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New sustainable product development: consumer's research in the early stages of production

This study aimed to analyze the 'voice of the consumer' applying modified Kano's Model in a questionnaire focused on a new functional food product. The consumer research was carried out using an online questionnaire and the responses were used to classify the attributes of a dietary supplement, identify the main consumer needs and desires, and analyze the acceptance of a new dietary supplement that contains palm heart bark and Lentinula edodes. Results show that protein content and nutritional benefits are high performance characteristics that satisfy the consumer of dietary supplements. Consumers tend to select gluten-free and 'clean label' products containing natural ingredients with both nutritional and health benefits. The naturalness demand lead to palm heart bark and mushroom acceptance as food ingredients. This appears to be the only academic study that describes the application of this methodology and auxiliary methods to the food industry for consumer research and to direct improvement efforts in the early stages of new product development (NPD). Also, this study highlights a market opportunity to develop an innovative and practical product with natural compounds that are both nutritive and bioactive, enhancing human health and wellbeing as well as environmental sustainability associated with the disposal of agro-industrial waste from heart-of-palm processing.

Keywords: Kano's Model; Dietary supplement; Agro-industrial waste; Edible mushroom; Sustainability.

Desenvolvimento de um novo produto sustentável: pesquisa de mercado nos estágios iniciais de produção

Este estudo teve como objetivo analisar a 'voz do consumidor' aplicando o Modelo de Kano modificado em um questionário focado em um novo produto alimentar funcional. A pesquisa de consumo foi realizada por meio de um questionário online e as respostas foram utilizadas para classificar os atributos de um suplemento alimentar, identificar as principais necessidades e desejos do consumidor e analisar a aceitação de um novo suplemento alimentar que contém casca de palmito e Lentinula edodes. Os resultados mostram que o teor de proteína e os benefícios nutricionais são características de alto desempenho que satisfazem o consumidor de suplementos alimentares. Os consumidores tendem a selecionar produtos sem glúten e com "clean label" contendo ingredientes naturais com benefícios nutricionais e para a saúde. A exigência de naturalidade levou à aceitação da casca do palmito e do cogumelo como ingredientes alimentícios. Este parece ser o único estudo acadêmico que descreve a aplicação desta metodologia e métodos auxiliares à indústria de alimentos para pesquisa do consumidor e para direcionar os esforços de melhoria nos estágios iniciais do desenvolvimento de novos produtos. Além disso, este estudo destaca uma oportunidade de mercado para desenvolver um produto inovador e prático com compostos naturais nutritivos e bioativos, melhorando a saúde e o bem-estar humano e a sustentabilidade ambiental associada ao descarte de resíduos agroindustriais do processamento de palmito.

Palavras-chave: Modelo Kano; Suplemento alimentar; Resíduo agroindustrial; Cogumelo comestível; Sustentabilidade.

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INTRODUCTION

Consumers are demanding food products that go beyond basic needs and starting to think about food and nutrition as a way to enhance their wellbeing, physical and mental health, and to prevent disease, as well as the increasing awareness regarding environmental sustainability (BOLUDA et al., 2017). This emerging consumer behavior has been referred to as 'health and wellness' and it represents a new market segment and creates an opportunity for food innovation. Thus, the importance of developing products such as the functional food (KHAN et al., 2013), the dietary supplements and the gluten-free and/or lactose-free products (CIACCI et al., 2015) has attracted attention. However, this niche may be associated with a high risk of product failure and a possible reason for this is that the product development process ignores the consumer preferences and levels of acceptance (BIMBO et al., 2017).

Among the key factors of new product development/innovation (NPD), the 'voice of the consumer' is of great importance, together with product superior value for the consumer and innovativeness, to achieve competitiveness in the market. Thus, consumer-oriented NPD is seen as a key determinant for innovation (GRUNERT et al., 2014; THOMAS et al., 2021) and new nutrition-modified and functional food products (BIMBO et al., 2017).

The selection of a methodology for market and consumer research is crucial and a survey form may help it. However, the evaluation of the responses needs to be carefully carried out, particularly in the food context, due to the complex relation and interaction among product preferences, characteristics, and design features (GRUNERT et al., 2014). Therefore, it is important to choose a methodology that evaluates consumer responses in an interconnected way. Kano's Model of consumer satisfaction (KANO et al., 1984) may be an interesting tool to be applied to questionnaires to aid the development of new food products.

Kano's Model is not commonly used in food research and thus it is of interest to evaluate its application as an alternative method to evaluate food characteristics. This model has been used worldwide to identify both the explicit and implicit consumer needs and desires. These are identified based on a questionnaire that contains pairs of questions for each product/service characteristic (attribute). The first question (positive/functional) refers to the client's reaction when the attribute is present, or its performance is highest. The second question (negative/dysfunctional) refers to the client's reaction when the attribute is absent or its performance is insufficient (MATZLER et al., 1998). This tool suggests a non-linear relation between performance and satisfaction, classifying the characteristics of products or services as attributes that are neutral, basic/must be, one-dimensional, attractive (TONTINI et al., 2010) or reversal (TONTINI, 2000).

