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ABSTRACT

The physical-chemical and sensory properties are elements to be taken into account during the development of cosmetics. Moisturizers represent one of the most important classes of personal care products and often appear in a wide range of different color options. This study aimed to develop a moisturizer in the form of gel-cream and explore the options of metallized colors through sensory analysis. According to the results obtained, it was possible to observe that the type of pigment affected the judges' perception showing that the influence of this component should not be disregarded in the postponement of new formulations. It is possible to infer that a consumer's reaction to a cosmetic is not only based on its effectiveness, but

also on the way in which its physical characteristics are perceived, including color, appearance, skin sensation and smell.

Keywords: Cosmetics, Sensory analysis, Color.

INTRODUCTION

The development of new cosmetics is a challenging and important activity for companies and is closely related to the needs and trends or consumption fashions. Over the past few years, the cosmetic area has grown in a representative way and refers to several innovative actions, such as evoking feelings of well-being, relaxation, reduction of wrinkles, increase of the skin's natural hydration factors, restoration and increase of the skin microbiota, among others. Thus, the appearance and sensory of cosmetics must be taken into account when formulating products (HERMAN, 2007).

Stimulating the senses is the effective way of building the field of sensations and emotions, an environment that is multidimensional and of infinite possibilities (MORAES, 2007). In the perspective outlined by Moraes (2007), communication in marketing takes into account the stimuli to the senses having as a technical reference creativity and the capacity for innovation in formulations, packaging and formats. Neurosensory cosmetics, which also evolved, act on the senses in order to promote pleasant sensations through textures, colors and fragrances (IWAMOTO et al., 2016). In this context, a cosmetic must be pleasant to use and this is the result of the harmony of different characteristics related to sensory quality (SHIRATA; CAMPOS, 2016) so, it is necessary to optimize properties such as color, appearance, odor, texture, consistency and interaction of different components in order to achieve a balance that translates into excellent quality and that is of good acceptability.

Sensory parameters can influence the different stages of the product development cycle and range from the selection and characterization of raw materials, as well as the establishment of the specifications of the production process, the optimization of the formulation, the quality tests, the choice of packaging, storage conditions and the study of the useful life of the projected formulation (ISAAC et al., 2012). A consumer's reaction to a cosmetic is not only based on its effectiveness, but also on how its attributes are perceived (GONÇALVES et

al., 2013). In the sensory analysis, the different phases in which the user has contact with the product are considered. For cosmetics, the stimuli associated with only three of the five senses prevail: sight, touch and smell (MORAES, 2007; TEIXEIRA, 2009; ISAAC et al., 2012). These senses are stimulated by the sensory perception of the body that makes neural associations, thus being able to rescue memories and emotions (PASCHOARELLI et al., 2015). For Stein (2012) the sensory process has several stages that involve stimulation, sensation, perception and response. Sensory stimuli therefore consist of very interesting strategies to be considered when designing cosmetic products. Therefore, variables that influence human behavior contribute to the decision on whether or not to purchase a product (MOURA, 2018).

In the case of cosmetics, the visual presentation portrays the consumer's first contact. In this experience, appearance and color are highlighted, which in practice are associated with personal reactions of acceptance, indifference or rejection. The color has three distinct characteristics which are the tone, determined by the wavelength of the reflected light; the intensity, which depends on the concentration of coloring substances and the brightness, which is the amount of light reflected in comparison with the amount of light that falls on it (TEIXEIRA, 2009).

Color can also play a role in transmitting information, creating a lasting identity and suggesting images and symbolic values (HYNES, 2009). The choice of certain colors may be related to individual preferences (HYNES, 2009; WESTLAND; SHIN, 2015) that may be influenced by fashion trends (PALMER; SCHLOSS, 2010). Color must be taken into account in product development, not only to improve its aesthetic or sensory characteristics, but because colors trigger specific signals in the central nervous system, through the stimulation of the photoreceptor cells of the retina, when the eye absorbs certain wavelengths of the light reflected from the surface of an object (BENSON et al., 2019; JIMÉNEZ et al., 2019). These cells, through the optic nerves, transmit electrical impulses to the brain, which translates color into sensations, emotions and impressions (BENSON et al., 2019; JIMÉNEZ et al., 2019). In the study carried out by Heller (2013), which gathered the opinion of 2000 people in relation to color preference and its association with specific feelings, it was established that the choice of colors is not made by tastes, but by past experiences what is evidenced through psychological symbolism. Still within this line of thought, other research reports that the senses have a strong impact on the consumer at the time of the purchase decision, since they direct human behavior (LINDSTROM, 2008; VIDAL; WOLFF, 2014).

