CONSUMER ACCEPTANCE OF ZOPHOBAS MORIO (SUPERWORM) BASED FOOD PRODUCTS IN SELECTED PROVINCES OF MINDANAO, PHILIPPINES: PERSPECTIVES ON THE POTENTIAL OF ENTOMOPHAGY FOR FOOD SECURITY

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Abstract

Edible insects are a great alternative source of animal protein for human consumption to address a growing population's increasing need for nutrients amidst the marginalization of agricultural lands. However, entomophagy, the eating of insects is not yet adopted on a large scale in the Philippines, unlike other Asian countries. There is a need to educate Filipinos on the consumption of insect-based foods. This study assessed the Superworm-Based Food Products (SBFPs) in terms of their sensory attributes for acceptability and positive consumer action. Data were gathered through surveys and tasting sessions. One hundred fifteen (115) participants comprised of pupils, students, faculty, and staff members in selected provinces of Mindanao evaluated the product using a hedonic scale. Descriptive sensory analysis was performed to determine SBFPs' sensory characteristics. ANOVA was used to determine the significant difference in preference among SBFPs and Correlation analysis was employed to determine factors affecting its acceptability. Results show that SBFP acceptance was highest for its appearance, taste, aroma, and texture. The Super Brownies was the most accepted product and significantly differed ($p<0.01$) from all SBFPs. The appearance, taste, aroma, and texture were strongly correlated ($p<0.01$) to its overall acceptability. These findings are positive indicators that can lead to mass production and commercialization of SBFPs and pursue more focused consumer studies like targeting extreme climate vulnerable and resource-scarce communities.

Keywords: Acceptability, insects as food, entomophagy, food consumption, food security

Introduction

Food insecurity is a reality brought about by constraints of resources, climate change, and an increase in population. Thus, it is vital to develop and put into action mitigation methods to ensure an adequate, safe food supply (Van Huis et. al. 2013). Along this vein, there is a quest for alternative protein sources as prompted by factors such as the rising demand for meat globally, animal disease, and the restricted land area for animal farming. For instance, using edible insects as a substitute protein source for human consumption is intriguing due to their low greenhouse gas emissions and minimal environmental impact (Van Huis, 2016). Eating edible insects is a possible solution to the world food issue because they are plentiful, and have a high protein content, as well as vitamins and minerals (Shantibala et al. 2014). Insect farming is simpler and doesn't require as much area as farming cattle, and they generate less trash and require less water (Van Huis, 2013), Lensvelt and Steenbekkers, 2014). However, in the Philippines, entomophagy—the practice of eating edible insects—is not widely accepted. In contrast to other regions of the world where eating insects is common, being a fantastic source of protein. Alley and Potter (2011) explained that when new foods are presented, it typically causes food neophobia, a prevalent feature and protective behavior among people who are reluctant to eat novel meals. It significantly affects children's and adults' nutritional intake, frequently in a negative way. Studies were conducted on how to overcome food neophobia. Williams et al. (2008) discovered that the number of exposures necessary for voluntarily consuming novel foods reduces as more foods are included in the diet. In addition, Lensvelt and Steenbekkers (2014) disclosed that giving participants the chance to consume insect food and trying to change their attitudes towards entomophagy are both crucial. Thus, "educating" customers about entomophagy should be done in the widest meaning possible. Moreover, Busse and Siebert (2017), pointed out that consumer participation in open innovation is a critical tactic in the food industry, particularly for increasing consumer approval and fostering effective market introduction.

A first step toward a better understanding of consumer responses to eating insects and their potential market adoption is the profiling of customers who are willing to incorporate them into their diets (Verbeke, 2015). Therefore, there is a need to consider socio-demographic characteristics. For example, Sogari, et. al. (2019) discovered that men are more willing to try insects than women. Liu et. al. (2020) reported that age, home size, household income, and region are the primary determinants of whether or not people consume edible insects. Paoletti (2005) noted that in some places, eating insects as food is a common practice. Several studies on how to overcome the disgust of edible insects were conducted to promote entomophagy. According to Schösler et al. (2012), consumers' reactions to insects rely on how the items are presented to them, and these reactions change depending on whether the insects are visible, covered in chocolate, or used as a protein source. The likelihood of acceptance typically rises as the visibility of the entire insect decreases. Their research on customer responses to pizza with insect protein and chocolate-covered locusts suggests that there may be chances to market insects as a delicacy or as a component of ready-to-eat foods. Likewise, in their study of participants who ate dishes based on insects, Lensvelt & Steenbekkers (2014) discovered that acceptance is higher when insects are hidden. Also, Caparros et. al. (2014) created different insect formulations (mealworms and house crickets), and customers favored insects with well-known flavors and crispy textures. Results indicate that if consumers can associate cooking insects at home with familiar flavors, they will do so. Harman et al. al. (2015) found that respondents were more ready to eat processed insect-based foods than unprocessed ones. Ruby et. al. (2015) noted that participants were least opposed to eating entire insects and most open to taking small amounts of insect flour in a favorite cuisine. Gmuer et al. (2016) reported related findings that a greater anticipated acceptance of foods in which insects are incorporated as a processed ingredient rather than presented whole. Food exposure, according to Sogari et. al. (2019) enhances product familiarity, influences one's desire to try new foods, and lessens neophobic reactions.

