Consumer Acceptance of Sustainable Insect-Based Food Product Packaging with Eye Tracking and Emotion Tracking Technologies

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Introduction

- The human population is predicted to reach nine billion people by 2050 (United Nations, 2019), increasing demand for food and putting a strain on natural resources and the food supply.
- Compared to traditional animal sources, insects are more sustainable because they require less use of natural resources such as water and land, and produce less greenhouse gas emissions (Rumpold & Schluter, 2013; van Huis et al., 2013; Dossey, Morales-Ramos, & Guadalupe Rojas., 2016).
- Consumer hesitation toward insect consumption may be due to the perception of insects as disgusting (La Barbera, Verneau, Amato, & Grunert, 2018; Lammers, Ullmann, & Fiebelkorn, 2019; Woolf et al., 2019) and an unfamiliarity with insects as a food source (Hartmann, Shi, Giusto, & Siegrist, 2015; Lammers et al., 2019; Tan, van den Berg, & Stieger, 2016).
- Eye tracking has been used on a wide variety of food product packages to study consumer attention, perceived importance of packaging aspects, and perceived similarities/differences between the products presented (Varela et al., 2014; Hazuchová et al., 2018; Motoki et al., 2021; Puerta et al., 2022).
- Cluster segmentation was used to identify and characterize early adopters of edible insects (Rovai et al., 2021).
  1. No-thank-you's: unwilling to consume insects in any form.
  2. Hideaways: only willing to consume insects if they are nonvisible.
  3. Daredevils: willing to try insects in any form.
  4. Peekaboo's: willing to consume insects in most forms.

Objectives

The objectives of this consumer acceptance study were to (1) evaluate insects as a sustainable food ingredient, (2) assess the effect of sustainability messaging, and (3) determine the relationship between emotional response and visual assessment related to consumer acceptance of products containing edible insects.

Materials & Methods

Entomophagy Questionnaire
- Participants segmented into clusters

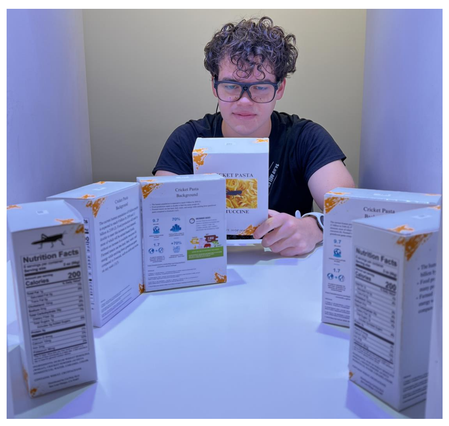
Product Acceptability Questionnaire
- Pasta Test (Pre Intervention)

Intervention
- Interview (Pre Intervention)
- Package Acceptability Questionnaire (with glasses and wristband)

CL	Cricket image "C"	Long message "L"	Text only
CLI	Cricket image "C"	Long message "L"	Text+image "I"
CS	Cricket image "C"	Short message "S"	Text only
CSI	Cricket image "C"	Short message "S"	Text+image "I"
L	No cricket image	Long message "L"	Text only
LI	No cricket image	Long message "L"	Text+image "I"
S	No cricket image	Short message "S"	Text only
SI	No cricket image	Short message "S"	Text+image "I"

- Interview (Post Intervention)

Product Acceptability Questionnaire
Pasta Test (Post Intervention)



Scan here to see packages.

Cricket Control

Results - Demographics and Segmentation

- The study population (n = 74) was primarily female (64%), in the 18-24 age range (49%), with normal vision (77%), White or Caucasian (62%), with some college (31%) or a Bachelor's Degree (30%).

Table 1. Cluster assignment counts and percentages.

Cluster Label	Count	% Respondents
No Thank-You's	2	3%
Hideaways	41	55%
Daredevils	13	17%
Peek-a-boo's	14	19%
Flat	5	7%

Results - Cricket Pasta Acceptability

Table 2. Insect detection response percentage for "Which pasta contains insects?" in Post Intervention Pasta Questionnaire.