Odor is another important sensory property, perceived by the olfactory organ when certain volatile substances are inhaled (IAL, 2008). Depending on the concentration, these substances stimulate different receptors according to their specific threshold values (TEIXEIRA, 2009). The presence and type of fragrance affects the perception of some characteristics, showing that the influence of these components should not be disregarded (GONÇALVES et al., 2013).

By touch it is possible to perceive the texture of a product. The texture refers to the set of all geometric and surface rheological and structural properties that can be perceived by the tactile mechanical receptors (TEIXEIRA, 2009). Among other properties provided by a particular cosmetic, by touch it is possible to check, for example, the residual grease sensation, softness, hydration, refreshing and dry touch (ISAAC et al., 2012).

In market studies, sensory analysis becomes an important tool that can be applied in comparative tests between competing products and also, in consumer acceptance tests for other items to be launched for consumption (ISAAC et al., 2012). Formats, colors and visual signs, when combined, allow innovative forms of presentation to the consumer (MORAES, 2007).

Cosmetics often appear in a wide range of different color options (WESTLAND; SHIN, 2015), among them moisturizers represent one of the most important classes of personal care products, ranging from preventive action in xeroderma, skin aging and other skin disorders. skin (LEONARDI; GASPAR; CAMPOS, 2002; RIBEIRO, 2010). In xerosis the main affected layer of the skin is the epidermis; changes in the organization of corneocytes and in the cell renewal process, as well as delipidation and reduced ability to retain water, lead to dryness generating a decrease in flexibility and threatening the protective barrier function (BARCO; GIMÉNEZ-ARNAU, 2008). In addition to the aesthetic problem, due to its dry and rough appearance, dehydrated skin presents marked losses of biomechanical and biological properties. To ensure its physiological protective role, the stratum corneum must have adequate flexibility and elasticity (RIBEIRO, 2010). In most cases, dehydrated skin can be adequately treated with the daily application of moisturizers, which makes this class of cosmetics the most commonly used (CROWTHER et al., 2008; CHANDAR et al., 2009). These products are capable of restoring the water content of dehydrated skin, providing conditions necessary for the recovery of its natural properties by forming a barrier against

transepidermal water loss (RIBEIRO, 2010).

The quality of a moisturizer involves, in addition to the efficacy, safety and stability of the formulation, in this universe, the aspect and the sensorial must also be considered aiming at great acceptability by the consumer market. Based on the hypothesis that the appropriate use of color can greatly impact the success of a project, this research aimed to develop multifunctional moisturizers in the form of gel-cream made with three different colors. Different metallized pigments were used in order to make a practical comparison of their isolated use in the same hydrating base. It also had the purpose of determining the macroscopic, physicochemical characteristics, preliminary stability and sensory analysis of the products.

MATERIALS AND METHODS

STUDY SETTING

The samples were developed at the Laboratory of Pharmacy Industry, of the São Francisco University (USF) in the city of Bragança Paulista - SP. When designing the test compositions, the use of pharmaceutical grade raw materials was considered important.

RAW MATERIAL SELECTION

Multifunctional moisturizing gel-cream formulations have been developed. For the preparation of the samples, the emulsification technique by phase inversion was used, as described in Ferreira and Brandão (2008).

The raw materials were named according to the trade name and International Nomenclature Cosmetics Ingredients (INCI), as recommended in the specific legislation for cosmetics (BRASIL, 2015).

Three moisturizing gel-cream formulas were prepared to compare the effect of adding different metallized pigments (Table 1). After production, tests were carried out to determine

the physical-chemical properties, assess sensory acceptability and preliminary stability study.

Table 1 – Qualitative and quantitative description of moisturizers in gel-cream.

