

Exploring the attitudes of consumers towards a sustainable cactus-based paint (*Opuntia spp*)

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ABSTRACT

Sustainable products are alternatives to conventional products that encompass consumer needs, environmental protection, and health. In this context, the objective of this study was to evaluate the attitudes of consumers towards a sustainable product of cactus (*Opuntia spp*) based paint for a possible commercialization. The research consisted of several stages, among them are: 1) Preparation of the product; 2) Design of the measuring instrument and 3) Testing of the product. For stage 2, 212 surveys were applied, where besides knowledge and perception questions, valid scales in the literature of Domain Specific Innovativeness (DSI) and Health Consciousness (HCS) were considered. Stage 3 was performed with 32 people. With the information gathered, descriptive and bi-variant analyses were conducted. The findings showed that sociodemographic characteristics such as age, income, and marital status may influence consumer attitudes toward an innovative product such as cactus-based paint. Similarly, awareness, involvement, and health valuation positively influence consumer choices, which are key elements in consumer motivation when buying a sustainable product such as the cactus-based paint. Once the consumer was in direct contact with the product and after the corresponding correlated tests, the most valuable attributes among the participants were: hypoallergenic (4.66), sustainable (4.63) and color range (4.63). Overall, the results show that there is an interest from consumers to products that reduce environmental impact and take health into account. However, it is necessary to deliver to the consumer detailed product information for better acceptance and market success.

Keywords: Cactus product, consumer conduct, home paint.

INTRODUCTION

Environmental pollution is a serious health hazard in Mexico and around the world. It has been estimated that if countries reduce levels of pollution, they could reduce the number of deaths resulting from strokes, lung cancer, asthma, among other diseases. Obviously, the lower the

levels of air pollution are, the better health will be, regarding the diseases just named, not only in the long term, but also in the short term, according to the World Health Organization (WHO, 2016).

Among the various types of pollution, domestic lead exposure is progressive and is attributed to various sources, one of them wall paints with lead compounds, as well as toy paint or glazed ceramic kitchen pots (Rodríguez *et al.*, 2016). As a proposal to address this situation, alternatives have come up, such as sustainable paints used in green buildings. Among the characteristics of such products are the following: absence of plastic components in its formula, paint free of chemical synthesis (a possible contributor to the Sick Building Syndrome)¹ and a static electricity preventer, which means less dust, an element that affects people with allergies.

In this way, the demand for solvent-based paints is decreasing due to its high content of Volatile Organic Compounds (VOC) and strict regulations regarding its use (Markets and Markets, 2018). Water-based segment is expected to grow at a higher Compound Annual Growth Rate (CAGR) between 2017 and 2022, due to its organic nature and the trends in the purchase of ecofriendly products. Among the craft paints, the lime paint is a water-based type, whose water is a volatile or binder solvent and the slaked lime [Ca (OH)₂] produces the load and the pigment (Lozano, 2002). It is particularly suitable for interior painting, although it is also used for outdoors in the case of restorations.

Although the sustainable products alternative represents a feasible way to counter the negative impacts of the industrial products on the environment, the truth is that their acquisition and use are subject to the preferences and choices of consumers. It is for this reason that several studies have focused on studying the factors that influence the selection of a product. More particularly, some studies have related the consumer innovativeness (Domain Specific Innovativeness-DSI) with new food product adoption (Michon *et al.*, 2010; Barrena *et al.*, 2013; Terán *et al.*, 2015; Hung *et al.*, 2016; Salgado *et al.*, 2016, 2018) and the health consciousness (HCS) has focused on food and exercise (Droms *et al.*, 2009; Kaynak and Eksi, 2014). In both cases, no studies have been found analyzing DSI and HCS towards alternative home paint products.

Commercialization of lime paint is not extensive, being limited to homemade, where the knowledge in its development has been passed through generations, but as being considered unattractive for being colorless. In this research, cactus (*Opuntia spp.*) based paint was selected, where the raw material is available at the local and regional territory.

¹The Sick Building Syndrome (SBS) is a “Set of sicknesses caused by the contamination in the air and lack of ventilation in closed places, which produces in at least 20% of their occupants, symptoms such as, throat soreness or tightness; dry, itchy skin, or unexplained rashes; Itchy, irritated, dry, or watery eyes, headaches, tiredness and difficulty concentrating, frequent colds and unspecified hypersensitivity. These symptoms tend to disappear when one leaves the building” (INSH, 2008).