A well-known argument in entomophagy, states that taste is likely to play a significant role in determining whether or not insect-based diets are preferred (Deroy, Reade, & Spence, 2015). Also, appearance, safety, and quality were shown to be most likely to affect customer desire to attempt to eat insects (Wilkinson et al. 2018). Kim et. al. (2019) reiterated that insects may be able to address issues with the traditional food supply chain, such as the world's energy, water, and land shortages. Through the development of acceptable processing techniques, as well as by describing the health benefits and outlining the importance of lessening reliance on other food sources, academic, industrial, and government-led activities have tried to lessen negative opinions about insects. This study assessed consumer acceptance of Superworm-Based Food Products (SBFPs) and explore the personal and product-related factors that affect their acceptability. This study is among the few that determine the potential of insects to complement traditional protein sources. This study's result may serve as a benchmark for promoting insect-based foods.

Materials and Methods

The research used an exploratory survey research design. This method compiles, condenses, presents, and analyzes data on new subjects (Mutai, 2014). This is appropriate in exploring the acceptance of SBFPs that had not been done by many researchers. Moreover, it used the sensory evaluation: descriptive and affective (acceptance test) which involved rating the difference in acceptance of SBFPs among participants in terms of their appearance, taste, aroma, and texture.

Super Chocolate Muffins

Super Brownies

Super Chantilly Lace

Super Cookies with raisins

Super Oatmeal Chocolate Cookies

Super Binangkal with Malunggay

The participants were obtained through purposive sampling. It is a method that is frequently used in qualitative research to identify and choose participants (Patton, 2002). This entails locating and choosing people or groups of people who are particularly knowledgeable about or have firsthand experience with a topic of interest (Cresswell & Plano Clark, 2011). This is necessary since SBFPs are novel food. Rogers (1995) explained that no individual will accept any innovation without being first aware of it. Bernard (2002) noted the importance of availability and willingness to participate. Furthermore, Lawless and Heymann, (2010) asserted that when performing affective tests, a sample size of 75-150 individuals can be considered adequate. With these, a total of 115 participants were included; 29 college students of MSU, Marawi City, Lanao del Sur, 30 high school students from Esperanza, and 32 pupils from Labangan, Zamboanga del Sur. It also included 24 faculty and staff members. They were selected because of their prior awareness, knowledge, and experience with edible insects. They were recipients of the educational campaign conducted by Dr. Sabado who pioneered the promotion of entomophagy in the area. Those who voluntarily accepted SBFPs or those with Parent's consent were included.

This research utilized a questionnaire with two (2) main parts: Part I is composed of consumer demographics. Part II comprises the acceptance of SBFPs'. It was subjected to face and content validity by the experts of entomophagy, professors of Crop Protection and Entomology, and the organizer of the Insect Eating Festival (IEF) at MSU, Marawi City. All questions were translated into local dialects to ensure understanding among high school students and pupils. Creswel (2005) underlined that content validity denotes that inferences may be drawn about the populations being studied and that the answers make sense. It was also pre–tested for reliability with coefficient alpha=0.967 indicating high reliability of questions used in data gathering.

Before administering the questionnaire, respondents were subjected to screening to exclude those allergic to crustaceans that would likely develop insect-food allergies. Pregnant women are also excluded. Orientation was also given as to the nature and purpose of the study, that participation is voluntary; no monetary compensation is received for participation and all responses be treated with utmost confidentiality. They were encouraged to assess themselves and ensure that they are not too hungry nor too full before taking the test in order not to affect the result. Also, they were encouraged to carefully answer every question based on their personal information, view or belief, and

experience and by not sharing their answers with others. The questionnaire was presented chronologically**.** All questions were explained orally to ensure the best understanding, especially for students and pupils from Esperanza and Labangan, Zamboanga del Sur. Each participant was encouraged to observe physical distancing and was asked to taste each SBFP one at a time. Each one was motivated to drink the water provided after tasting every sample. They were asked to rate each sample on a hedonic scale where extreme sides will be noted from "totally dislike" (left) to "totally like" (right). For the children, the face" / "smiley" scale (with one extreme with a frowning smiley face and anchored at the other extreme with a happy smiley face) was used. These SBFPs were subjected to laboratory analysis to ensure that it is safe for consumption. Also, the research was submitted to the ethics committee for review and consideration. Data gathering started on July 28, 2020 and ended on August 7, 2020. SBFPs.