This study aimed to analyze the voice of the consumer by applying modified Kano's Model to a questionnaire on a new functional food product. The study provides an initial insight into a promising tool for application in the early stages of consumer research and identifies a market opportunity, by way of a product that integrates agro-industrial waste (palm heart by-product) and an edible and medicinal mushroom (*Lentinula edodes*) through the use of biotechnology to make a dietary supplement (shake), which

can enhance human health and wellbeing as well as environmental sustainability.

MATERIALS AND METHODS

This study was part of a large project on products development and the data was collected between 1st April and 30th April 2019. Ethical clearance was sought from the Human Research Ethics Committee of the Regional University of Blumenau (FURB, Brazil) (registration number CAAE: 02116918.5.0000.5370).

Study population

Participants were selected randomly using electronic invitations by emails and announcements published on social networks. The recruitment aimed to cover a wide range of profile variability and the questions could be answered by all people who were willing to collaborate, whether they were consumers of dietary supplements or not. The participation was voluntary and anonymous, personal data were maintained confidential, and, before answering the questions, all participants needed to inform consent. An overview of the general profile of the respondents is given as part of the study results.

Questionnaire

In order to identify criteria for the development of new food product formulations (in this case a dietary supplement in the form of a shake), a semi-structured questionnaire was designed and applied online (Survey Monkey® Site). The questions were aimed at identifying the influencing factors and assess consumer satisfaction with dietary supplements.

The questionnaire was comprised of three parts. In the first, there were questions regarding personal details: age, gender, education level, physical activity, and dietary supplement consumption. In the second part, there were questions about the frequency of dietary supplement consumption and the importance of some aspects related to product choice: flavor, nutritional value, composition, price, brand, variety of flavors, and function. In addition, in this part, three questions were based on the modified Kano's Model (TONTINI, 2000). These questions were used to obtain further in-depth information on the attributes of the dietary supplements (shakes), namely: flavor (At1), caloric value (At2), dietary fiber content (At3), protein content (At4), presence of natural ingredients (At5), health benefits (At6), nutritional benefits (At7), price (At8), and consistency (At9). Finally, in the third part, there were multiple-choice questions related to the respondents' opinion on a dietary supplement (shake) with a high level of dietary fiber, protein, and β-glucans, and containing in its formulation a waste from palm heart processing and an edible mushroom (Shiitake/*Lentinula edodes*), as well as which flavor they would prefer for this product. These questions were presented together with clear explanations of the benefits of each compound and β-glucans were explained as 'a molecule that performs important activities on the immunological system, antitumor, antiviral, antibacterial and anti-inflammatory functions, and that helps to inhibit an increase in cholesterol'.

If the response to the question about dietary supplement consumption in the first part was negative, the questionnaire jumped directly to the third part. If the response was positive, the questionnaire continued

to the second part and then to the third. There was no possibility to go back to revise responses to earlier questions.

Data Analysis

Data obtained from the second part of the questionnaire were analyzed using the modified Kano's Model (TONTINI, 2000), the importance-performance analysis (MARTILLA et al., 1977), improvement gap analysis (TONTINI et al., 2010) and standardized gap analysis (TONTINI et al., 2008; TONTINI et al., 2007). The other answers (first and third parts) were statistically analyzed using descriptive analysis.

Modified Kano's Model

Data management and analysis of Kano's Model questions were performed using the procedure previously reported (TONTINI, 2000). To determine the level of consumer satisfaction or dissatisfaction about the presence or absence of an attribute, a modified methodology to identify attributes inside Kano's Model was developed. This allows a more in-depth identification of the attributes and their classification as attractive, one-dimensional, must be or neutral (TONTINI et al., 2007). The scale used to answer functional and dysfunctional questions allows consumers to better express their level of satisfaction [extremely dissatisfied (-4), very dissatisfied (-3), dissatisfied (-2), slightly dissatisfied (-1), neutral or indifferent (0), slightly satisfied (+1), satisfied (+2), very satisfied (+3) and extremely satisfied (+4)].

To obtain the attributes classification graph, the Kano+ and Kano- coefficients were calculated using the average responses of the consumers for satisfaction/dissatisfaction obtained for the functional/ dysfunctional questions, for each attribute. These coefficients were standardized from 0 to 1 through dividing by the maximum value in the scale and a dispersion graphic was plotted (Kano+ *versus* Kano-). This graph was divided into quarters: I) attractive, II) one-dimensional, III) must be, and IV) neutral, using the average of Kano+ and Kano- for all of the attributes, and the reversal area was divided using a line from zero of the Kano- axis to 1 of the Kano+ axis.