The total cactus pear production in Mexico, including fodder cactus, vegetable cactus (nopalitos) and tuna (fruit), is 1,502,315 metric tons per year with a planted surface of 76 thousand hectares (SIAP, 2018). Cactus pear is a plant that is produced in 27 states, where Mexico City, Morelos, San Luis Potosi, Jalisco, Aguascalientes, Hidalgo, and Puebla contribute with almost 95% of the national production (Anaya-Pérez and Bautista-Zane, 2008). Cactus pear is among the 27 crops with the largest cultivated area at national level and it is in 42nd place in economic production (SIAP, 2018).

It is a plant with nutritional and economic benefits. The cactus pear and tuna growers earn between USD\$3,162 and \$3,795 ha⁻¹ yr⁻¹, which represents six times more income than the producers of corn and beans earn in the same land space (SAGARPA, 2015). These economic characteristics are favorable to produce cactus pear. On the other hand, considering that the cactus-based paint is hypoallergenic and desertic regions like the one chosen for this study presents environmental and development conditions, such as extreme weather, scarce vegetation (that contributes to the generation of dust), urbanized areas (that increase pollution) and heat islands (that increase pollen production), that exacerbate allergies and asthma (Mendoza et al., 2001; Roa et al., 2009; Terán et al., 2009; García and Martínez, 2010; National Wildlife Federation, 2010; Mancilla et al., 2015) led to the study being carried out in the city of Caborca, Sonora, México. The research will analyze the attitudes of consumers towards a cactus-based paint. Attitudes are based in cognitive evaluations that can be heuristic or rational, supported by experience or knowledge (Argyriou and Melewar, 2011). The same way, the expected benefits play an important role in the consumer behavior. There are functional benefits and related benefits. The first ones are related with the tangible needs like quality, convenience, prices, and others. The second ones are associated with intangible benefits like the ones that result from the relationship established between the provider of the service and the consumer (Calvo-Porrá et al., 2015).

Accordingly, the objective of this study was to evaluate the attitudes of consumers towards a sustainable product of a cactus (*Opuntia spp.*) based paint. In this sense, this work tries to provide information in the understanding of consumer and his relationship with the innovativeness and health consciousness as also with the acceptance of sustainable products. Innovations are not only about invention, but also of taking knowledge previously acquired and combining it with skills and available resources, resulting in a modification of goods and services, making it more useful to the consumer (Arzak, 2011). There are different types of innovations: of the product, of the process, of marketing, technological and social. Bearing in mind the aim of the study, in this research "innovation" is of the marketing as well as of the process. The findings could be used for marketing strategies to attract more consumers and contribute to the development of local economies.

MATERIALS AND METHODS

Study area

The research was conducted in the Caborca County, Sonora, Mexico (Fig. 1) with a population of 85,631 inhabitants (INEGI, 2015). Caborca is a region whose main economic activity is based on agriculture, followed by mining, farming, and trade.

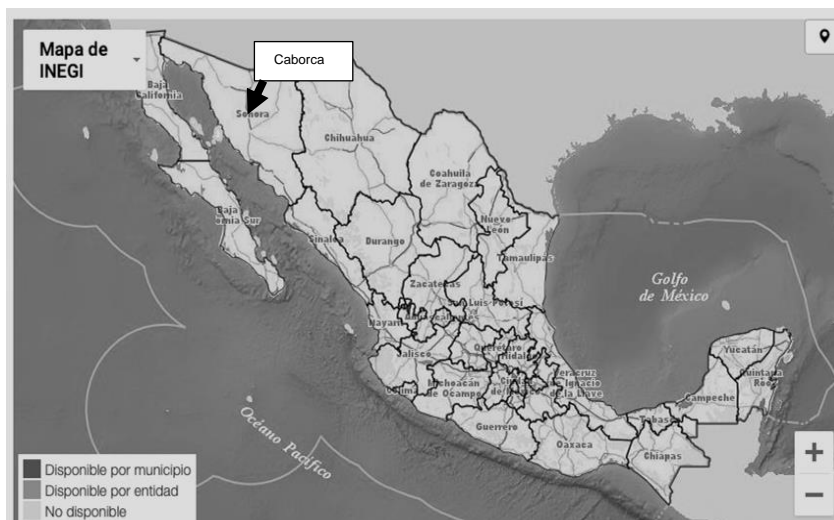


Figure 1. Location map of Caborca, Sonora, Mexico.

Source: INEGI (2018) <http://www.beta.inegi.org.mx/app/mapas/>

Design of the study

The study consisted of three phases: 1) Preparation of the product; 2) Design of the measuring instrument (survey application); and 3) Testing of the product.

