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EFFECT OF FRUIT ORIGIN ON CONSUMERS' CONSCIOUS AND UNCONSCIOUS ASSESSMENT OF QUALITY AND PURCHASE INTENTION

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Abstract. Recently, researchers have developed an interest in the analysis of emotional responses to food. For this reason, the use of implicit (non-verbal) measures to assess consumer response is increasing. In this research, the objective is to find out if there were differences in consumer response (conscious and unconscious) to melon of various origins: Spain, Morocco and Brazil. To do this, we used the biometric measures (Electroencephalography (EEG) and Skin Conductance Response (SCR)) and questionnaires to assess various melon attributes. The results reveal that consumers do not respond differently to fruit from different origins, either consciously or unconsciously.

Keywords: Neuroscience; Electroencephalography (EEG); Skin Conductance Response (SCR); food; emotional response; consumer behaviour.

JEL Classification: C91; D12; D87; D91; M31.

Introduction

Recently, researchers have developed an interest in the analysis of emotional responses to food. The use of a questionnaire (verbal response) does not always reflect what the consumer thinks. Sometimes, social desirability or an afterthought process can change the consumer's first impression of the food (Verastegui-Tena et al., 2018). For this reason, the use of implicit (non-verbal) measures to assess consumer response is increasing as it can provide a more holistic view of the reactions to food (Walsh et al., 2017).

Faced with a stimulus, the person has very fast mechanisms of which he or she is not aware. The implicit measurements can reflect them (Lebens et al., 2011). Furthermore, there are studies which show the relationship between them and consumer's decisions. On one hand, previous studies suggest that emotional responses toward food or beverage products are associated with purchasing behaviour (Songa et al., 2019; Spinelli et al., 2015). On the other hand, recent studies also demonstrate that emotional responses to food or beverage products can provide crucial information under both blind and informed tasting-conditions (Kenney & Adhikari, 2016; Schouteten et al., 2017).

In this research, we tried to find out if there were differences in consumer response (conscious and unconscious) to melon of various origins. Research on country-of-origin labelling has systematically assessed whether the national origin of a product alters evaluations and preferences towards products (Gineikiene et al., 2016; Hu & Wang, 2010; Laforet & Chen, 2012). Although traditional research techniques, such as surveys or focus groups, can provide information about the influence of the origin on the purchasing process, taking into account the implicit measures can improve the data collected (Casado-Aranda et al., 2020; Dagger & Raciti, 2011).

To do this, we used the biometric measures of Electroencephalography (EEG) and Skin Conductance Response (SCR). Both are neuro-research techniques. The former measures brain activity and the latter the skin conductance, i.e. the measure of how electricity is conducted through the skin (Smith et al., 2019). In addition to these measurements, we used questionnaires

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to assess various sensory attributes of the melons. Finally, we asked them about overall liking and purchase intention.

All this information has implications when preparing the fruit to the market and adapting it to the consumer. As we learn more about consumers, we can better tailor products and marketing strategies to their preferences. Implicit measures complement the information collected so far with the usual techniques (Meyerding & Mehlhose, 2020).

Therefore, the research objective is to find out if there were differences in consumer response to melon of different origins. The aim is threefold: i) check whether there are significant differences according to origin from the data collected with the implicit measures; ii) check whether there are significant differences according to origin based on the data collected with the explicit measures; and iii) to propose marketing strategies that could be developed in the fruit industry according to the results obtained.

The paper is structured as follows. First, material and methods are explained. Then, we present the results obtained. Next, we discuss them in order to offer new insights to the fruit sector and, finally, the conclusions are drawn.

1. Material and methods

1.1. Participants

Participants were recruited among the staff and students of the Universitat Politècnica de València by means of an online questionnaire. For participating, they received a reward for their time. The sample consisted of 95 people (50 women and 45 men) aged between 19 and 70 years old.

Exclusion criteria included having a neurological disorder, psychotropic use and being left-handed to obtain adequate implicit measures. Right-handed participants are typical for EEG studies because cortical hemispheric specialization is different for left-handed individuals (Walsh et al., 2017).

1.2. Samples and sample preparation

Three samples of commercial varieties of melon were used in this study. Each sample was identified with a three-digit code and was from three different origins: Spain, Morocco and Brazil. The samples were served cut into thin slices to evaluate the flavour, together with a freshly cut piece to evaluate the aroma at room temperature, both on a medium white plate of 20 cm.

1.3. Electroencephalography

Brain activity was measured using electroencephalography. Raw EEG data was acquired at a sampling rate of 500 Hz through iMotions, version 9.3 (Copenhagen, Denmark: iMotions A/S, 2022) with Enobio 8 (Neuroelectrics, Barcelona, Spain) device with a forehead setup. This setup consisted of a headband with 6 channels arranged according to the international 10/20 system in the orbitofrontal, F8 and F7, prefrontal, AF7 and AF8, and frontopolar, Fp1 and Fp2, areas.