Descriptive Statistics is used in describing personal, product-related factors and acceptance of SBFPs using the Likert Scale. Descriptive analysiisbe a very helpful method in product development, according to Lawless and Heymann (2010). It may be used to characterize a wide range of product changes and provide a precise specification of a product's sensory qualities. The Correlation analysis is employed to determine the consumer demographics and product attributes associated with acceptance of SBFPs. The analysis of variance (ANOVA) is utilized to examine significant difference in acceptance among SBFPs. All tests of significance were set at 0.05% level and analyzed using Statistical Package for the Social Sciences (SPSS).

Results and Discussions

1.1.4a. Consumer Demographics and Suitable Attributes of SBP's

There were slightly higher proportion of male respondents (51%), aged 6 to 11 years (35%) and 18 to 23 (30%) years old, comprised of Maguindanaoan (30%), Cebuano (30%) and Meranao (26%). They belonged to a household with 4 to 7 members (61%). This result is expected considering the respondents and locale of the study. In view of the potentials for edible insects to provide an alternative source of protein, especially on households experiencing poverty incidence with expected low protein intake among members (children), additional demographic characteristics were included, such as: health considerations for food choice, familiarity and experience with edible insects. Responses indicated that food like edible insects which contains high protein (AWM=2.86), low in cholesterol (AWM= 2.71) and high in fiber (AWM = 2.68) are very important to them. This implies their concern for health and nutritional value of food. Based on Belluco et al. (2015) study, numerous species of insects have protein contents above 60%. With regards to their familiarity with eating insects. Results revealed their awareness on insect eating as popular in some culture or tribe (ethno-entomophagy) (AWM=2.59), they heard that few insects are edible (AWM=2.55) and are served in some restaurants (AWM=2.53). Results show that they have experienced eating insect whenever available (AWM=2.42) or on occasional basis (AWM = 2.18) (Table 1). Their existing familiarity and awareness and experience on edible insects can be attributed to the lectures on entomophagy in Crop Protection and Entomology courses at Mindanao State University, Marawi City. Moreover, the Insect Eating Festivals organized in the University and the educational campaign on entomophagy in the elementary and secondary schools at Labangan and Ezperanza Zamboanga del Sur, respectively.

Table 1. Consumer demographics

Indicators	Student -Respondents			Faculty/ Staff (LDS &ZDS)	Total	Percentage
	College (MSU, LDS)	High School (Esperanza, ZDS)	Elementary (Labangan, ZDS			
	n=29	**n=30**	**n=32**	**n=24**	115	100.00
Gender						
Male	9	18	21	11	59	51
Female	20	12	11	13	56	49
Age						
6-11	-	13	27	-	40	35
12-17	1	16	5	-	22	19

18-23	21	1	-	13	35	30
>24	7	-	-	11	18	16
Mean= 16						
Tribe						
Meranao	28	-	-	2	30	26
Cebuano	-	21	2	11	34	30
Maguindanaon	1	-	30	3	34	30
Subanen	-	9	-	8	17	14
Household Size						
1-3	2	3	-	4	9	8
4-7	9	24	22	15	70	61
8-11	15	2	10	4	31	27
>12	3	1	-	1	5	4

Indicators	Student –Respondents			Faculty/ Staff/ (LDS &ZDS)	Both	
	College (MSU, LDS)	High School (Esperanza, ZDS)	Elementary (Labangan, ZDS			
	Mean	Mean	Mean	Mean	Average Weighted Mean	Adjectival Meaning
Health Considerations in food choice						
1. contains a lot of vitamins and minerals	2.69	2.93	2.88	3.00	2.88	Very Important
2. high in protein	2.72	2.83	2.88	3.00	2.86	Very Important
3. high in fiber	2.21	2.67	2.88	2.96	2.68	Very Important
4. low in cholesterol	2.31	2.77	2.75	3.00	2.71	Very Important
Overall	2.48	2.80	2.84	2.97	2.77	Very Important

Legend:

2.51 – 3.00	-	Very important
1.51 – 2.50	-	Moderately important
1.00 - 1.50	-	Not important