The *Opuntia* genus belongs to the Cactaceae family and is well known as cactus pear plant or nopal (Sáenz *et al.*, 2004). It has several uses. One of the most common is the food like vegetables, where the Mexican *per capita* consumption is 6.4 kg (FAO, 2017). But its usefulness extends to several areas, like preparation of sweets, animal feed (Bravo-Hollins, 1978; Fischer and Turner, 1978), energy, medicine, cosmetics, agricultural products (Barbera, 1995) nutraceutical nutrition (Sáenz, 2002), diabetes control (Basurto *et al.*, 2006) and industrial uses (Sáenz *et al.*, 2004). The production in Sonora is 3,093.80 tons yr⁻¹ with 149 hectares planted (SIAP, 2018). *Opuntia* genus presents a great distribution and representativeness. There are over 200 species from Canada to Patagonia (Illoldi-Rangel *et al.*, 2012).

Regarding the species, *O. spinulifera* has not been completely documented and referenced in the scientific literature, therefore the records around its mucilage are scarce (Vargas *et al.*, 2016; Madera-Santana *et al.*, 2018). It can be easily identified by presence of adult trunks, ovate, piriform, or subcircular cladodes, the apex obtuse or acute, with whitish acicular spines, yellowish or straw base (Scheinvar *et al.*, 2011) (Fig. 2), produces xocnostle and it is one of the best ones for creating craft paints by generating greater fixation, with high viscosity and

abundance compared to other *Opuntia* and does not release fine powders (talcum) (Vargas-Rodríguez *et al.*, 2012; Vargas *et al.*, 2016). This extract has also shown improved water resistance when painting concrete (Chandra *et al.*, 1998). Vargas *et al.*, (2016) reported that the mucilage yield was 4.4%. The sowing of this crop in the County of Caborca is by backyard farming and there are no official records about it. This crop could be an alternative that the local grower must consider sowing by, not requiring large amounts of water.



Figure 2. *Cladodes*, fruit, and flower of the *O. spinulifera*

Source: Rodríguez G. (2018)

https://www.naturalista.mx/photos/16544996?fbclid=IwAR2YwpJV5Acud_l_tt9RCw5GxUJBQnHWskqIUoXwWkilitbe5nHvbp6TwEU

Preparation of the product

Experimental stage 1

Ingredients used according to Mora and Vargas (2015): lime (40%); grain salt (3.5%); liquid cactus adhesive (500 g) and 3 L of water to prepare 7 L of paint.

The method for mucilage extraction was as follows: initial cladodes cleaning with a solution of drinking water, cupric hydroxide, and chlorine (1: 5: 4 volume/volume/volume) for 2 min. Thorns were removed manually. The cuticle and the epidermis were removed with a knife, trying to recover as much of chlorenchyma and parenchyma, in which the largest number of cells that store the mucilage are found (Domínguez-Canales *et al.*, 2011). Then they were cut into longitudinal pieces of about 1 cm, liquified with a liter of water, and left to macerate for 12 h. Mucilage was filtered to remove the liquid from the solids (Fig. 3) in approximately 25 min. It was mixed with grain salt and lime, then left to macerate for 24 h.



Figure 3. Filtration of mucilage to remove the liquid from the solids (left). Mixture with grain salt and lime to macerate for 24 h (right).

The result was a lumpy consistency. Organic pigments in green and orange were then added. The green one belongs to the green series of copper phthalocyanine of the polycyclic pigment, and orange powder pigment is an isoindoline pigment (PY 139). It was then used to paint on 3 types of surfaces: brick, wood, and concrete block. To each material approximately 300 milliliters of paint were used. It was observed that once dry, the material released a light powder. The effect "talcum" is documented in other studies (Vargas-Rodríguez *et al.*, 2012).

Experimental stage 2

The same process described above was carried out. Only 700 g of cactus adhesive were added in 1 liter of water and left to macerate for 12 h. Organic pigments were added in green and orange powder (Fig. 4). They were applied to materials such as brick, wood, and concrete block. The color looked favorable on materials of brick and concrete block, while on wood material was not acceptable. The drying process took approximately from 20 to 30 minutes.