INGREDIENTS	AMOUNT % (p/p)			OCCUPATION
	F1-D	F2-P	F3-V	
<i>Focus Gel 305</i>	3,0	3,0	3,0	Pre-neutralized emulsifier
<i>DUB C12C15</i>	1,0	1,0	1,0	Emollient
<i>Glicirrizinato potassium</i>	0,1	0,1	0,1	Humectant
<i>Biomíneral 5</i>	0,1	0,1	0,1	Humectant
<i>Beauplex VH</i>	0,1	0,1	0,1	Conditioner
<i>Mica Focus Pearl Iri Gold</i>	1,0	-	-	Golden pigment
<i>Mica Focus Pearl Glittering White</i>	-	1,0	-	Silver pigment
<i>Mica Sunpuro Maroon C 846278</i>	-	-	1,0	Red pigment
<i>Fragrância</i>	0,4	0,4	0,4	perfume
<i>Triadine/Cosmoguard MT CP</i>	0,1	0,1	0,1	Preservative
Demineralized water QSP	100,0	100,0	100,0	Vehicle

Caption: QSP-Sufficient Quantity For. Source: Research data (2019).

CHEMICAL PHYSICAL ANALYSIS

The samples were stored at room temperature ($25^{\circ} \pm 2^{\circ}\text{C}$) protected from light, in a stability chamber ($40^{\circ}\text{C} \pm 2^{\circ}\text{C}$) and refrigerator ($5^{\circ}\text{C} \pm 2^{\circ}\text{C}$) and exposed to natural light for a period of 28 days. The tests were carried out at zero time, this being considered the time of 24 hours after the preparation of the products and for 28 days, with sampling intervals of 7 days. Sample stored at room temperature protected from light was taken as a reference. The preparations were evaluated for organoleptic properties such as appearance, color, odor, touch. Tests were also carried out, such as pH determination and homogeneity by centrifugation. The studies were conducted according to the Cosmetic Products Stability

Guide (BRASIL, 2004), Cosmetic Products Quality Control Guide (BRASIL, 2007) and protocol for physico-chemical tests of phytocosmetic stability (ISAAC et al., 2008).

The spreadability test was also performed using the methodology proposed by Borghetti and Knorst (2006) being calculated according to: E_i corresponds to the sample's spreadability for weight i in grams per mm^2 ; d is the average diameter (mm^2); p is 3.14. The spreadability factor was calculated by: where: E_f is the spreadability factor; $\sum E_i$ is the sum of the spreadability and $\sum m_i$ is the sum of the accumulated weight. The spread of the product that can be measured as extensibility (BORGHETTI; KNORST, 2006; ISAAC et al., 2008).

SENSORY ANALYSIS

The study was adapted according to protocols for sensory analysis described in IAL (2008) and Isaac et al. (2012). During the acceptance tests, the conditions of temperature, humidity and light were standardized. The analysis was carried out with 30 untrained judges (sample for convenience), without restriction as to the type of skin and consumers of moisturizing cosmetics. For the analysis of color, appearance, texture and global acceptance, a 9-point structured hedonic scale was also used. For characteristics such as spreadability, touch, sensation during use and after application, a 5-point intensity scale was used. For the purchase intention, a 5-point scale was also used. The data were tabulated and evaluated statistically through analysis of variance (ANOVA), considering a significance level of 5% ($p < 0.05$) using the *GraphPad InStat* 3.1 program (2019). The results were also analyzed using the Acceptability Index (AI) and by frequency distribution of acceptance grades. To perform the AI calculation, the mathematical expression according to Dutcosky (2011) and Minim (2013) was adopted, with $\text{AI} (\%) = (A \times 100) / B$, Where: AI - acceptability index; A - average grade of the hedonic scale; B - maximum possible grade. AI values greater than 70% are considered satisfactory.

ETHICAL ASPECTS

The study was approved by the Research Ethics Committee of Universidade São Francisco under CAAE n. 65833817.6.0000.5514 and Opinion n. : 1.986.021.

RESULTS AND DISCUSSION

The cosmetics market remains expanding, new products appear with the most different technologies. In this competitive universe, sensory performance expands the market potential and offers tools for the improvement and development of new formulations. This study aimed to develop and comparatively evaluate the influence of the addition of different metallized pigments, in moisturizers in the form of gel-cream. The macroscopic, physical-chemical characteristics, preliminary stability and sensory analysis of the products were also determined.