Importance-performance analysis

In order to evaluate the consumer satisfaction regarding the actual performance of the attributes, the average value for the declared actual satisfaction regarding the actual performance of the attributes was calculated (TONTINI et al., 2010), using the scale: extremely dissatisfied (-4), very dissatisfied (-3), dissatisfied (-2), slightly dissatisfied (-1), neutral or indifferent (0), slightly satisfied (+1), satisfied (+2), very satisfied (+3) and extremely satisfied (+4). A graph of satisfaction *versus* attribute performance was then plotted to observe the influence of the alteration of the attributes on consumer satisfaction, where the performance may be low (obtained from the dysfunctional question), actual (obtained from the actual satisfaction question), or high (obtained from the functional question) (TONTINI et al., 2007).

The importance-performance matrix was used together with Kano's Model to identify improvement opportunities through the construction of a bidimensional matrix of attribute performance *versus* attribute

importance. This matrix was also divided into quarters: I) major weakness, II) major strength, III) minor weakness, and IV) minor strength, using the median of all the attributes along each axis (GARVER, 2003). The performance in this matrix was presented as the consumer satisfaction regarding the actual performance, and the importance was presented as the declared/explicit importance obtained in the question about the importance of each attribute applying the scale: not at all important (1), not important (2), neutral or indifferent (3), important (4), extremely important (5).

Improvement gap analysis

Improvement gap analysis (IGA) was performed, since this method allows a comparison between the expected consumer dissatisfaction if an attribute has a low performance and the expected satisfaction if an attribute has high performance. Thus, the functional and dysfunctional questions were used together with another question about consumer satisfaction with the actual performance of the attributes applying the same satisfaction scale. The improvement gap (IG) in relation to the functional question and the dissatisfaction gap (DG) in relation to the dysfunctional question were calculated for each attribute according to previously reported. A graph of IG *versus* DG was plotted dividing into quarters: I) critical: improve, II) basic: keep current performance, III) neutral: evaluate if needed, and IV) excitement: evaluate for improvement, using the average of the gaps for all of the attributes (TONTINI et al., 2010).

Standardized gap analysis

The positive and negative gaps, that represent the levels of satisfaction with an increase or decrease in the attribute performance, were also calculated. The Gap+ is the difference between the average of the satisfaction/dissatisfaction for the functional question and the average for the actual satisfaction, for each attribute. The Gap- is the difference between the average of the satisfaction/dissatisfaction for the dysfunctional question and the average for the actual satisfaction, for each attribute. After the calculations, these two gaps were standardized by dividing by the standard deviation of all the gaps for all attributes (positive and negative) (TONTINI et al., 2008).

Subsequently, in order to highlight the gains and losses of satisfaction due to an increase or decrease in the performance of the attributes, a graph was plotted with two bars for each attribute. One bar represents the increase in satisfaction expected due to the improvement or presence of the attribute (Gap+) and the second bar represents the decrease in satisfaction expected due to the reduction or absence of the attribute (Gap-). Also, on the graph, there are two dividing lines of neutrality, that were established using the average of standardized gaps (positive and negative). A third line was added to the graphic to represent the actual satisfaction for the attributes for evaluation and a comparison with the satisfaction gaps.

It is important to highlight that the analyses of the improvement gap and the positive/negative gaps are not different methods to classify the attributes of the Kano's Model, but rather auxiliary methods to direct improvement efforts.

RESULTS

At the end of the survey period, 282 valid answers had been obtained. The results obtained in the three parts of the questionnaire applied in this study and their analysis will be detailed in the following sections.

Profiles and general preferences of the respondents

The responses obtained in the first part of the questionnaire were analyzed using descriptive analysis and Table 1 provides an overview of the general profile of the respondents. It can be observed that the participants were, predominantly, 35 to 39 years old, female, with graduate-level education, and they practiced physical activity. Most participants were not consumers of dietary supplements (shakes) and most of those who did consume dietary supplements stated that the frequency was once a week or less than once a month.

Respondents who practiced physical activity were asked to specify the activity. The answers were synthesized through categorization as 'endurance' (sports and activities that are predominantly aerobic), 'balance' (the focus is on body balance during the activity), 'strength' (activities that involve weight training), and 'flexibility' (exercises aimed at improving body flexibility). Among these categories, the responses were primarily 'endurance' activities, followed by 'strength' activities.

Among the dietary supplements, shakes were consumed by 30.7% of respondents and other products (e.g. capsules) by 1.8%, and the greatest demand for dietary supplements was from those who practiced physical activity, were female (69.01%) and 25 to 39 years old (45.1%), and the education level was higher degree (50.7%).

Table 1: Respondents Profile.