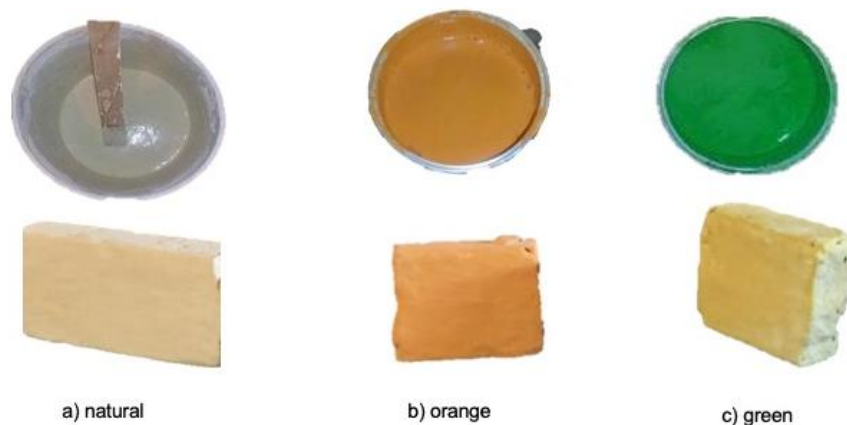


Figure 4. Pigment palettes and their application in brick.

Design of the measuring instrument (survey application)

In the first section of the survey, elements related to frequency and consumption habits were

included (Table 1).

In the second section, two scales were used: 1) Domain Specific Innovativeness (DSI) by Goldsmith and Hofacker (1991), which was adapted to sustainable products by Gurtner and Soyez (2016) (Table 2), and 2) the Health Consciousness Scale (HCS) by Gould (1988) (Table 3); both being measured on a five-point Likert scale.

Table 1. Items of the frequency of use and consumption habits of paints.

How often do you paint your house	Half-year	1 year	Between 1 and 2 years	Between 2 and 5 years			
Type of paint you use in the interior of house	Oil-based paint	Latex paint	Water paint	All	Other		
Type of paint you use in the exterior of house	Oil-based paint	Latex paint	Water paint	All	Other		
Place where you buy the paint	Paint shop	Supermarket	DIY store	Other			
Have you bought ecological paints in the last 5 years	Yes	No	Do not know				
Have you heard about cactus-based paint	Yes	No	Do not know				
Have you bought nopal-based paint?	Yes, where?	No	Do not know				
Reasons why you have not bought it	Ignorance of the product	The commercial unavailability	Marketing	Low quality	Short duration	Unpleasant appearance	Other
If cactus-based paint were available at paint shops would you be willing to buy it?	Yes	No	Why?				

Source: Own elaboration.

Table 2. Domain Specific Innovativeness Scale for sustainable products.

In general, I am among the first in my circle of friends to buy new ecological product when it appears.

If I heard that a new ecological product was available in the store, I would not be interested enough to buy it (R).

Compared to my friends, I own very little new ecological products.

In general, I am the last in my circle of friends to know the titles/brands of the latest new ecological products.

I do not like to buy new ecological product before other people do (R)

I will not buy a new ecological product if I have not heard/tried it yet (R)

(R) = Indicates reverse scored items. Source: Adapted by Gurtner and Soyez (2016).

In the case of DSI scale, as suggested by the authors, before completing any analysis, the corresponding scores to the items indicated with “R” must be inverted in order to obtain valuations, considering that the questions are asked in a negative sense. The author of the HCS scale tried to include the multifaceted nature of the concept with four sub-dimensions (i.e., health alertness, health self-consciousness, health involvement, and self-monitoring of one’s health) and comprises nine items. In the third section, sociodemographic items were asked such as age, civil status, monthly income level, sex, and scholar level.

Table 3. Health Consciousness Scale.

<i>1. Health alertness</i>
I am alert to changes in my health
I am usually aware of my health
<i>2. Health self-consciousness</i>
I reflect about my health a lot
I am very self-conscious about my health
I am generally attentive to my inner feelings about my health
<i>3. Health involvement</i>
I am constantly examining my health
I am very involved with my health
<i>4. Health self-monitoring</i>
I am aware of the state of my health as I go through the day
I notice how I feel physically as I go through the day

Source: Gould (1988).

Sample

For the application of the measuring instrument, consumers of the city of Caborca were selected from 18 to 65 years old. Sample size was calculated with INEGI (2015) data, establishing 212 surveys with a sample error of 5.65 and a confidence level of 95%.

Data collection

The data survey was conducted in the parking lot of various commercial establishments (supermarkets, and commercial businesses) in August 2017. The questionnaires were answered voluntarily, without any financial compensation, and had an average duration of 15 to 20 minutes.