To place it on the participant, first the forehead was cleaned with 96% ethanol, a small amount of conductive gel was applied on the semi-dry AgCl electrodes (Neuroelectrics, Barcelona, Spain) specifically designed to measure brain activity in the frontal area. Finally, the headband was adjusted to the participant's head avoiding any hair between the electrodes and the skin.

This setup was used because the aim of the experiment was to measure only the brain activity of the frontal lobe cortex of both cerebral hemispheres in order to subsequently calculate frontal alpha asymmetry (Alpha variable) as an indicator of approach or withdrawal to the stimuli presented (Briesemeister et al., 2013; Coan & Allen, 2003).

1.4. Skin Conductance Response

Skin Conductance Response (SCR, unit: mSiemens) was measured at a sampling rate of 128 Hz using a SHIMMER™ sensor (SHIMMER™, Dublin, Ireland), and raw data was collected using iMotions, version 9.3 SCR module. The Shimmer SCR sensor consists of two pregelled electrodes placed on the hypothenar and thenar eminences of the palm of the non-dominant hand of each participant.

The participant was instructed to keep hand movements to a minimum and was discouraged from talking throughout the study. The variables obtained from the SCR are peak counts, peaks per minute and average peak amplitude.

1.5. Sensory analysis

The tasting session was carried out by means of the tasting sheet, which made it possible to establish the sensations conveyed by the fruit during the sensory analysis (Baxter et al., 2005). Each tasting session was divided into three different parts, in which the visual, olfactory and gustatory phases were evaluated (Chen & Nussinovitch, 2001; Piombino et al., 2013). In each of the phases, a positive and a negative evaluation was made in order to have a complete characterization of the melon (Lotong et al., 2003).

The sensory attributes were organized as follows: i) visual: appearance and pulp colour; ii) odor: fruity, fermented and negative aromas; iii) flavour: sweet, acid, cucumber, fermented and negative taste, juiciness and stringiness. For every sensory attribute, participants were asked in 2 different ways: i) the assessment of the attribute from 1 (low intensity of the attribute) to 9 (high intensity of the attribute), and ii) the liking of that attribute in a 5-point Just-About-Right (JAR) scale.

Finally, participants evaluated the overall liking of the melon and the purchasing intention in a scale from 1 (low) to 9 (high).

1.6. Overview of the design

In order to carry out the experiment, procedures similar to those described in the studies elaborated by Samant & Seo (2020) and Brouwer et al. (2017) were followed and adapted.

After arranging a two-hour appointment and obtaining informed consent, the EEG and SCR setup and electrode application began, which took about 15 minutes for each participant. The two SCR electrodes were attached first, followed by the EEG headband. The trained lab technician was responsible for covering and calibrating the machine. The participants were instructed to sit in front of the video screen and minimise movement to ensure the quality of the SCR and EEG recordings.

Each participant's session began with baseline EEG/SCR recordings with water. Then, the sample was served and each participant was asked to evaluate the visual appearance and the aroma of the sample by smelling it. EEG and SCR responses were measured for 20 s while each participant smelled the sample (a "smelling" time window) and for 20 s after smelling the sample (a "after smelling" time window).

Finally, each participant had to put two slices of melon in his or her mouth and hold them in his or her mouth to evaluate the taste of the sample. EEG and SCR responses were measured for 20 s (a "tasting" time window), then, he was instructed to chew and swallow the sample and to rest for 20 s (a "after tasting" time window).

After each sample, participants were asked to complete a questionnaire with sensory attributes, as described in section 1.5, overall liking and purchase intent. A one-minute break was given between sample presentations. Three melon samples were presented in a randomized sequential monadic fashion. All participant's instructions were given through the software iMotions, version 9.3 (Copenhagen, Denmark: iMotions A/S, 2022) and a moderator quietly sat at the back of the room, controlled the computer monitor where participant saw the instructions and provided the samples that the software instructed it to present to the participant.

After tasting all three samples, each participant was given a 2-min break, after which she/he was asked to see, again the three melon samples together and given the option of re-tasting any of the samples. The aim of this activity was to emulate purchase decision-making situations consumers might encounter in real-life scenarios. After re-evaluating the samples, the participant was asked which one he/she would buy and the reasons for his/her choice.

1.7. Statistical analysis

The biometric measures were referred to their corresponding baseline in each stage, i.e., smelling, after smelling, tasting, after tasting. We computed the difference between the measure for each sample and the measure taken on the control sample. These data were tested by one-way analysis of variance (ANOVA) to assess whether there were main effects due to the country of origin perceived.

The sensory evaluations were tested to assess whether there was any dependence due to the perception of origin country of the sample. We performed three different tests, depending on the kind of variable. The majority of tests were one-way ANOVA. This was the case of *Appearance Assessment* variable.