Sample	Total %	Hideaways %	Peek-a-boo's %	Daredevils %
Control Pasta	19 B	17 B	25	27
Cricket Pasta	81 A	83 A	75	73

Different letters within a row indicate significant differences ($p<0.05$) between the clusters.

- When comparing Pre and Post Intervention pasta hedonics for Total Population, there was a significant difference for cricket pasta aroma with Pre Intervention having a higher rating.
- There was a significant difference between Pre and Post Intervention for cricket pasta appearance in Hideaways with Pre Intervention having a higher rating.

Table 3. Delta emotions for pasta acceptance test.

Sample	Cluster	Intervention	Adventurous	Calm	Good	Good Natured	Joyful	Mild	Pleasant	Warm
Control Pasta	T	Pre	-13B	0	7	0	-3B	-1	16A	1
		Post	1A	-1	0	-9	6A	-1	1B	0
	H	Pre	-16B	0	8	0	-3B	8A	21A	0
		Post	3A	0	-5	-3	8A	-8B	-3B	-3
	P	Pre	-8	0	0	8A	0	-33B	8	8
		Post	8	-17	8	-25B	0	17A	-8	0
	D	Pre	-17	0	0	-8	0	0	8	0
		Post	0	0	8	-8	0	8	17	8
Cricket Pasta	T	Pre	-7	13A	21A	-4	4	-6	6	3
		Post	-3	-10B	-1B	-1	-1	-6	6	11
	H	Pre	-13	16A	21A	0	0	0	3	-3
		Post	-5	-13B	-5B	-3	-3	-5	11	16
	P	Pre	0	33	33	0	8	-33	0	0
		Post	-8	0	8	-17	0	0	0	-17
	D	Pre	0	0	0	-25B	-8	0	25	17A
		Post	0	-8	8	17A	8	-17	0	-17B

Different letters within sample and cluster indicate significant differences ($p<0.05$). Only emotions that had significance from Pre to Post Intervention are shown. The 25 emotions used in the study include active, adventurous, aggressive, bored, calm, daring, disgusted, enthusiastic, free, good, good natured, guilty, happy, interested, joyful, loving, mild, nostalgic, pleasant, satisfied, secure, tame, understanding, warm, wild, and worried.

Results - Packages

Table 4. Package hedonics where 1 = Most Preferred and 6 = Less Preferred.

Package	Cluster	Cricket Language Hedonic	Cricket Language Amount Hedonic	Cricket Imagery Hedonic	Cricket Imagery Amount Hedonic	Sustainability Messaging Hedonic	Sustainability Messaging Length Hedonic	Sustainability Messaging Content Hedonic
CL	T	5.18CD	5.17BC	4.01B	4.07B	5.80B	5.17C	6.2BC
	H	4.95B	4.99BC	3.59	3.75B	5.81DE	5.13BC	6.24BC
	D	5.23	5.19	4.31	4.29	5.11B	4.03B	5.66
CLI	T	5.38CD	5.65ABC	4.43A	4.73A	7.11A	6.26AB	7.16A
	H	5.13B	5.36ABC	3.93	4.31A	6.93 AB	5.93ABC	7.09AB
	D	5.69	5.53	5.23	5.13	7.11A	6.41AB	7.16
CS	T	4.98D	4.95C	4.1AB	4.26B	5.65B	5.72ABC	6.22BC
	H	4.98B	4.78C	3.75	3.90AB	5.66E	5.67ABC	6.42ABC
	D	5.36	5.63	4.78	4.84	5.43B	5.56AB	6.11
CSI	T	5.79ABC	5.65ABC	4.32AB	4.41AB	6.91A	6.44AB	6.85AB
	H	5.63AB	5.50ABC	3.85	4.11AB	6.89ABC	6.40AB	6.91ABC
	D	6.57	6.01	5.22	4.89	7.44A	7.18A	7.23
L	T	5.45CD	5.42ABC	4.01B	4.07B	6.00B	5.18C	6.20BC
	H	5.18B	5.15ABC	3.59	3.75B	5.87CDE	4.75C	6.16C
	D	5.23	5.50	4.31	4.29	6.43AB	5.84AB	6.33
LI	T	6.35A	6.07A	4.43A	4.73A	6.82A	6.07ABC	7.06A
	H	6.23A	5.77AB	3.93	4.31A	6.74ABCD	6.10AB	7.12A
	D	6.79	7.29	5.23	5.13	6.85AB	6.06AB	7.04
S	T	5.62BCD	5.74AB	4.10AB	4.26B	5.96B	5.59BC	6.05C
	H	5.32B	5.35ABC	3.75	3.90AB	5.94 BCDE	5.76 ABC	6.27ABC
	D	5.45	5.66	4.78	4.84	6.29AB	5.07AB	6.07
SI	T	6.15AB	6.15A	4.32AB	4.41AB	7.10A	6.58A	7.07A
	H	5.77AB	6.00A	3.85	4.11AB	7.10A	6.44A	7.12A
	D	6.69	6.25	5.22	4.89	7.11A	7.06A	7.40