Characteristics	%	Characteristics	%
Age (years)		**Dietary supplement's consummer (*shake*)**	
13 and younger	0.4		
From 14 to 17	7.9	Yes	23.0
From 18 to 24	18.2	No	74.5
From 25 to 39	43.2	Other dietary supplement	2.5
From 40 to 59	26.8	**Dietary supplement's consumption frequency**	
60 and older	3.6		
Gender		Daily	18.8
Women	72.1	Once a week	17.2
Men	27.1	More than once a week	28.1
Non binary	0.7	At least once a month	9.4
Education level		Occasionally	26.6
Mandatory studies	8.9	(less than once a month)	
High School (completed)	3.9	**Physical activity category**	
High School (uncompleted)	10.4	Endurance	57.0
University degree	22.9	Balance	1.0
PhD or master's degree (completed or in progress)	53.9	Strength	32.5
Physical activity's practitioner		Flexibility	9.5
Yes	58.2		
No	41.8		

All of the respondents who answered that they consumed dietary supplements, regardless of the type, were asked to declare the importance of aspects for selecting dietary supplements. Figure 1 compares

the results obtained from the importance of these aspects. It can be seen that all aspects are considered important, and among the greatest importance are the function (56.3%), nutritional value (55.6%), composition/ingredients (48.4%), and flavor (39.7%). The least important aspects were the brand and the variety of flavors, which demonstrates that they are indifferent to the purchasing choices. In general, it seems that the function of the dietary supplement and its nutritional value could be the major factors for purchasing choices, although a general evaluation of the product characteristics is considered very important.

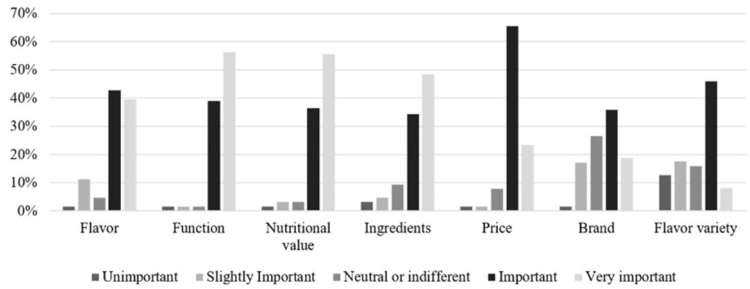

Figure 1: Importance of atributtes in the dietary supplements (shake) choice.

Modified Kano's Model

Figure 2 shows details of the classification of the attributes according to the modified Kano's model, and each point on the graph represents one attribute studied.

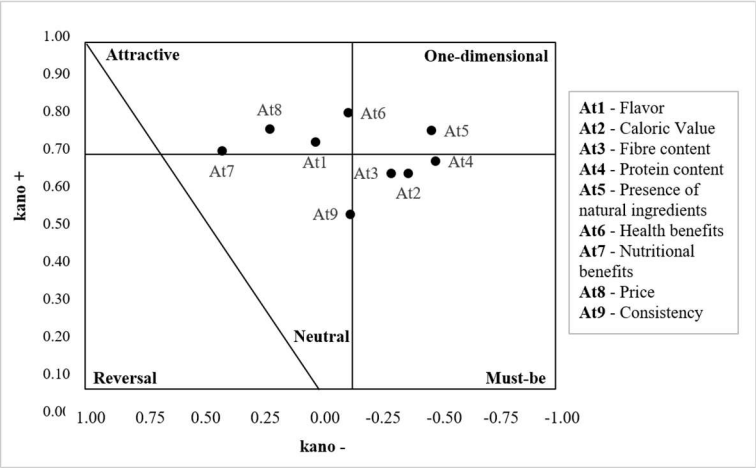

Figure 2: Classification of the attributes according to the modified Kano's model. Legend: At: Attribute [flavor (At1), caloric value (At2), dietary fiber content (At3), protein content (At4), presence of natural ingredients (At5), health benefits (At6), nutritional benefits (At7), price (At8), and consistency (At9)].

The placement of a point in the 'must be' quarter indicates that the attribute is considered basic. Thus, its presence will not be noted by consumers and will not provide a highest satisfaction; however, its absence will provide a high level of dissatisfaction. The 'must be' attributes are understood to be prerequisites and are not explicitly required (MATZLER et al., 1998). Caloric value, fiber content, and protein content were identified as 'must be' attributes. Based on the applied questionnaire, the levels of satisfaction for supplements with low caloric value (Kano+) and with high caloric value (Kano-) were then compared. When the caloric value is low, this characteristic will not be more satisfactory and will not be noted, but when it is high the consumer will be dissatisfied. The same logic applies to fiber and protein contents and in both

cases, the respondents were asked about a high content (Kano+) and low content (Kano-).

When the attribute is placed in the 'one-dimensional' quarter (performance attributes), this indicates that the satisfaction is proportional to the performance and these attributes are, generally, explicitly required by consumers (MATZLER et al., 1998). The presence of natural ingredients was classified as a one-dimensional attribute. Therefore, if natural ingredients are present in a dietary supplement (Kano+) the consumer will be highest satisfied, and their absence (Kano-) will lead to dissatisfaction.

Regarding the 'attractive' attributes, it is understood that the presence or high performance of such characteristics will provide a highest level of satisfaction but a low performance will not lead to dissatisfaction. These attributes are considered as 'key points' since they have the greatest influence on the consumer satisfaction level but are not explicitly required and not even expected by consumers (MATZLER et al., 1998). Price and flavor were placed as attractive attributes. Referring to the price, its placement indicates that a dietary supplement that is more nutritive than others with a similar price (Kano+) will provide the highest satisfaction; however, if it is more nutritive and more expensive than others (Kano-) it will not provide dissatisfaction. The same logic can be applied to similar (Kano+) and lowest (Kano-) flavor characteristics.