We also performed Pearson's Chi-squared test upon the dichotomic variables, such as *Fermented Aroma Perception*. Finally, there were some questions which were not responded by all the consumers. In these cases, due to the sample size and the lack of normality, Kruskal-Willis tests were performed, as it was the case of *Fermented Aroma Assessment* variable.

2. Results

Table 1 shows the results for the implicit measures performed. In total, we have 16 variables. The 4 implicit measures (Alpha, peak counts, peaks per minute and average peak amplitude) determined at different moments during the tasting session (at the moment of smelling the melon, after smelling, at the moment of tasting the fruit and after tasting).

ANOVA was used to assess whether there were main effects due to the country of origin. The results show that there are not significant differences for any variable.

Table 1. Implicit measures for the different stages designed (source: own elaboration)

	Stage	Measure	Test	Statistic	p-value
1	Smelling	EEG: Alpha	One-Way Variance	0.230	0.792
2	Smelling	SCR: peak counts	One-Way Variance	0.340	0.715
3	Smelling	SCR: peaks per minute	One-Way Variance	0.340	0.715
4	Smelling	SCR: average peak amplitude	One-Way Variance	1.040	0.356
5	After Smelling	EEG: Alpha	One-Way Variance	0.030	0.967
6	After Smelling	SCR: peak counts	One-Way Variance	2.680	0.070
7	After Smelling	SCR: peaks per minute	One-Way Variance	2.690	0.070
8	After Smelling	SCR: average peak amplitude	One-Way Variance	0.020	0.983
9	Tasting	EEG: Alpha	One-Way Variance	0.280	0.755
10	Tasting	SCR: peak counts	One-Way Variance	0.050	0.954
11	Tasting	SCR: peaks per minute	One-Way Variance	0.050	0.952

End of Table 1

	Stage	Measure	Test	Statistic	p-value
12	Tasting	SCR: average peak amplitude	One-Way Variance	0	0.999
13	After Tasting	EEG: Alpha	One-Way Variance	0.190	0.829
14	After Tasting	SCR: peak counts	One-Way Variance	0.280	0.754
15	After Tasting	SCR: peaks per minute	One-Way Variance	0.290	0.750
16	After Tasting	SCR: average peak amplitude	One-Way Variance	0.040	0.966

Table 2 shows the results for the explicit measures performed. In total, we have 24 variables for the visual, olfactory and gustatory phases, overall liking and purchasing intention.

Different tests were used to assess whether there were main effects due to the country of origin. The results show that there are not significant differences for any variable.

Table 2. Explicit measures for the different sensory attributes (source: own elaboration)

	Measure	Test	Statistic	p-value
1	Appearance assessment	One-Way Variance	1.160	0.316
2	Appearance liking	One-Way Variance	0.150	0.864
3	Pulp color assessment	One-Way Variance	0.350	0.707
4	Pulp color liking	One-Way Variance	0.100	0.902
5	Fruity aroma assessment	One-Way Variance	2.900	0.056
6	Fruity aroma liking	One-Way Variance	2.010	0.136
7	Fermented aroma perception	Chi-squared test	1.390	0.498
8	Fermented aroma assessment	Kruskal-Wallis Test	1.450	0.484
9	Negative aroma perception	Chi-squared test	1.090	0.580
10	Sweet taste assessment	One-Way Variance	0.140	0.867
11	Sweet taste liking	One-Way Variance	0.470	0.624
12	Acid taste assessment	One-Way Variance	0.120	0.890
13	Acid taste liking	One-Way Variance	0.220	0.799
14	Cucumber taste perception	Chi-squared test	0.040	0.981

End of Table 2

	Measure	Test	Statistic	p-value
15	Cucumber taste assessment	Kruskal-Wallis Test	0.980	0.612
16	Fermented taste perception	Chi-squared test	1.020	0.601
17	Fermented taste assessment	Kruskal-Wallis Test	0.100	0.950
18	Negative taste perception	Pearson's Chi-squared test	1.130	0.569
19	Juiciness assessment	One-Way Variance	0.110	0.898
20	Juiciness liking	One-Way Variance	0.840	0.431
21	Stringiness assessment	One-Way Variance	0.150	0.865
22	Stringiness liking	One-Way Variance	0.210	0.810
23	Overall liking	One-Way Variance	1.160	0.314
24	Purchasing intention	One-Way Variance	1.310	0.270

After tasting the 3 samples, participants were asked which one they would purchase. Spain obtained the 50.48% of the answers, Morocco was chosen in the 25.71% of the cases and Brazil in the 23.81% left.

Table 3 shows the reasons for their selection. As participants could choose more than one answer, the sum is greater than 100%. Taste is the most preferred reason (69.52%), followed by aroma (27.62%) and origin (25.71%).