Moisturizers are used to reduce dryness of the skin by different mechanisms such as occlusion, moisturizing and active hydration. To guarantee their effects, moisturizers are formulated with a variety of ingredients in order to provide hydration, increase the stability of the product and also favor acceptance among consumers (RIBEIRO, 2010). It includes ingredients such as emulsifiers, emollients, humectants, sequestrants, stabilizers, water, fragrances, sensory modifiers, dyes, specific assets, among others (FERREIRA; BRANDÃO, 2008). Cream-gel is an emulsion with a high percentage of water and low oil content, consisting of a hydrophilic colloidal stabilizer and consistency agent (FERREIRA; BRANDÃO, 2008).

In this study, the components were carefully chosen with the objective of causing a pleasant feeling to use and moisturizing effect. *Focus Gel* 305 was used as a hydrophilic colloidal stabilizer, thickener and emulsifier. It is a polymer that expands when in contact with water, at room temperature, without the need for neutralization, resulting in pleasant and stable oil-in-water emulsions. *DUB C12C15* is a non-greasy emollient with medium spreadability. Emollients are rich in substances capable of filling intercorneocytic cracks, favoring hydration and reducing transepidermal water loss (RIBEIRO, 2010). *BEAUPLEX VH* is a multifunctional input in the form of a blend of vitamins (E, C, B₃, B₅ and B₆) with moisturizing, antioxidant, nourishing and protective properties (SOUZA; JUNIOR, 2016).

Dryness of the skin compromises the corneal barrier function and increases water loss, which can increase the release of cytokines, which in turn will induce an inflammatory process and eczema. Potassium glycyrrhizinate is obtained from *Glycyrrhiza glabra* L., it was used in the formulation in order to minimize the irritating effects caused by dry skin. Biomineral 5 is an

association of the natural extract of *Saccharum officinarum* with important micronutrients for the maintenance of eudermia skin. It acts in the regulation of cellular functions and cutaneous homeostasis, improves skin elasticity, promotes emollient, moisturizing, moisturizing and conditioning action. *Triadine / Cosmoguard* MT CP was used as a preservative (SOUZA; JUNIOR, 2016). The same fragrance was used in the studied formulations with the objective of perfuming them and making them more attractive from a sensory point of view. Water was used as a vehicle.

Micas are pearlescent pigments available in different colors used in cosmetics with the aim of giving shine and a colorful effect. In this study, three different pigments were used, the *Mica Focus Pearl Iri Gold* (gold), used in the F1-D sample; *Mica Focus Pearl Glittering White* (silver) used in sample F2-P and *Mica Sunpuro Maroon C 846278* (red) added in sample F3-V.

In order to obtain acceptable characteristics, the formulations were submitted to a preliminary stability study for 28 days and after this period they were evaluated in terms of appearance, homogeneity by centrifugation, odor, pH and spreadability. This study is considered a predictive procedure, based on data obtained from samples stored in situations that aim to accelerate possible changes in market conditions (ISAAC et al., 2008; ISAAC et al., 2012). Although every predictive procedure does not represent an absolute result, it has an excellent probability of providing relevant data on the behavior of a product during its storage and use (BRASIL, 2004).

After carrying out the tests under different stress conditions, the formulations did not show changes in aspect, color, odor, homogeneity, tactile sensation. Phase separation was also not observed, even in samples stored at different temperatures. The slightly acidic pH of the skin is an important protective factor, maturation of the epidermal barrier and for the repair processes. In adults, the skin pH is less than 5 ($\text{pH} < 5$) (DARLENSKI; FLUHR, 2017). According to the data obtained in practice, the pH results for the tested formulations were considered acceptable throughout the study, being 5.45 ± 0.37 for the F1-D sample; 5.24 ± 0.23 for sample F2-P and 5.42 ± 0.18 for sample F3-V.

The acquisition and continuity of the use of cosmetics are related to the sensation caused by the consumer and can be assessed by sensory analysis (ISAAC et al., 2012). For greater acceptability, it is necessary to develop formulations in accordance with pleasant sensory

attributes. Figure 1 shows the appearance of the studied samples.