Table 1 continued…

Indicators	Student –Respondents			Faculty/ Staff/ (LDS &ZDS)	Both	
	College (MSU, LDS)	High School (Esperanza, ZDS)	Elementary (Labangan, ZDS			
	Mean	Mean	Mean	Mean	Average Weighted Mean	Adjectival Meaning
Familiarity of eating insects						
1. I have heard that few insects are edible	2.10	2.73	2.47	2.96	2.57	Strongly Agree
2. I have heard insect eating as popular in some culture or tribe	2.24	2.67	2.47	2.96	2.59	Strongly Agree
3. I have heard edible insects served in some restaurants	2.03	2.77	2.34	2.96	2.53	Strongly Agree
4. I have heard about insects but have not tried myself	1.97	2.17	2.47	2.58	2.30	Agree
Overall	2.09	2.58	2.44	2.64	2.44	Agree
Previous experience with edible insects						
1. I have never tried edible insects	2.07	1.27	2.22	2.46	2.01	Agree
I have tried eating insects once	2.07	1.80	2.13	2.50	2.13	Agree
I have tried eating insects on several occasions	1.72	2.13	2.16	2.71	2.18	Agree
I eat edible insects whenever available	1.76	2.53	2.63	2.75	2.42	Agree
I eat edible insects regularly	1.59	2.10	2.53	2.63	2.21	Agree
Overall	1.84	1.97	2.33	2.61	2.19	Agree

Legend:

2.51 – 3.00	-	Strongly Agree
1.51 – 2.50	-	Agree
1.00 - 1.50	-	Disagree

The SBFP's sensorial attributes show consistent rating from all types of consumers; pupils, students and faculty and staff members. Acceptance was highest for its appearance (AWM=4.43), followed by taste (AWM=4.37), then Aroma (AWM=4.06) and Texture (AWM=3.71). For instance, Super Brownies was liked very much in terms of its appearance (AWM=4.70), taste (AWM=4.64) and aroma (AWM = 4.41). Similar responses given to Super Chocolate Muffins' appearance (AWM= 4.52), taste (AWM = 4.53) and aroma (AWM = 4.36). The appearance, taste, aroma and texture of Super Chantilly lace (AWM=4.49, 4.40, 4.03, 4.11) and Super Binangkal with Malunggay (AWM = 4.19, 4.05, 3.80, 3.80) were liked by the consumers. Related ratings can be observed with the appearance, taste, aroma of Super Oatmeal Cookies (AWM=4.39, 4.34, 3.87 and Super Cookies with raisins (AWM=4.29, 4.28, 3.89). However, its

texture was neither liked nor disliked, which suggest a need for improvement (Table 2). In order to describe further the sensorial attributes of all SBFP's and as basis for production, specific descriptors were included in each attribute. Adapting UTT, BAFT, B.Sc. Food Science and Technology, Student Project for PROJ2005 Capstone, 2012), for appearance, descriptors like appetizing, dry, greasy, crumbly and flat were used. For taste, specific description like tasty, salty, fatty, burnt, undercooked were adopted. Aroma is to be described as rancid, aromatic, musty, savory and mild. Texture is to be rated as dry, chewy, moist, tender, grainy. The results showed similar specific attributes in all SBFP's as rated by different consumers. SBFPs had an appetizing appearance being not greasy and crumbly. It were tasty, not undercooked or burnt nor fatty and salty. It had a pleasing aroma, savory, mild. Musty and not rancid. Results revealed the suitable attributes and multisensory attributes of SBFP samples (Figures1-3).

Table 2. SBFPs overall attributes as rated by the consumers

	SBFPs							
Sensorial Attributes	Super Chocolate Muffins	Super Brownies	Super Chantilly Lace	Super Cookies with raisins	Super Oatmeal Cookies	Super Binangkal with Malunggay	Overall	Adjectival Meaning
Appearance	4.52	4.70	4.49	4.29	4.39	4.19	4.43	Like
Taste	4.53	4.64	4.40	4.28	4.34	4.05	4.37	Like
Aroma	4.36	4.41	4.03	3.89	3.87	3.80	4.06	Like
Texture	3.96	3.93	4.11	3.20	3.26	3.80	3.71	Like