There is a clear trend in the predominance of health benefits and nutritional benefits in the 'attractive' attributes quarter. Nonetheless, the health benefits attribute (presence: Kano+, and absence: Kano-) is on the threshold between the quarters of 'attractive' and 'one-dimensional' attributes, and the nutritional benefits attribute (highest value: Kano+, and similar to others: Kano-) is on the threshold between the quarters 'attractive' and 'neutral' attributes. This suggests a trend where consumers are more satisfied when the health benefits are present and the nutritional benefits are highest, but if this is not the case they will not be dissatisfied. At the same time, the absence of health benefits may lead to dissatisfaction, because it tends to be placed in the 'one-dimensional' quarter. The same applies to highest nutritional benefits, which does not strongly influence consumers, being enough as similar to other dietary supplements, since it tends to be placed in the neutral quarter.

The 'neutral' quarter is the space containing aspects to which consumers are indifferent or they do not know how to make use of them or rarely/never use them (TONTINI, 2000). The consistency attribute is in the 'neutral' quarter, although it is almost at the threshold between the 'neutral' and 'must be' quarters. Hence, a highest (Kano+) or least (Kano-) consistency can be perceived as a low-influence factor in terms of consumer satisfaction or even a non-observed characteristic, but if the product presents a very low consistency, the consumer may be dissatisfied. Finally, none of the characteristics were classified as a 'reversal' attribute, an area where attributes with a very high performance that results in consumer dissatisfaction or with a very low performance that results in consumer satisfaction are placed (TONTINI et al., 2008).

Importance-performance analysis

It is apparent from Figure 3 that for dietary supplements the consumer satisfaction with the performance of the actual attributes is lower than the satisfaction when the performance was highest. In

addition, the opposite situation occurs, that is, the satisfaction of the respondents was lowest when the performance of the attributes was lower than the actual performance, except for the price attribute, where satisfaction with the actual price was lower than that for a price lower than or similar to the actual price, but with higher nutritional value.

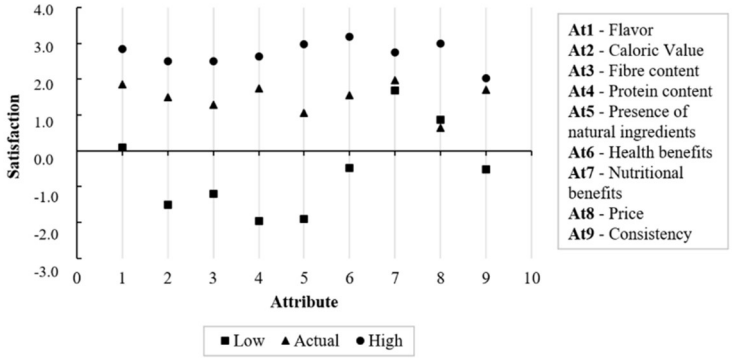

Figure 3: Satisfaction of attributes performance. Legend: At: Attribute [flavor (At1), caloric value (At2), dietary fiber content (At3), protein content (At4), presence of natural ingredients (At5), health benefits (At6), nutritional benefits (At7), price (At8), and consistency (At9)].

Figure 4 shows the matrix of declared importance *versus* satisfaction for the actual performance of attributes. The attributes placed in the quarter I need to be maintained at present, because both their performance and importance seem to be high, thus these attributes do not need immediate attention. Only the protein content and nutritional benefits were placed in quarter I.

In quarter II there are attributes that need more attention because their declared importance is high, but their actual performance is low. This means that these characteristics might represent a competitive disadvantage or a threat to the company. The price is placed in quarter II and thus it is necessary to pay more attention to decreasing the price of new dietary supplements. It can also be observed that the health benefits attribute is placed on the border between quarters I and II. It can, therefore, be assumed that the importance of health benefits is high, but the performance is partly declared as high and partly as low, so it is necessary to work on this factor and improve the performance from the viewpoint of the consumers.

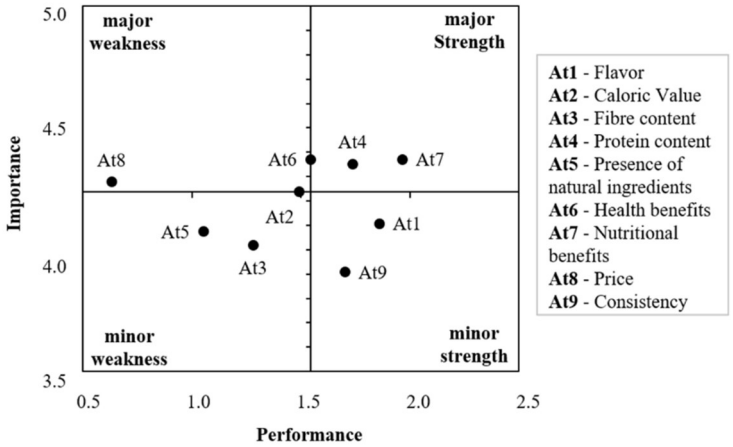

Figure 4: Importance-Performance Analysis. Legend: At: Attribute [flavor (At1), caloric value (At2), dietary fiber content (At3), protein content (At4), presence of natural ingredients (At5), health benefits (At6), nutritional benefits (At7), price (At8), and consistency (At9)].

