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Article

Technical requirements of a convenience food to meet the demands of a customer segment

Requisitos técnicos de um alimento de conveniência para atender às exigências de um segmento de clientes

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Abstract: Meeting customer needs is a step towards achieving the success of a product or service. As dynamic lifestyles have been taking place in society, the demands regarding food have changed, and the easiness of preparation and healthiness have become demanded by a segment of customers. Convenience foods are examples to fulfill these changes and stand out for their practicality, but with reservations about healthiness. Considering these new demands and the importance of incorporating customer needs into the product, this study aimed at defining the technical characteristics of an instant noodles that meets consumer demands in terms of practicality and healthiness using the quality function deployment method. A questionnaire was developed and applied to a group of target customers with higher acceptability and receptivity to this type of product. This group was chosen through factorial and cluster analysis. The technical requirement that most impacted customer needs was the amount of protein (mushroom), which met the health requirement, but had a strong influence on the final price of the product.

Keywords: healthy food; nutritional value; mushroom; protein source; target customer.

Resumo: Atender às necessidades dos clientes é um passo para alcançar o sucesso de um produto ou serviço. Com as mudanças no estilo de vida que vêm ocorrendo na sociedade, as demandas com relação à alimentação sofreram alterações, e a facilidade de preparo e a saudabilidade passaram a ser exigidas por um segmento de clientes. Os alimentos de conveniência são exemplos que atendem a essas mudanças e que se destacam pela praticidade, mas com reservas quanto à saudabilidade. Considerando essas novas demandas e a importância de incorporar as necessidades dos clientes ao produto, o objetivo deste trabalho foi definir as características técnicas de um macarrão instantâneo que atendesse às demandas do consumidor com relação à praticidade e à saudabilidade, empregando o método de desdobramento da função da qualidade. Um questionário foi elaborado e aplicado para um grupo de clientes-alvo com maior aceitabilidade e receptividade a esse tipo de produto, o qual foi escolhido por meio da análise fatorial e de "cluster". O requisito técnico que mais impactou as necessidades dos clientes foi a quantidade de proteína (cogumelo), que atendeu ao quesito de saudabilidade, mas teve forte influência no preço final do produto.

Palavras-chave: alimento saudável; valor nutricional; cogumelo; fonte de proteína; cliente-alvo.

1. Introduction

Organizations define their strategies to meet stakeholder requirements, and, among them, the customer can be considered as the main one. As customers express their needs subjectively, the challenge is to incorporate them into the product or service through technical characteristics and requirements. Darmawan et al.[1] highlighted that the main customer demands regarding automotive batteries were durability, performance, price and being environmentally friendly. Two main requirements were pointed out to meet these demands: one referring to the useful life of the product and the preservation of the environment, absorbent fiberglass blanket (AGM), and another to the reduction of the cost met by the manufacturing techniques. Franco Junior et al.[2] defined the main technical characteristics for the service area of an agricultural tractor dealership: percentage of loyal customers; deadline; average time of professional training. Dias Júnior et al.[3] described that the main demands from customers for charcoal to be used for barbecues were easiness of ignition, formation of embers and flames, and price. Thus, the technical characteristics of wood quality and carbonization are fundamental for barbecue charcoal to meet customer demands. Marcos and Jorge[4] observed that the shelf life and the degree of firmness of table tomatoes are indispensable technical requirements to guarantee the external appearance and durability demanded by the customer.

The food sector has great importance in terms of political, economic, social, scientific, and cultural aspects[5]. The importance of this sector and its trends highlights the needs of defining the appropriate characteristics of the food to serve the consumer. Waisarayutt and Tutiyapak[6] highlighted that the rice noodle consumer's demands are focused on the nutritional value of the seasoning, the softness of the noodles and the easiness to use the packaging. Product rehydration time and packaging material were the main technical requirements to meet the requests. Park et al.[7] identified the needs of North American customers for bulgogi, one of the most traditional dishes in Korea: flavor, freshness, taste, tenderness, and juiciness. To meet these demands, attention must be paid to controlling marinating time, locating the bulgogi menu, improving the cooking and serving processes, developing the recipe by parts of the meat, and using various seasonings. Other studies focused on the technical requirements of food can be cited, such as the one by Pinto and Paiva[8] for functional dough for pies; Bevilacqua et al.[9] approaching the quality of virgin olive oil; Cardoso et al.[10] regarding organic fruit jelly; and Djekic et al.[11] over the mushroom *Agaricus bisporus* Portobello. The development of processes such as airtight closure, canning in glass[12] and technologies such as refrigerators, freezers, and microwave ovens, allowed a raise in shelf life and facilitated the use of food[13],[14],[15].

In recent decades, three trends have been highlighted for the sector[16]: healthy food with a focus on health; the convenience ones, ready to use; and sustainable options, such as vegan. Convenience ones fit into today's lifestyle, allowing easy preparation and time saving. However, there are still reservations regarding the use of convenience foods, among them the low amount of fiber, the presence of unhealthy fats and additives, besides the excessive use of salt. Due to the need to meet customer demands, the importance of practicality and the reservations regarding the healthiness of convenience foods, this study aimed at defining the technical characteristics for an instant noodle that met the consumer's demands regarding practicality and healthiness.

2. Material and methods

Ethical approval for the involvement of human subjects in this study was granted by Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo (Esalq/USP), Research Ethics Committee. Reference number: 01215418.7.0000.5395.