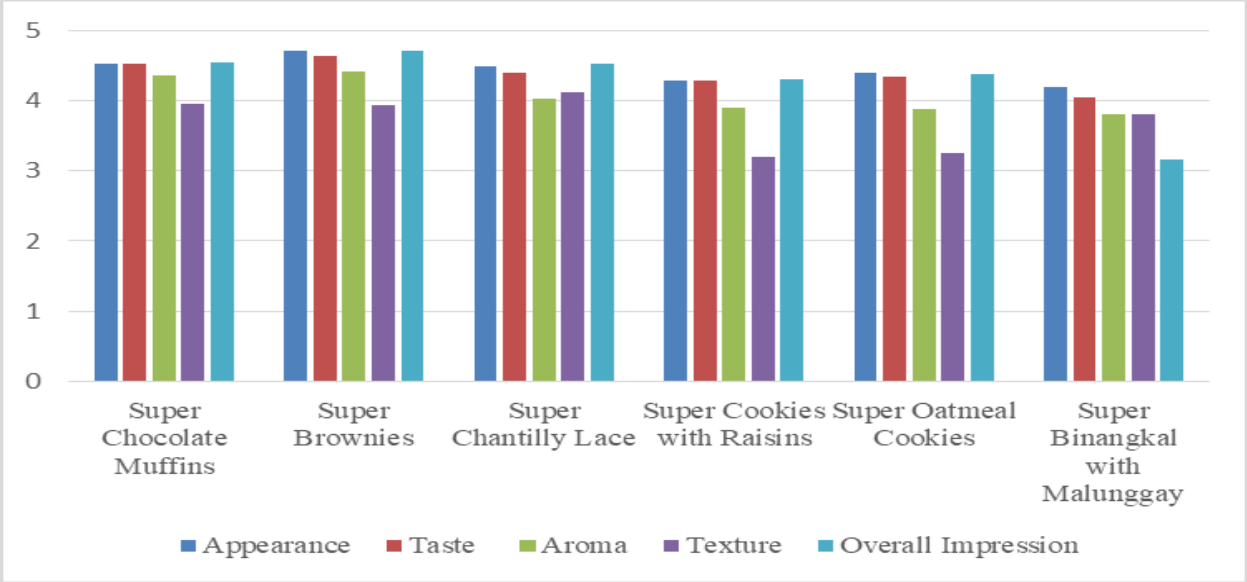

Figure 1. Overall attributes and multisensory characteristics of SBFPs

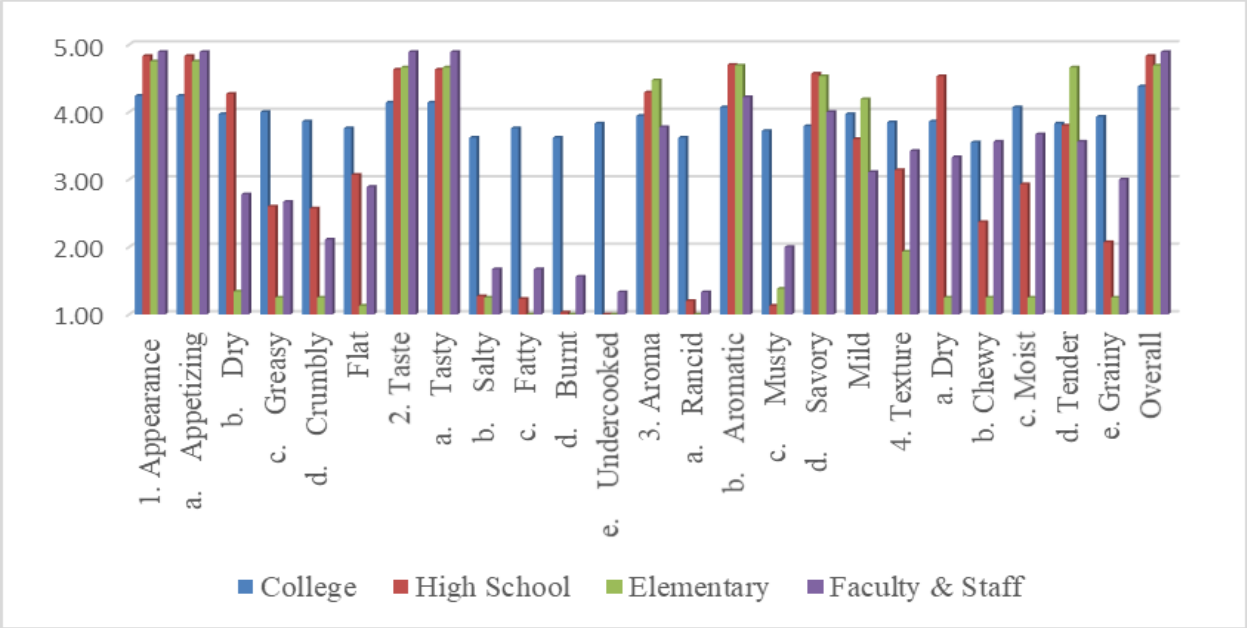

Figure 2. Specific Attributes and Multisensory characteristics of Super Chocolate Muffins