The attributes that were placed in quarter III have low priority because although they have low performance, their importance is also declared as low. The fiber content and the presence of natural ingredients appear to be weaknesses of actual dietary supplements. However, these attributes present low declared importance and have lower priority than the others. Quarter III also partly contains the attribute caloric value, which also appears in quarter II. This finding suggests that this attribute has high performance, but the importance is partly declared as high and partly as low. Hence, in some situations, the caloric value needs to be given more attention than others.

Lastly, the attributes that do not require attention because their performance is high while their importance is low are placed in quarter IV, which in this study were flavor and consistency. Therefore, there is no need to improve these characteristics.

Improvement gap analysis

The IGA matrix is shown in Figure 5. The attributes placed in the quarter I are those considered critical to any improvement, since increasing their performance will provide an increase in satisfaction, and a decreased performance will lead to high dissatisfaction. The attributes in this quarter need immediate attention because there is low actual performance and/or consumer satisfaction may increase if the performance is improved. The attribute 'presence of natural ingredients' is placed in the quarter I and thus the more natural ingredients included the better the satisfaction and vice-versa, and this attribute needs immediate attention to achieve improvements in new products.

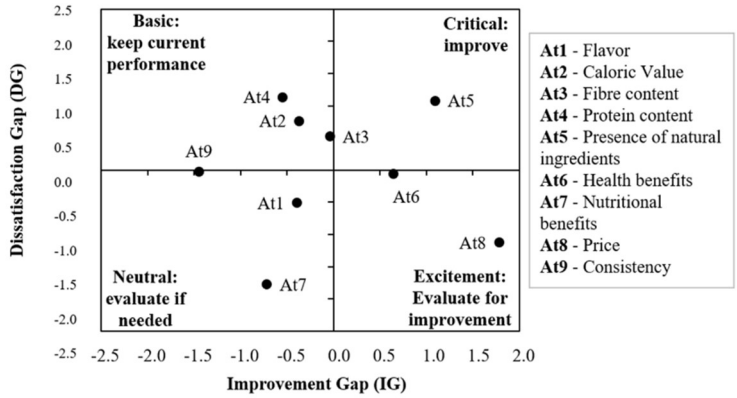

Figure 5: Improvement Gap Analysis Matrix. Legend: At: Attribute [flavor (At1), caloric value (At2), dietary fiber content (At3), protein content (At4), presence of natural ingredients (At5), health benefits (At6), nutritional benefits (At7), price (At8), and consistency (At9)].

The attributes in quarter II (the basic attributes) do not necessarily need to be improved, however, attention is required to ensure that the performance does not decrease because this might lead to dissatisfaction. The caloric value and protein content attributes were placed in quarter II, possibly because consumers are accustomed to these characteristics in actual dietary supplements. It can also be observed that the fiber content attribute is placed in quarter II but is very close to quarter I. Thus, this attribute may merit immediate attention since an increase in its performance could increase the level of consumer satisfaction.

The attributes in quarter III are considered neutral. An improvement in their performance will not lead to a higher level of satisfaction, and their removal would not lead to high dissatisfaction. The flavor and the nutritional benefits need no attention since both are in quarter III. It can also be observed that the attribute consistency is placed between quarters II and III, with a greater trend toward quarter III. Thus, this may be a neutral attribute, or if its performance increases it could provide higher consumer satisfaction.

The attributes in quarter IV are considered attractive. Their absence will not lead to high dissatisfaction but if one of these attributes is present or improved the consumer satisfaction may increase. Therefore, the need for the improvement of the attributes in quarter IV requires evaluation, since in some cases it could enhance the competitiveness of the product when offered or improved. The attractive attributes tend to be classified both in quarter IV and II and the placement will be dependent on the actual performance and whether or not consumers are accustomed to the attribute. This situation occurs because when the performance increases and consumers become accustomed to an attractive attribute, the Gap+ decreases, and the Gap- increases (the consumer does not want to lose the benefit), shifting the placement from quarter IV to II.

The price is placed in quarter IV, thus it does not promote high consumer dissatisfaction when it is highest. This suggests that when the consumers evaluate the dietary supplements they take into consideration the benefits rather than the price; however, the alteration of this factor may lead to better satisfaction. The attribute health benefits was also placed in quarter IV, suggesting that consumers pay more attention to nutritional benefits rather than health benefits in dietary supplements, and subsequently, they are not dissatisfied with the absence of the health benefits attribute. The health benefits attribute is very close to quarter I, so it can be treated as a critical point that needs attention and improvement in order to increase the level of consumer satisfaction.