The spreadability, defined as the expansion of a semi-solid formulation on a surface after a certain period of time is one of the essential characteristics of topical formulations, as it is related to the application at the place of use (BORGHETTI; KNORST, 2006). The consistency determination by spreadability was used as an option to evaluate the expandability of the formulations on a surface as a function of weight. The results revealed similar behaviors with a spreadability factor E_f for F1-D equivalent to $2.88\text{mm}^2 / \text{g}$, for F2-P of $2.72\text{mm}^2 / \text{g}$ and F3-V of $2.43\text{mm}^2 / \text{g}$. The spreadability characteristics can be associated with the intrinsic properties of the gel-cream base used in the preparation of the samples and can infer the sensory perception at the moment of application on the skin.

Figure 1 – Shows the appearance of the samples studied F1-D (golden); F2-P (silver) and F3-V (red).

Source: Research data (2019).

Sensory analysis was performed with 30 untrained judges, aged between 18 and 40 years. Through the responses to the questionnaire, it was possible to evaluate the different sensory aspects of the formulations F1-D, F2-P and F3-V. Table 2 shows the average score and standard deviations related to the attributes: color, odor, appearance, texture and global acceptance. The statistical analysis was performed in order to identify whether there is a significant difference between the samples. According to the results obtained, there was a difference only in the color attribute. Table 2 also shows the AI were greater than 70% with the exception of F3-V, which had lower scores for color and appearance. According to

Dutcosky (2011), a product can be sensorially well accepted when AI is above 70%. These findings are in line with the studies by Camgöz et al. (2002) who identified that hue is only one of the three dimensions of perceptual color, however, colors having greater saturation and brightness seemed to be more preferred than the same hues with less saturation and brightness.

It is interesting to note that, in this study, the samples have the same formulation differing only in color and the formulation F3-V (red) had lower and statistically significant scores when compared to the grades of samples F1-D (golden) and F2-P (silver). Palmer and Schloss (2010) postulated a theory identifying that individuals may differ in their color preferences. For Stein (2012) in the sensations caused by cosmetics, the brain works with different stimuli simultaneously (appearance, odor, touch, color). In the product experience, the consumer transforms the senses of sight, smell and touch into neural signals interpreted by the brain. This multisensory perception can be synergistic if the combination of stimuli is favorable ($1 + 1 = 4$), on the other hand, it can be suppressed if the combination is unfavorable ($2 + 2 = 1$) (STEIN, 2012; BENSON et al., 2019; JIMÉNEZ et al., 2019). The synergistic or suppressive effect of color and odor has been studied by Jiménez and others (JIMÉNEZ et al., 2019). The study involved samples with vanilla odor in beige and red and samples with mint odor in purple and blue. The results showed that color influenced olfactory perception. One sample with a vanilla odor is not expected to be red and another sample with a mint odor is purple. These findings are in agreement with the results of this study, the sample F3-V (red), was the least accepted by the tasters, most likely due to the suppressive effect caused by the color in the same hydrating product formulation. A moisturizer is probably not expected to be formulated in red.

In neuroscience this approach has been applied by neuromarketing (LINDSTROM, 2007; LINDSTROM, 2013; BENSON et al., 2019; JIMÉNEZ et al., 2019) and the more the senses are involved in the interaction with the product, the more loyalty there will be for the specific brand.

Table 2 – Mean values, standard deviation and acceptance index in the analysis of measured sensory attributes (n = 30).

Influence of color on the physicochemical and sensory properties of moisturizing cosmetics

Sample	Color	fragrance	Appearance	Texture	Global Acceptance
	Average $\pm$ DPAI (%)	Average $\pm$ DPAI (%)	Average $\pm$ DPAI (%)	Average $\pm$ DPIA (%)	Average $\pm$ DPIA (%)
F1-D	7,63 ^a $\pm$ 1,6084,77	7,96 $\pm$ 1,2788,44	7,53 $\pm$ 1,5083,66	7,76 $\pm$ 1,3386,22	8,02 $\pm$ 1,1188,88
F2-P	7,60 ^{ab} $\pm$ 1,8884,44	7,73 $\pm$ 1,5385,88	7,46 $\pm$ 2,1282,88	7,53 $\pm$ 1,4783,66	8,03 $\pm$ 0,8589,22
F3-V	5,83 ^{ab} $\pm$ 2,3064,77	7,26 $\pm$ 1,3680,66	5,36 $\pm$ 2,4559,55	7,26 $\pm$ 1,6180,66	7,30 $\pm$ 1,0581,11

