes on to suggest that the use of natural contexts during research is ideal [66,67]. This study was conducted in a supermarket setting, where the participants are faced with numerous choices of what they can buy and can be perhaps be open to considering a new product. It should also be

noted that in the United States food product sampling in supermarkets is very common and would be seen as a normal experience in a natural context for most participants in this study.

4.3. Limitations of the Study

There were a number of strengths and potential limitations within the present study. A strength was that it was replicated in three different locations, under fairly similar experimental conditions. Moreover, a high percentage of consumers that were approached participated fully in the study (approx. 84%).

In terms of potential limitations, it should be noted that participants of the study were included on a voluntary basis simply based on personal interest when passing by the sample station; this sampling scheme may have biased results in favor of a more positive attitude towards new products or breadfruit products and therefore have a higher acceptance and willing to pay. This is essentially a shortcoming due to not being able to use randomization in a supermarket setting, in a natural and practical way. It should also be noted that differences in the product recipes may have had an impact on participant's acceptance ratings. Future studies could include additional breadfruit products sampled in a variety of locations with more participants to increase the power of the study.

5. Conclusions

In this study, consumer acceptance and willingness to pay were found to be positively impacted by product information about the products: (i) being made of breadfruit, (ii) cultural significance, (iii) nutritional benefits and (iv) breadfruits potential contribution to food security.

As hypothesized: it is evident that consumers are highly influenced by product information about breadfruit when trying new novel products in the Hawaiian Islands, similar to other products and locations in previous consumer studies. In this study, the sampling of three novel breadfruit products in three separate locations has shown that customers who received information about the product prior to sampling had a higher acceptance score and were also more willing to pay a premium price for a single portion of the product. As demonstrated in the literature, consumer acceptance tends to increase through repeated exposure, and this should also be considered when introducing consumers to novel breadfruit products. Persuading consumers to try a novel breadfruit product, and subsequently, to purchase and consume it on a regular basis, will require a creative approach. A deeper understanding of concept associations will be highly relevant for future marketing and promotion of novel breadfruit products. Studies addressing exactly which variables have the most impact on consumer acceptance and investigations into consumer behavior would prove very useful in guiding entrepreneurs in their marketing approaches. Building a positive narrative around breadfruit products is crucial for increasing consumer acceptability and revitalizing breadfruit for improving food security in the Hawaiian Islands. In conclusion, this study has demonstrated compelling documentation that could be used for future development and launching of novel breadfruit products on the Hawaiian Islands, bringing awareness about local consumer acceptance and increasing their willingness to pay for a product knowing that it is comprised of this viable and important local resource. Additionally, further consumer studies should be conducted on other islands around the Pacific or Caribbean where breadfruit is widely consumed. Such comparative studies would also yield valuable insights for Hawaiian entrepreneurs.

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