Standardized gap analysis

Figure 6 shows the results obtained from the classification of the attributes of the dietary supplements using the standardized gaps. An attribute is considered significant as a potential generator of satisfaction or dissatisfaction when the positive and negative gaps cross the neutrality lines (TONTINI; SANT'ANA, 2008). If the increase in satisfaction is higher than the average of the standardized gaps, the improvement or offer of the attribute will be considered relevant. The same applies to the consideration of an attribute as a significant potential generator of dissatisfaction when this attribute is absent.

The attributes that presented the highest gain in satisfaction when they are present in the dietary supplement are the following: the presence of natural ingredients, health benefits, and price. Thus, health benefits and price attributes are considered 'attractive' and do not provide dissatisfaction if absent, and the presence of natural ingredients is classified as 'one-dimensional' because, along with the satisfaction with its presence, its absence will provide significant dissatisfaction. Additionally, the attributes caloric value, fiber content, protein content, and consistency were identified as those which provide high dissatisfaction when absent but their presence does not lead to a high level of satisfaction. Thus, these four attributes are classified

as 'must be'.

Furthermore, the attributes flavor and nutritional benefits lie between the neutrality lines, therefore, their presence or absence does not generate significant satisfaction or dissatisfaction. Lastly, the graph in Figure 6 presents a line showing the gap between consumer satisfaction with the actual consumed products and general satisfaction (considering all of the respondents). It can be observed that the characteristics studied have only positive gaps and the highest ones are the flavor, protein content, nutritional benefits, and consistency.

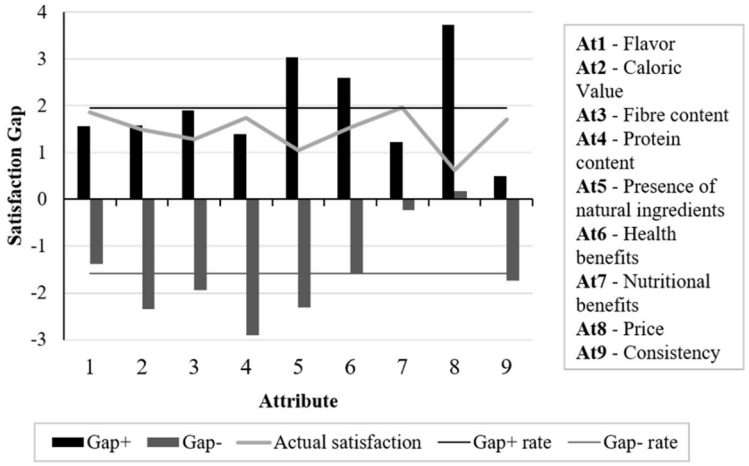

Figure 6: Standardized Gap Analysis.

New product development

The respondents were asked to indicate their opinion about a new dietary supplement containing palm heart bark and an edible mushroom. Analysis of the results showed that 72.6% of the answers were 'interesting' and 13.2% were 'interesting with conditions'. Thus, interest in this new product was found to be high, and the conditions required by the consumers included: be palatable, pleasant flavor, vegan, sugar-free, the ingredients need to be clear, presence of natural ingredients, high consistency, absence of large particles, maintenance of actual dietary supplement functions, gluten-free, proven and explicit benefits, explicit differential factors for the product and the environment, and with no negative effects. A minority of participants (14.3%) indicated 'no interest' in this new product suggested, and their explanations were: they do not use dietary supplements, they lack knowledge regarding the benefits, they are skeptical of the benefits, and/or they have no interest in the proposed ingredients.

Regarding a dietary supplement with a high content of protein, fiber, and β-glucans, the majority of respondents expressed interest in the proposed dietary supplement, answering 'very interesting' (56.8% for protein and fiber content, and 67.7% for β-glucans content) and 'interesting' (32.7% for protein and fiber content and 23.3% for β-glucans), whereas only a small number of respondents indicated that the proposal is 'indifferent' (around 8%) or 'slightly interesting' and 'not at all interesting' (less than 2%). The negative answers were explained by the non-use of dietary supplements or skepticism regarding the benefits.

The responses obtained for shakes flavor were synthesized through the categorization of flavors as sweet, salty, fruity, and neural. Whilst a minority choose salty (1.5%) and neutral (0.4%) flavors, in general,

the participants preferred sweet (63.4%) and fruit (34.7%) flavors and the most commonly mentioned flavors were chocolate (55.4%) and vanilla (42.2%).

DISCUSSION

This study aimed to analyze the 'voice of the consumer' applying Kano's Model in a questionnaire on a new functional food product. That appears to be the only academic study that describes the application of this methodology to the food industry for consumer research in the early stages of NPD. Also, there were not found studies that applied auxiliary methods to direct improvement efforts besides Kano's model. So far, the Kano's model has been applied to study products that have already been commercializing (LAGERKVIST et al., 2017; RIVIÈRE et al., 2006).