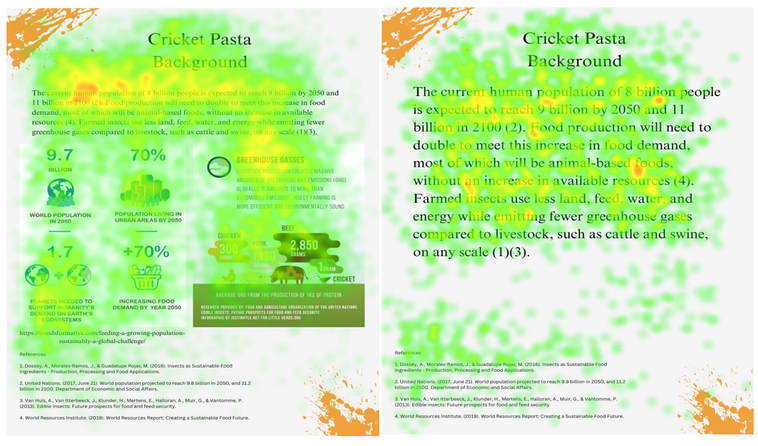
Results - Packages

Table 5. Delta emotions for package acceptance test.

Package	Cluster	Active	Calm	Mild	Pleasant
CL	T	6	-21B	-13AB	-5A
	H	6	-21B	-13AB	-5AB
	P	0	5	1	-2
	D	-14B	-15	0	-7
CLI	T	-3	-3AB	8AB	-1AB
	H	-3	-3AB	8AB	-1AB
	P	-12	5	4	-12
	D	0AB	9	8	0
CS	T	4	12A	-6AB	-1AB
	H	4	12A	-6AB	-1AB
	P	0	10	-1	0
	D	11AB	14	13	-1
CSI	T	-1	12A	7AB	9AB
	H	-1	12A	7AB	9Ab
	P	-2	-35	-6	1
	D	-5AB	11	-2	5
L	T	1	-14AB	10A	-21B
	H	1	-14AB	10A	-21B
	P	0	-3	-12	-1
	D	-11AB	14	18	-23
LI	T	6	13A	-14AB	10AB
	H	6	13A	-14AB	10AB
	P	0	-25	-18	-11
	D	1AB	15	-9	22
S	T	-1	-3AB	-20B	6AB
	H	-1	-3AB	-20B	6AB
	P	2	-9	12	17
	D	-8B	-17	-9	-8
SI	T	-1	12A	3AB	13A
	H	-1	12A	3AB	13A
	P	10	3	-9	19
	D	24A	-20	15	-1

Different letters within sample and cluster indicate significant differences ($p<0.05$). Only emotions that had significance from Pre to Post Intervention are shown. The 25 emotions used in the study include active, adventurous, aggressive, bored, calm, daring, disgusted, enthusiastic, free, good, good natured, guilty, happy, interested, joyful, loving, mild, nostalgic, pleasant, satisfied, secure, tame, understanding, warm, wild, and worried.

Image 1. Heat maps for Long Message with Related Image and Long Message without Related Image from Tobii Pro Lab.



Conclusions

- Hideaways had the highest percentage of participants who correctly identified which pasta sample contained insects.
- Messaging through text and related image had participants paying greater attention to the back of package.

References

Scan below to view references used along with a digital copy of this poster and abstract.

Acknowledgments

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