Data analysis

For the data analysis, first, the internal consistencies of the scales were calculated by using the coefficient of Cronbach's alpha. A pilot survey was applied to 25 people, to debug the scale. Of the six items from the original DSI scale, three of them remained, with a Cronbach’s coefficient of 0.652. According to Nunnally (1967) and Hair *et al.* (2005) at the early stages of research, a reliability value of 0.6 or 0.5 may be enough. Just like in the original scale, the items (1) are inverted based on the suggestions of the authors. After it was calculated for each individual (i), a total score (P_i) was calculated by adding those assigned to each of the items. Thus, j ($P_{i,j}$):

$$P_i = \sum_{j=1}^6 P_{i,j}$$

Once the sum of DSI scale was calculated, the median value was used as a cut off to segment respondents. On the HCS scale, the coefficient was 0.896, which is quite acceptable. To check the multidimensionality of the HCS scale, a factorial analysis was carried out without rotation. The first factor has 53% of total variances extracted, which suggests that it cannot be considered as multidimensional (Carmines and Zeller, 1979). Next, it was calculated for everyone (i) a total score (Pi), adding the scores to each item, and then the median value was used as a cut off in order to segment respondents. In both cases (DSI and HCS) a Chi-square test was performed, between segments 5 and 10%, to find the differences between groups. Subsequently, univariate, and bivariate analysis were carried out. The analysis was performed with the statistical package of SPSS 20.0 (20.0, IBM Corp., IBM SPSS Statistics for Macintosh, Armonk, NY, USA, 2011).

Testing of the product

The product test is a qualitative technique that is considered an *ad hoc* study within the applications of marketing research. An *ad hoc* test is usually done to discover the issues or defects that cannot be found by following the formal process. The product was presented to 32 people (potential consumers) in the town of Caborca with ages between 18 and 64. The assessment was conducted in two phases: 1) without environmental information, with only functional characteristics being provided of the paint (color, composition, labelling, etc.) and 2) with environmental information, where all the attributes of the product were explained, particularly how the paint reduces environmental impacts on the planet and also how the paint has a low risk of producing allergic reactions. In each one, people evaluated eight attributes: sustainable, hypoallergenic, quality, durability, odor, performance, waterproof and colors, on a five-point Likert Scale (where one = I do not like it at all; and five = I like it a lot). Additionally, some more variables were included: age, sex, and occupation. Also, a space to add comments or suggestions in each phase of the evaluation was provided. Univariate and bivariate analysis were carried out with the statistical package of SPSS 20.0 (20.0, IBM Corp., IBM SPSS Statistics for Macintosh, Armonk, NY, USA, 2011).

RESULTS AND DISCUSSION

In order to achieve the main objective of the research, a survey was conducted with 212 people, of which 50.5% were women, 65.6% were in the age range of 18 to 35, followed by those who are among 36 and 44 (15.6%), as well as 45 to 54 (11.3%). Most participants had an income lower than USD \$433.60 a month (64.2%), while 15.1 % of the surveyed had an income between USD \$433.65 - \$758.80.

The sample was also formed by a high amount of married people (45.3%), while 36.3% were unmarried and 9.4% were widowed. Regarding the level of education, most of the respondents hold a bachelor's degree (52.9%), followed by those with a technical education (20.8%), and those with only high school studies (13.6%). Socio demographic characteristics of the sample maintain similar tendencies with the general population, also for the civil status, the monthly income level and gender. For this reason, it is possible to consider that the analyzed sample presents some tune guidelines for the general population (Table 4).

Surveys

Regarding the frequency and consumption habits of respondents 44.3% of them, paint their house every 2 to 5 years. 54.2% use latex paint to paint the house interior, followed by 34.0% using water paint; the latter is direct competition with cactus-based paint due to its consistency. Latex paint was the most used to paint in the house exterior among participants, with 45.8%, followed by oil-based paint with 27.4 %.

Table 4. Socio-demographic and economic characteristics of the sample of the population of Caborca and Sonora State, Mexico.

	Percentage over the sample	Percentage over the population		Percentage over the sample	Percentage over the population
Age			Monthly Income Level*		
18-24	30.2	14.7	USD \$108.40	10.4	4.00
25-35	35.4	18.7	USD \$108.45–216.80	20.8	28.0
36-44	15.6	12.1	USD \$216.85-433.60	33.0	
45-54	11.3	10.7	USD \$433.65-758.80	15.1	
55-64	5.7	6.5	USD \$758.80-1084.01	11.3	59.00
≥65 years old	1.9	4.6	USD \$1084.01	9.4	
Civil status			Sex		
Married	45.3	35.0	Female	50.5	49.9
Single	36.3	32.0	Male	49.5	50.1
Divorced	4.7	2.4	Study Level		
Separated	1.9	5.2	Up to primary	4.7	2.7
Free Union	2.4	21.0	Secondary	7.1	39.8
Widower	9.4	12.0	High school	9.9	16.7
			Technical degree	20.8	---
			Bachelor degree	52.9	21.9
			Higher (Master degree and PhD)	8.0	

Note: Percentage of ages over the population of the city of Caborca; the official data of the monthly income level consider only the classification of more than USD\$108.40; study level refers to Sonora State (INEGI 2019; COESPO, 2015).