It is known that NPD needs to be based on consumers' needs and desires (LAGERKVIST et al., 2017), then to explore the Kano's model and the auxiliary methodologies in the early stages of NPD can lead to 'ideal' product for consumers, before laboratory scale and manufacturing, minimizing resources spend. In this study, the non-linear relation between the performance of attributes and consumer satisfaction proposed by Kano's model, and the classifying of the attributes, aid an understanding of the view of consumers/respondents regarding certain dietary supplement characteristics.

According to the comparison of current products and new ones, the results indicate that the new products, broadly, needs attention to have more flavor, lower caloric value, higher fiber and protein contents, more natural ingredients, greater health and nutritional benefits, lower price, and any consistency, than the current dietary supplements, to have greater consumer satisfaction. The nutritional benefits attribute was indicating as low priority, and this finding was unexpected because one of the main characteristics of dietary supplements is the nutritional value, which is associated with its function. Thus, it could be that consumers are accustomed to its presence, and the significance is implicit, or they do not have a clear perception of this attribute, and they do not pay attention to nutritional value when the food is labeled as healthy or with high protein content. It is, therefore, important to indicate the characteristics of the food, such as functional and health benefits, to attract the attention of consumers (BOLUDA et al., 2017). Finally, the presence of health benefits may provide consumer satisfaction and even offer a competitive advantage to the company and the product.

Together these results provide important insights into consumer needs and desires, help to make recommendations for NPD, and can help to identify the priorities to focus efforts to reach the 'ideal' new dietary supplement. Besides observing the trends in consumer behavior, it is important for the food industry to search for innovations with new scientific approaches and techniques of food transformation and introduction. For this reason, it is interesting to develop new products with added value that provide convenience, nutritional factors, functional properties, variety, and economic savings (BETORET et al., 2011).

Dietary supplements have become a frequent source of essential nutrients when these are not provided by food ingestion alone (BERTULUCCI et al., 2010). They add a high nutritional value to the diet, enriching, complementing, and/or supplementing the food intake and providing benefits in terms of life

quality and wellness (FERREIRA et al., 2016). The part of the current study regarding NPD showed a high interest in a new dietary supplement containing palm heart bark and an edible mushroom. Most answers demonstrate interest and some respondents require conditions for the new product, which show the 'free-from products', especially gluten-free diet, as an increasingly popular choice because consumers perceive these products as more healthful (PRADA et al., 2019). Therefore, the results emphasize that clean labels (MATTAR et al., 2018) and naturalness has been presenting as an influencing factor in consumers' acceptance of novel technologies (HARTMANN et al., 2018).

The respondents' answers highlight an interest in dietary supplements that contain high contents of protein, fiber, and β-glucans, but it is necessary to ensure that all of the benefits provided by the product are clearly informed. Therefore, it is important to consumer awareness about ingredients to maintain align the health motivation and the information strategies for nutritional purposes (BORNKESSEL et al., 2014). These results are in accordance with the rising demand for products that offer more than the basic necessities along with increasing awareness regarding environmental sustainability and healthy food (VAN BUSSEL et al., 2019). This scenario creates an opportunity for the food industry in relation to adding value and seeking innovation for new products.

The use of agro-industrial waste from palm heart processing (bark) may generate products of interest for human consumption. This by-product is considered a promising source of compounds with high dietary fiber content and can be used in biotechnological processes, using edible mushrooms such as *Lentinula edodes*, to obtain new products, such as dietary supplements, thus minimizing the adverse environmental impacts (PASKO et al., 2022; TIMM et al., 2022). These fungi contain significant amounts of protein, dietary fiber, minerals and vitamins, and also are used in the prevention of diseases such as hypertension, hypercholesteremia, cancer and diabetes because of its diverse bioactive compounds, such as β-glucans (TIMM et al., 2019). Consequently, the consumer demands observed in this study can be met through the generation of a product that fulfills nutritional and health needs, being a source of nutrients and bioactive compounds, while reducing the environmental problems associated with the inadequate disposal of these residues.

The questionnaire and analysis applied in this study showed good potential for application in the early stages of the food product development process since they allow the consumer needs and desires to be measured in detail. The use of the modified Kano's model and the auxiliary methods for food consumer-oriented studies was found to be a promising methodology since the results are aligned with the means-end chain analysis (GRUNERT et al., 2014). These demonstrate the importance of the consumers in NPD, emphasizing the need for appropriate methodologies to analyze consumer behavior.

The current study data must be interpreted with caution and it is important to bear in mind that this study does not consider other factors and attributes that possibly affect dietary supplements choice, once food choice is a mixing of variables as biological, physiological, psychological, and socio-cultural (CLICERI et al., 2018).

CONCLUSIONS

This paper describes the application of modified Kano's Model to a questionnaire used to analyze the 'voice of the consumer' with regard to a new functional food product. Thus, the results should help food companies and researchers to formulate adequate product development practices, strategies, and consumer research, as well as to determine the characteristics of consumer behavior. In addition, this study highlights a market opportunity in the form of a product developed through biotechnology, with natural compounds that are both nutritive and bioactive, which can enhance human health and wellbeing as well as environmental sustainability.

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