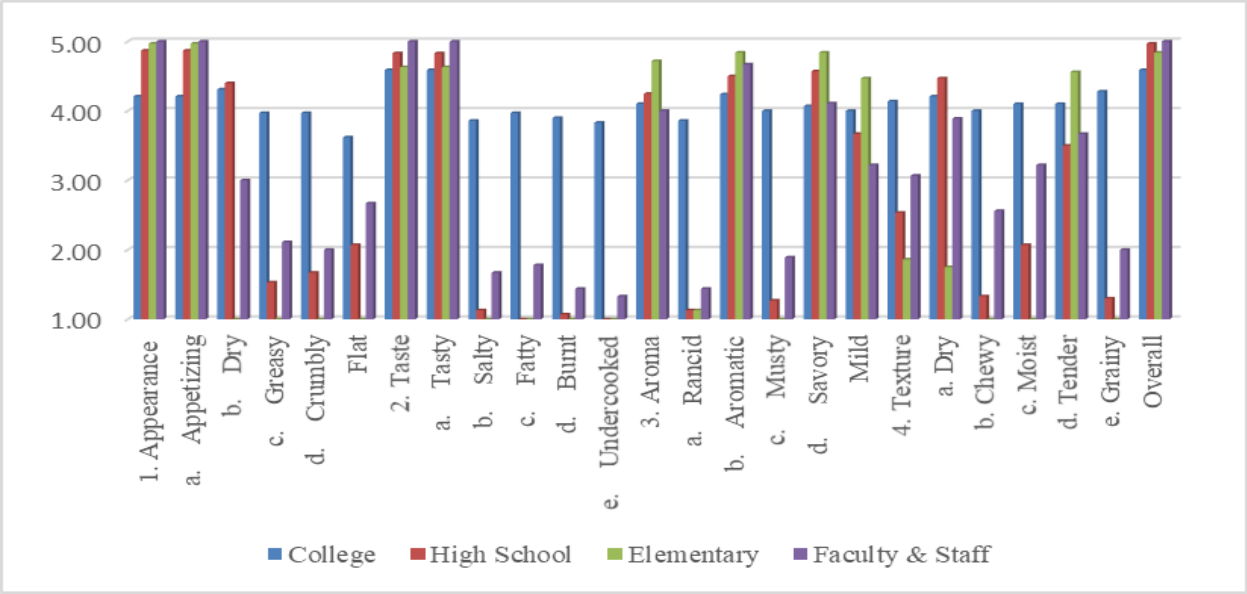

Figure 3. Specific Attributes and Multisensory Characteristics of Super Brownies

Among SBFPs, Super Brownies significantly differed as the most appealing to the consumers in all attributes. Brownies are common in school canteens. This finding is in agreement with the study of Selvakumaran (2017) that the texture, and flavor of the brownies were most preferred by the panelists. Likewise, Super Oatmeal Cookies differed significantly. This result is also consistent with The Khouryieh et. al (2012) research showed that panelists liked and approved of the color and flavor of cookies produced with 50% rolled oats.

1.1.4b. SBFP's acceptance, Consumer Demographics and product attributes associated with its acceptability

Mean consumer ratings for the overall acceptance of SBFPs are shown in Table 3. The SBFPs such as Super Brownies (AWM=4.70), Super Chocolate Muffins (AWM=4.55), and Super Chantilly lace (AWM=4.52) were totally accepted. The Super Oatmeal Choco Cookies (AWM=4.37) and Super Cookies with raisins (AWM=4.30) were accepted. However, Super *Binangkal* with *Malunggay* (AWM= 3.16) was neither liked nor disliked. These conform to the sensorial attributes rating. The SBFPs with sensorial attributes very much liked by consumers were also totally accepted. For the purpose of determining attitudes and food actions of consumers like the frequency of their consumption, their motivation to consume SBFP, and have a more action-oriented indication of acceptance. The Food Action Rating (FACT) was included. The result shows that consumers would eat SBFPs every opp**o**rtunity they had (AWM=4.91), very often (AWM=4.82), now and then (AWM=4.78), and frequently (AWM= 4.67) when motivated (AWM=3.46) (Table 4). This indicates their positive behavior toward SBFPs that match up with their driving force for acceptance.

Table 3. Overall acceptance of SBFPs as rated by the consumers

SBFPs	Sensorial Attributes					
	Appearance	Taste	Aroma	Texture	Overall	Adjectival Meaning
Super Chocolate Muffins	4.52	4.53	4.36	3.96	4.55	Totally like
Super Brownies	4.70	4.64	4.41	3.93	4.70	Totally like
Super Chantilly Lace	4.49	4.40	4.03	4.11	4.52	Totally like
Super Cookies with raisins	4.29	4.28	3.89	3.20	4.30	Like
Super Oatmeal Cookies	4.39	4.34	3.87	3.26	4.37	Like
Super Binangkal with Malunggay	4.19	4.05	3.80	3.80	3.16	Neither like nor Dislike
Combined	4.43	4.37	4.06	3.71	4.14	Like

Legend:

4.51 – 5.00	-	Totally like
3.51 – 4.50	-	Like
2.51 – 3.50	-	Neither like nor Dislike
1.51 – 2.50	-	Dislike
1.00 - 1.50	-	Totally Dislike