As for ecological paints, only 11.3% of the interviewed has bought them in the past five years. 91% of respondents does not have knowledge of the cactus-based paint and only 2.4% has purchased it in stores in other areas of Mexico (INMA, SPR de RL de CV enterprise is located in San Jerónimo Micatlán and OXICAL in Milpa Alta). On request, the participants did not specify the place of shopping, but indicated that they have a previous experience and knowledge with the cactus paint. Among the reasons referred to why they have not bought the cactus paint are: the unavailability (lack of product, commercial unavailability, marketing and others) with 98.1%; low quality (0.5%); short duration (0.5%) and unpleasant appearance (0.9%). On the possibility of acquiring cactus-based paint if it were available, 90.6% of the individuals would buy it for the following reasons: 1) support the environment (78); 2) curiosity (77); 3) be natural (15); 4) another alternative (15); low cost (7). These results are coincident with Camarena *et al.* (2020) findings, where it was identified that Sonora consumers recognize the organic products, but the limited supply at the commercial establishments of the region reduces the possibility of purchase.

Regarding attitudes towards innovation (Table 5), the values of the scale were from 1 to 5, where 5 is the maximum value. The results show that consumers do not like to buy new sustainable products before other people do, with an average score of 3.78. Followed, by the category of respondents who are the last of their circle of friends to know about the latest ecological products, with 2.75 points, as well as the category of people who will not buy a new ecological product if they have not heard/tried it yet (2.72). Basically, the results hint at that prior knowledge and information received indirectly are an important reference for consumers when assessing and buying a sustainable product.

Moreover, about the HCS scale (Table 5), the results showed that the most valued factors by consumers are related to awareness of health and how they feel physically as they go through the day, with values of 4.17 each (considering a 5-point scale). Also, be aware of health and alert to changes in, it is also relevant, with values of 4.08 for the attention and alert, and 4.07 for the changes; whereas feelings, involvement and appreciation of health aspects are less valued by the consumer.

Awareness of health and of how they feel every day are key elements for the consumer. Although awareness of health is a relatively recent study concept, the truth is that it is an individual variable, which assesses the degree to which people play an active role in keeping good health (Gould 1988), and the willingness of consumers to commit themselves to health actions (Becker *et al.*, 1977). Nevertheless, previous studies found that in the decision process of consumers, the health information and the environmental care are the most important factors at the moment to choose an organic and traditional product (De Magistris and Gracia, 2008; Resano *et al.*, 2018).

Table 5. Mean values of the attitudes to innovation and health considering the scales of Domain Specific Innovativeness (DSI) and Health Consciousness (HCS).

Item	Mean	Std. Dev.
Domain Specific Innovativeness scale (DSI)		
In general, I am the last in my circle of friends to know the titles/brands of the latest new ecological products	2.75	1.319
I do not like to buy new ecological product before other people do (R)	3.78	1.204
I will not buy a new ecological product if I have not heard/tried it yet (R)	2.72	1.458
Health Consciousness Scale (HCS)		
I am alert to changes in my health	4.07	1.046
I am usually aware of my health	4.08	1.076
I reflect about my health a lot	3.96	1.170
I am very self-conscious about my health	4.03	1.030
I am generally attentive to my inner feelings about my health	3.86	1.082
I am constantly examining my health	3.65	1.243
I am very involved with my health	3.83	1.154
I am aware of the state of my health as I go through the day	4.17	0.968
I notice how I feel physically as I go through the day	4.17	1.021

(R)= Indicates reverse scored items.

To understand the relations between the variables, the median (8) was used as a cutoff to segment respondents. In the case of the DSI scale, it was found that 52.8% has a low adoption of products with sustainable innovation and 47.2% is highly innovative. For the differences between groups a Chi-square test was performed between segments at 5 and 10% level of significance, respectively.

In the HCS scale, the median (36) was the cutoff, finding that 36.8% is slightly conscious, and 63.2% is highly conscious about health. To distinguish the differences between groups, a Chi-square test was performed with significant results between segments at 5%. The cactus paint is a hypoallergenic product. This attribute has a direct effect on the health of the people, and the HCS scale permits to obtain segments of consumers that give a special value to this characteristic.