Caption: SD: Standard deviation. Different letters in the same column indicate an extremely significant difference by the Tukey test ($p < 0.05$); IA: Acceptability Index (ideal $> 70\%$). Source: Research data (2019).

The development of products with sensory quality and proven efficacy must be routine in the contemporary cosmetic industry. The cosmetic characteristics of the products were evaluated (MONTEIRO et al., 2013). Table 3 shows the results of items such as touch and stickiness, spreadability, sensation of use, sensation after use. The results show that there was no significant difference between the samples although the lowest scores were observed for the F3-V formulation.

Table 3 – Average values, standard deviation and acceptance index in the analysis of the measured cosmetic attributes ($n = 30$).

Sample	Touch and stickiness	Spreadability	Feeling during use	Feeling after use
	Average $\pm$ DPAI (%)	Average $\pm$ DPAI (%)	Average $\pm$ DPAI (%)	Average $\pm$ DPIA (%)
F1-D	4,23 $\pm$ 0,7784,60	4,56 $\pm$ 0,7291,20	4,46 $\pm$ 0,6289,20	4,50 $\pm$ 1,0880,00
F2-P	4,26 $\pm$ 0,6985,20	4,33 $\pm$ 0,8086,60	4,13 $\pm$ 0,8682,60	4,3 $\pm$ 0,7986,00
F3-V	4,10 $\pm$ 0,8882,00	4,03 $\pm$ 0,9680,60	3,96 $\pm$ 0,9679,20	3,93 $\pm$ 1,1478,60

Caption: SD: Standard deviation. There was no significant difference by the Tukey test ($p < 0.05$); IA: Acceptability Index (ideal $> 70\%$). Source: Research data (2019).

From the perception of the participants in relation to the use of the samples, it was possible to verify that all of them demonstrated to have good characteristics in relation to the touch, spreadability, sensation during and after the use, with AI above 70%. Regarding the purchase intention, 69% of the participants replied that they would buy the F1-D and F2-V samples compared to 54% who decidedly would not buy the F3-V sample (Table 4).

Table 4 - Average values, standard deviation in the assessment of purchase intention (n = 30).

Sample	Buy intention
	Average $\pm$ DP
F1-D	3,96 ^a $\pm$ 0,93
F2-P	3,86 ^{ab} $\pm$ 1,17
F3-V	2,63 ^{ab} $\pm$ 1,90

Caption: SD: Standard deviation. Different letters in the same column indicate an extremely significant difference by the Tukey test ($p < 0.05$). Source: Research data (2019).

These findings are in line with the formulators' expectations, and could demonstrate results on the influence of metallized colors on multifunctional moisturizers in the form of gel-cream. Sensory aspects and purchase intention indicated high acceptability and great market potential for samples F1-D and F2-V. It should also be considered that consumers of different products have different characteristics; in this regard, it is essential that each market segment understands what the consumers' wants and needs are. This study made a contribution in the cosmetic area, since the appropriate sensory favors adherence to use and consequent success in adhering to the product.

CONCLUSION

Within the experimental conditions used in this study it was possible to conclude that the objective of developing a multifunctional moisturizer, in the gel-cream cosmetic form, was successfully achieved. The physicochemical and preliminary stability studies were useful in

characterizing the formulations. The samples proved to be pleasant to the sensory attributes evaluated. The use of different metallic colors resulted in significant differences in the sensory profiles, suggesting that the color properties such as tone, intensity, and brightness, promoted a synergistic effect (samples F1-D and F2V) or suppressive (sample F3-V) in the sensory preferences. of the proposed moisturizer. These results can be used as a guide in the development of new cosmetics, contributing to the selection of different ingredients that can add different sensorial characteristics to the products.

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