Table 4. Food action rating on SBFPs by consumers

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Indicators	Student –Respondents			Faculty/ Staff/ (LDS &ZDS)	Both	
	College (MSU, LDS)	High School (Esperanza, ZDS)	Elementary (Labangan, ZDS			
	Mean	Mean	Mean	Mean	Average Weighted Mean	Adjectival Meaning
1. I would eat it at every opp**o**rtunity I had	4.97	4.97	5.00	4.71	4.91	Strongly Agree
2. I would eat this very often	4.97	4.97	5.00	4.32	4.82	Strongly Agree
3. I would frequently eat it	4.76	4.67	5.00	4.26	4.67	Strongly Agree

Legend: 4.51 – 5.00 - Strongly Agree 3.51 – 4.50 - Agree 2.51 – 3.50 -Neither Agree nor Disagree
1.51 – 2.50 - Disagree 1.00 - 1.50 - Strongly Disagree

Table 4 continued…

Indicators	Student –Respondents			Faculty/ Staff/ (LDS &ZDS)	Both	
	College (MSU, LDS)	High School (Esperanza, ZDS)	Elementary (Labangan, ZDS			
	Mean	Mean	Mean	Mean	Average Weighted Mean	Adjectival Meaning
4. I like it and would eat it now and then	4.76	4.77	5.00	4.58	4.78	Strongly Agree
5. I would eat it if available but would not go out of my way	3.93	4.03	4.56	4.29	4.20	Agree
6. I do not like it but would eat it on an occasion	3.34	3.37	4.16	3.81	3.67	Agree
7. I would hardly ever eat it	3.17	3.23	4.00	3.77	3.54	Agree
8. I would eat it only if there were no other food choices	3.24	3.3	3.94	3.84	3.58	Agree
9. I would eat it only if I were forced to	3.14	3.23	3.94	3.52	3.46	Neither Agree nor Disagree

Legend:

4.51 – 5.00	-	Strongly Agree
3.51 – 4.50	-	Agree
2.51 – 3.50	-	Neither Agree nor Disagree
1.51 – 2.50	-	Disagree
1.00 - 1.50	-	Strongly Disagree

Acceptability of SBFPs is significantly associated with its appearance, (Chi-square=14.592, $p<0.01$), taste, (31.754, $p<0.01$), aroma (18.207, $p<0.01$), and texture (14.728, $p<0.01$) (Table 5). This confirms that SBFP's suitable sensorial attributes play an important role in its acceptance. This is in agreement with Jonas (2016) assertion that products' acceptance depends on their attributes and Deroy et al (2015) that an alternative sensorial-driven strategy, stands a much greater chance of making people eat insects on a regular basis. Capponi (2015) noted that consumers might be less resistant when introduced to the sweet varieties of insect based food.

Table 5a. _Average scores of SBFP's sensorial attributes as rated by the consumers

SBFPs	Sensorial Attributes					*F*-value	*p*-value
	Appearance	Taste	Aroma	Texture	Overall impression		
						4.232	0.009*
Super Chocolate Muffins	4.52[a]	4.53[a]	4.36[a]	3.96[a]	4.34[a]		
Super Brownies	4.70[ab]	4.64[ab]	4.41[ab]	3.93[ab]	4.42[ab]		
Super Chantilly Lace	4.49[a]	4.40[a]	4.03[a]	4.11[a]	4.26[a]		
Super Cookies with raisins	4.29[b]	4.28[b]	3.89[b]	3.20[b]	3.92[b]		
Super Oatmeal Cookies	4.39[ab]	4.34[ab]	3.87[ab]	3.26[ab]	3.97[ab]		
Super Binangkal with Malunggay	4.19[b]	4.05[b]	3.80[b]	3.80[b]	3.96[b]		

Values are means, where 1 = totally dislike and 5= totally like. Different letters within a column indicate a statistically significant difference (p = 0.05, one-way ANOVA).
*means significant

Table 5b. SBFP's attributes and multisensory characteristics as rated by the consumers