Table 6 shows correlations between DSI, HCS scales, and socio-demographic characteristics. There were few variables that were statistically different between the segments. From the results obtained through the Chi-square test, there is a positive association among the attitudes towards innovation and age (0.166), marital status (0.173) and level of monthly income (0.135). Therefore, the attitude and willingness of consumers towards sustainable innovation is conditioned by age, income, and family relationships. These results are coincident with those found by Schlegelmilch *et al.* (1994), in which it is shown that socio-demographic variables account for less than 10% of the variation of the ecological performance.

In the case of health consciousness, it is noted that there are significant differences between segments with respect to age and income levels. Results establish that health awareness shown by people is motivated by their age and economic status, in such a way that their attitudes and decisions are conditioned by their socioeconomic status and age (young, adults or seniors). These results fall into the same findings provided by other studies (Gould 1988; Royne *et al.*, 2014).

Table 6. Shown the correlation between Domains Specific Innovativeness (DSI) and Health Consciousness (HCS) scales with the socio-demographic variables.

Factors	Age (years old)	Study Level	Sex	Civil Status	Monthly Income Level
Total DSI	0.096 (0.166)	0.075 (0.276)	-0.027 (0.694)	0.094 (0.173)	0.103 (0.135)
Total HCS	0.124 (0.007) *	0.071 (0.303)	-0.078 (0.257)	-0.101 (0.144)	0.086(0.025) **

*, ** Shown the existence of significant differences between groups for 1%, 5% maximum error level, respectively. Values in parenthesis are the levels of probability.

In general, it was noted that the socio-demographic and economic characteristics can outline some guidelines of how they influence consumers and their attitudes towards innovations and health awareness. However, evidence suggests a lack of consensus on the socio-demographic profile of the environmentally aware consumer, raises the issue of the importance of these variables (Bertrandias and Elgaaied-Gambier, 2014).

Testing of the product

The cactus-based paint test was performed by consumers between 18 and 64 years old, with the segment of consumers between 36 and 46 years being the most represented (34.4% of the sample), followed by participants between 25 and 35 years (25.1%), and lastly participants between 18 and 24 years (21%). The 53.1% of the people interviewed were male. The occupations mentioned were students, professionals, housewives, public employees, entrepreneurs, employees in private companies and unemployed.

In the first phase of the study, the results showed that, at the moment of making the purchase, the attributes “sustainable” and “colors” were more important for consumers, with average rating of 4.30 and 4.24 respectively. It was also identified that the hypoallergenic attribute was important. In the second phase, it was determined that the most valued attribute was the fact that it is a “hypoallergenic” paint, with the average rating of 4.67. Another important characteristic for the consumers was that it was a “sustainable” paint, followed by a variety of colors.

When comparing the results between the first and the second phase of the product, significant differences were found ($p < 0.10$) between the assessments of both stages (Table 7). The scores obtained were above the average value, showing that the attributes included in the experiments were highly valued by consumers. It was identified that once the consumers came into direct contact with the product and using their senses to evaluate it, the order of the evaluations were modified, and the “hypoallergenic” characteristics were the most valued attribute (mean score of 4.67). Being a sustainable product and its colors were second in importance (average score of 4.64 in both cases).

Other features such as quality, performance, durability, and the fact that the product is waterproof were important, but slightly less valued than the former ones. In general, it was found that being in contact with the product can generate slight variations in the valuation and assessment of the attributes from the consumers. All scores rose, which displays the relevance of the information that is available prior to the decision to purchase. It was also found that the attributes that should be highlighted as a marketing strategy are the facts that it is a hypoallergenic product and a sustainable paint without neglecting the relevance of its colors.

Table 7. Blind and open product test comparison (mean values and standard deviation).

	First stage mean (blind test)	Second stage mean (open test)	Chi-square
1.Sustainable	4.28 ± 0.729	4.63 ± 0.609	0.002**
2.Hypoallergenic	4.22 ± 0.975	4.66 ± 0.602	0.001**
3.Quality	3.81 ± 0.965	4.00 ± 0.880	0.000***
4. Durability	3.72 ± 0.924	3.97 ± 0.782	0.010**
5. Odor	3.97 ± 1.177	4.25 ± 0.950	0.000***
6. Performance	4.03 ± 0.740	4.09 ± 0.734	0.011**
7. Waterproof	3.50 ± 1.136	3.97 ± 1.092	0.000***
8. Colors	4.28 ± 0.851	4.63 ± 0.609	0.000***

** , *** Shown the existence of significant differences between groups for 10%, 1% maximum error level, respectively.

Cactus-based paint is a product that is not completely unknown, and which has been developed over generations in an artisanal form. It is a product that can be produced commercially since is among the 27 crops with the largest cultivated area at national level. Besides this, the market demand for products with less environmental impact and products that do not cause problems in consumer's health is expanding and generating opportunities for products like cactus-based paint.