Table 3. Reasons for purchase of the sample finally chosen (source: own elaboration)

	Reason	Percentage
1	Aroma	27.62%
2	Taste	69.52%
3	Visual aspect (colour + defects)	21.90%
4	Origin	25.71%
5	Other	12.38%
	TOTAL	157.14%

3. Discussion

The use of implicit measures is increasingly being used to assess consumer reaction because it can offer a more complete view of the responses to food (Walsh et al., 2017). While it is true that this type of measure is being used in different products, it is not so common in fresh fruit. Although melon has been studied with the usual techniques (sensory and physico-chemical analysis) (Bianchi et al., 2016; Menezes Ayres et al., 2019), the use of implicit measurements is completely new.

The analysis of the effect of the country of origin has been studied in many products. International trade research postulates that, under certain circumstances, consumers prefer products made in their own country, regardless of their country-of-origin image. Specifically in the food sector, Gineikiene et al. (2016) discovered that consumers chose domestic products because they perceived them as healthier and more natural. The effect held across different samples and product categories (apples, tomatoes, bread, and yogurt).

Casado-Aranda et al. (2021) presented a neuroimaging experiment developed in Spain. The task combined low and high involvement goods marked with Domestic "Made in Spain" and Foreign "Made in USA" (similar culture) and "Made in China" (different culture) labels. The findings revealed that Domestic goods always convey neural rewarding sensations.

Brouwer et al. (2017) considered several stages during the cooking process, such as, exposure, frying, cooling and eating. They found significant differences in some of these moments while cooking chicken or mealworms.

In our case, as we did not find significant differences for any of the 40 variables analysed, our results are not consistent with those of previous studies. This may be due to two reasons. First, because of the type of fruit involved. Secondly, an average quality was sought for the samples. The positive part is that the information provided by the implicit and explicit measures coincide. Therefore, no social desirability or an afterthought process modifying the consumer's opinion is observed (Telpaz et al., 2015).

However, 50.48% of the consumers selected the sample from the country of origin (Spain). When asked about the reasons for purchase selection, taste came first (69.52%). This is in line with previous studies on other fruits (Baviera-Puig et al., 2021, 2023). Aroma is in second position (27.62%) and origin in the third one (25.71%). Although first sensory contact with food is mostly through the eyes (Wadhera & Capaldi-Phillips, 2014; Zhou et al., 2022), the visual aspect is the fourth reason (21.90%).

All the data collected can help us when preparing the products for the market in order to adapt them to the consumer. As a result, we can deduce that our consumers didn't hide information about their true preferences (Lim, 2018; Plassmann et al., 2012). In all the stages considered, there were not significant differences for the implicit measures. For the explicit measures, there were not significant differences for the melon sensory attributes. Thus, the origin does not influence the valuation and purchase decision of melons. Therefore, when it comes to communicating melons, this variable is not relevant. However, consumers do appreciate the taste and aroma when making their choice. Consequently, consumer preferences should be analysed in order to adapt the taste of melons to them.

As future lines of research, other experiments can be considered in which another variable is analysed, for example, the price of melon using implicit and explicit measures. To better understand the consumer's selection process, multi-criteria decision models, such as AHP, can also be developed to further investigate the importance given by the consumer to each of the melon sensory variables. Another possibility is to carry out the same experiment with another fruit to compare the results.

Conclusions

In this research, we tried to find out if there were differences in consumer response (conscious and unconscious) to melon of various origins.

First, we checked whether there were significant differences according to origin from the data collected with the implicit measures. The results show that there are not significant differences for any of the 16 variables analyses. The variables were collected using EEG and SCR in different stages of the experiment (smelling, after smelling, tasting and after tasting).

Second, we checked whether there were significant differences according to origin based on the data collected with the explicit measures. The results show that there are not significant differences for any of the 24 variables analyses. These variables correspond to the measurement of sensory attributes of melons by means of questionnaires.

Finally, we wanted to propose marketing strategies that could be developed in the fruit industry according to the results obtained. In this case, we can deduce that the origin has no effect on the consumer's conscious or unconscious assessment of the fruit. On the contrary, they give more importance to taste and aroma when making their purchasing decision. This must be taken into account at the time of harvesting the fruit so that both attributes are adapted to the consumer's tastes.

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Contribution

Amparo Baviera-Puig: conception and design of the work and drafting the article; Tomás Baviera: analysis and interpretation of data; Carmen Escribá-Pérez: acquisition of data; Juan Buitrago-Vera: acquisition of data and revising it critically for important intellectual content.

Disclosure statement

Authors do not have any competing financial, professional, or personal interests from other parties. The authors report there are no competing interests to declare.

This study was approved by the Research Ethics Committee of the Universitat Politècnica de València (UPV) (approval no. P04_17_06_21). Informed consent was obtained from all subjects involved in the study.

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