Indicators	Student -Respondents				*F*-value	*p-value*
	College (MSU, LDS)	High School (Esperanza, ZDS)	Elementary (Labangan, ZDS	Faculty/ Staff/ (LDS &ZDS)		
	n=29	n=30	n=32	n=24		
Super Chocolate Muffins					2.130	0.127
Appearance	4.24[a]	4.83 [a]	4.75 [a]	4.26 [a]		
Taste	4.14[a]	4.63 [a]	4.66 [a]	4.68 [a]		
Aroma	4.14[a]	4.67 [a]	4.63 [a]	4.00 [a]		
Texture	3.86 [a]	3.80 [a]	4.66 [a]	3.48 [a]		
Super Brownies					3.494	0.033*
Appearance	4.24[ab]	4.87 [ab]	4.97 [ab]	4.71 [ab]		
Taste	4.59 [ab]	4.83 [ab]	4.63 [ab]	4.52 [ab]		
Aroma	4.31 [ab]	4.57 [ab]	4.84 [ab]	3.90 [ab]		
Texture	4.14 [ab]	3.50 [ab]	4.56 [ab]	3.52 [ab]		
Super Chantilly Lace					1.065	0.408
Appearance	4.03 [a]	4.83 [a]	4.84 [a]	4.23 [a]		
Taste	4.03 [a]	4.53 [a]	4.88 [a]	4.13 [a]		
Aroma	4.14 [a]	4.33 [a]	4.39 [a]	3.29 [a]		
Texture	4.17 [a]	4.57 [a]	3.97 [a]	3.77 [a]		
Super Cookies with raisins					2.316	0.105
Appearance	3.97[b]	4.63 [b]	4.59 [b]	3.94 [b]		
Taste	3.69 [b]	4.57 [b]	4.63 [b]	4.19 [b]		
Aroma	3.97 [b]	4.47 [b]	4.28 [b]	2.87 [b]		
Texture	3.93 [b]	2.57 [b]	3.91 [b]	2.39 [b]		
Super Oatmeal Cookies					4.342	0.016*
Appearance	3.79 [ab]	4.73 [ab]	4.53 [ab]	4.45 [ab]		
Taste	4.00 [ab]	4.57 [ab]	4.28 [ab]	4.48 [ab]		
Aroma	4.00 [ab]	3.93 [ab]	4.03 [ab]	3.52 [ab]		
Texture	3.83 [ab]	2.17 [ab]	3.97 [ab]	3.06 [ab]		
Super Binangkal with Malunggay					2.498	0.087
Appearance	3.90 [b]	4.97 [b]	4.06 [b]	3.84 [b]		
Taste	3.76 [b]	4.83 [b]	3.59 [b]	4.03 [b]		
Aroma	3.69 [b]	4.27 [b]	3.75 [b]	3.52 [b]		
Texture	3.93 [b]	4.33 [b]	3.69 [b]	3.29 [b]		

Values are means, where 1 = totally dislike and 5= totally like. Different letters within a column indicate a statistically significant difference (p = 0.05, one-way ANOVA).
*means significant

Table 6. Consumer demographics and SBFPs sensorial attributes associated with acceptability of SBFPs

Correlation	Chi-square (χ^2) χ^2) value	*p*-value	Remarks
Consumer Demographics			
Age	11.788	0.067	Not significant
Gender	2.270	0.518	Not significant
Household Size	5.612	0.468	Not significant
Tribe	11.520	0.242	Not significant
Health Considerations In Food Choices	2.639	0.853	Not significant
Food Neophobia	3.813	0.702	Not significant
Familiarity of Eating insects	3.809	0.702	Not significant
Previous Experience with Edible Insects	7.344	0.290	Not significant
SBFP's Attributes			
Appearance	14.592	0.006*	Significant
Taste	31.754	0.000*	Significant
Aroma	18.207	0.001*	Significant
Texture	14.728	0.005*	Significant

*means significant at 0.05 level of significance

Conclusion

The results of this study indicate the importance of quality and strategy in promoting Superworm-based food products. Its acceptability is highly dependent on its appearance followed by taste, aroma, and texture deemed pleasurable, desirable, and appealing to the consumers. Consumers found it appealing when the Superworm appearance is concealed, transformed, and incorporated into well-known and accepted tasty and aromatic products like chocolate muffins, Chantilly lace, brownies, and oatmeal cookies. Thus, products' sensorial attributes are significantly associated with their acceptability. However, consumer demographics like health considerations for food choice, familiarity, and previous experience with edible insects do not significantly affect consumers' acceptability of Superworm-based food products. This suggests that awareness of the nutrient content of edible insects; e.g. high protein content, low in cholesterol does not guarantee its acceptability. And that when people have tried eating the product for the first time, it does not automatically denote acceptance, but rather motivation without reinforcement through the products' multi-sensory characteristics. Considering the novelty of the product, there is a need for continuous strategic educational campaigns and promotions.

The super brownies significantly differed from all products and was the most accepted product among pupils, students, faculty, and staff. This result can guide Superworm-based product specialization strategies. For instance, the product that is to be promoted through school canteens in different educational levels. Especially that consumers showed favorable attitude and action-oriented index of acceptance that they would eat the same products whenever available. In this consideration, there is a need to study marketing strategies. For example, the social obligation of labelling the products to inform the consumers with the presence of insects that can bring about allergic reactions similar to crustaceans (shrimps, crabs, and other relatives of insects). Hence, there is a need to obtain certification of safety. There is also a need to determine the packaging, the price of the product whether affordable and competitive along with the willingness to pay among consumers.

Nonetheless, acceptance test should not only be limited to schools but should be extended in the poverty-stricken villages, where malnutrition (low protein) intake among children is prevalent. With this, there is a need to innovate

on and develop food products that cater village type of recipes as viand for family meals particularly those living in the hinterland or far-flung areas.

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