It should not be forgotten that sociodemographic characteristics and their relations to consumer attitudes towards sustainable innovation and health awareness, helps to identify potential consumer segments based on age, income, and marital status. The evidence of the correlation tests clearly shows that a direct contact with the product and availability of appropriate information can produce slight variations in the consumers' opinions, especially in characteristics such as hypoallergenic, sustainable, as well as the variety of colors. Also is to consider that the test was realized in a controlled environment, where familiarity with the product was present, as the *Opuntia* cactus is a plant that is found in the area. These conditions can influence the decisions and valuations of consumers, as demonstrated in other findings. Previous knowledge and familiarity stimulate consumer choice (Resano and Sanjuán, 2018).

CONCLUSIONS

The presence of certain products generates negative impacts on the environment and on people's health. The objective of this study was to evaluate the attitudes of consumers toward the development of a sustainable product of a cactus (*Opuntia*) based paint. This product is considered artisanal and traditional. Research showed that most people who participated in the study use vinyl paint for painting the interiors and exteriors of their homes, and buying sustainable paint is just emerging. As for the cactus lime paint, it was identified that despite being a product with tradition in its preparation, knowledge is scarce, especially among younger consumers. However, *Opuntia* cactus plant is familiar to the participants and information exists in their memory. For that reason, the attitudes were more favorable. While most consumers are aware of the environment, the reality is that this awareness does not manifest in their buying behavior.

Although there is a receptive attitude towards sustainable products, the reality is that there is a lack of variety of sustainable products marketed in the town, so this can influence the research findings. Our results also allowed to detect that the possibility of acquiring cactus-based paint was positive, showed that the functional benefits are well valued by the consumers, particularly because the paint is environment friendly, curious and a natural product and also because of the low cost. Also, from a marketing point of view, it is necessary to consider two aspects: 1) provide information on the benefits of the product; 2) highlight the attributes most valued by consumers: hypoallergenic, sustainable and available in variety of colors.

The cultivation of *Opuntia* cactus is very extended in the country. Although the planting of *O. spinulifera* in the County of Caborca is by backyard farming, exploring products with market

potential is important because it provides economic alternatives for an important number of growers.

This research has identified an interesting market in cactus paint where there are elements appreciated by the consumers, but success and commercial positioning are dependent on the improvement of the product and the process of innovation, and also on marketing strategies.

This is an exploratory study that was conducted in the county of Caborca. The product is in an initial phase, and more tests will be needed to achieve a better result and presentation for marketing. Also, to increase a potential market, it can be segmented for the consumers, and is also necessary to help the local growers to adapt the products to the new requirements of the market.

SUGGESTIONS

Study findings suggest that individual's value natural resource-based products with less impact in the environment and health. It was identified that there is a latent attitude, particularly among the young, to the acquisition of these products. However, to promote the purchase decision, from the point of view of a business strategy, it is vital to include more information about the benefits of sustainable products. All of this is very important to stimulate buying, because there are consumers who are concerned about the environment but are not so convinced when selecting innovative sustainable products.

Is imperative to develop an integral strategy, where attributes of the product can be distinguished, as well as the marketing promotion for the knowledge and diffusion between the consumers. At the same time, it is necessary to work with the growers to generate a product that considers the market, but satisfies the health, quality, and production standards, without the omission of environmentally friendly aspects.

ETHICS STATEMENT

The research project is considered a risk free, as it is a type of study where the intervention or intentional modification in social, psychological, or physiological variables or sensitive aspects of people's behavior was not carried out. Participation was voluntary and anonymous, and the data of individuals is protected by the Ley Federal de Protección de Datos Personales en Posesión de los Particulares (2010) de México [Federal Law on Protection of Personal Data Held by Individuals].

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF SUPPORTING DATA

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests.

FUNDING

Not applicable.

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AUTHOR CONTRIBUTIONS

Conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, Deidad Reyes-Ulloa and Lizbeth Salgado-Beltrán; writing-original draft preparation, writing-review and editing, visualization, supervision, Dena María Camarena-Gómez and Lizbeth Salgado-Beltrán.

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