2.1 Quality function deployment (QFD)

To reach the aim of this study, the quality function deployment (QFD) methodology was applied, as proposed by Cheng et al.[17] and Govers[18]. The QFD methodology was developed in Japan in the late 1960s by Yoji Akao and Shigeru Mizuno and was based on transforming customer demands into technical specifications that are later deployed to plan production[19]. The first QFD matrix, also called the house of quality (HOQ), was developed in seven steps (Figure 1).

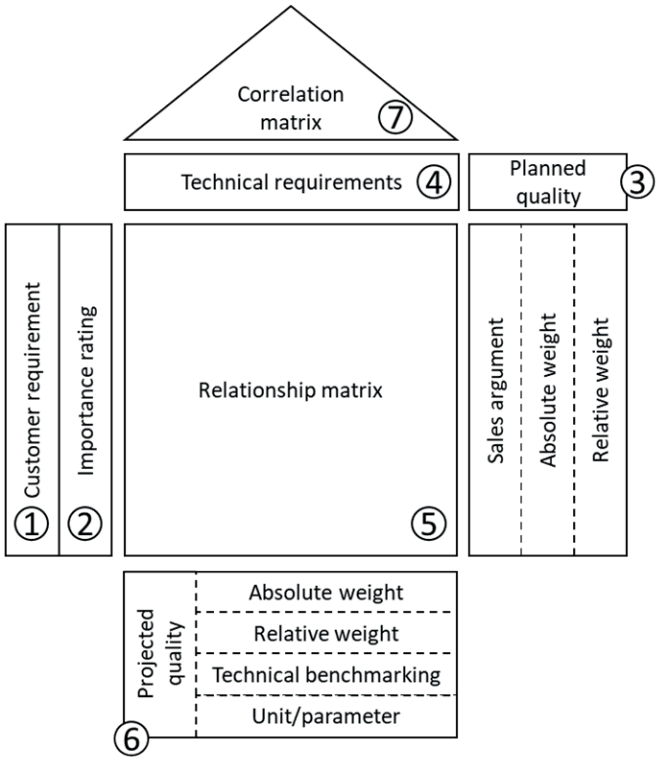

Figure 1. Steps used in the development of the matrix (house of quality)
Note: 1- customer requirement; 2- importance rating; 3- planned quality; 4- technical requirements; 5- relationship matrix; 6- projected quality; 7- correlation matrix
Source: Adapted from Cheng et al.[17] and Govers[18]

In step 1, the items referring to the customer requirement (WHATs) were established. To this end, a technical team was composed by six members of the extension group in food sciences (ESALQ Food), based at Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo (Esalq/USP), Brazil, and a mediator, the first author of this study. From team meetings, being supported by the brainstorming technique and bibliographical research, the preliminary attributes of the customer requirement (CR), the "WHATs", were defined. Next, a preliminary questionnaire was prepared based on the one proposed by Malhotra[20], applied to adjust the "WHATs" and to obtain the minimum number of individuals to be interviewed. Based on the results, the team made the adjustments and defined the sample size according to what proposed Cochran[21] (Equation 1).

$$No = \frac{(t \times s)}{(r \times X)} \quad (1)$$

where, No: was the number of individuals in the sample; t: was the student's t, 95% confidence interval; r: was the relative error, desired accuracy level of 10%; s: was the standard deviation; and X: was the average.

Step 2 involved the application of the questionnaire to obtain the importance rating (IR), referring to each "WHAT" and the consumer profile. The IR had a one-to-five scale, in which 1 was considered least important and 5 was the most important. The interviews to complete the questionnaires were carried out in person at two commercial establishments in different cities in the state of São Paulo, Brazil, and online, using the Google Forms digital platform and being disseminated on social networks and email to the Esalq community. The profile of the target customer was defined based on IRs values through factorial and exploratory analysis and clustering, according to Hair Jr. et al.[22], using Minitab 18.0® software.

In step 3, planned quality, the product concept was established. A value referring to the sales argument (SA), understood as a strategic benefit of the item, was assigned by the technical team to each "WHAT". The defined values were: 1 considered as neutral; 1.2 as medium; and 1.5 as strong. Then the absolute and relative weights of each item were calculated (Equations 2 and 3).

$$AW_i = IR_i \times SA_i \quad (2)$$

where, AWi: was the absolute weight of the required quality of the i-nth attribute (dimensionless); IRi: was the importance rating of the i-nth attribute (dimensionless); and SAi: was the sales argument of the i-nth attribute (dimensionless).

$$RW_i = \left(AW_i \times \left(\sum_{i=1}^{n} AW_i \right)^{-1} \right) \times 100 \quad (3)$$

where, RWi: was the relative weight of the customer requirement of the i-nth attribute, %.

The team's definition of the technical requirements, the "HOWs", to meet the customer's requirements, the "WHATs", took place in step 4, regarding extraction. This definition was carried out in meetings using the brainstorming technique, and the characteristics were grouped through the decision tree. In step 5, an evaluation was carried out by the team to define the values (VI) of the relationship between the items "WHATs" and "HOWs". The value nine (9) was assigned for the relationship considered strong, three (3) for average, one (1) for weak and zero (0) for inexistent. Based on these values and the relative weight of each required quality item (RWi), the value for each relationship was established (Equation 4).

$$AV_{ji} = RW_i \times VI_{ji} \quad (4)$$

where: AVji: was the absolute value of the relation referring to the i-th item of the customer requirement with the technical requirement j-th attribute (dimensionless); RWi: was the relative weight of the customer requirement for the i-th attribute, in (%); and VIji: was the value corresponding to the intensity of the relationship attributed to the i-th attribute of the customer requirement with the j-nth technical requirement (dimensionless).

In step 6, the prioritization and definition of values for the "HOWs" items took place, thus constituting the projected quality. Prioritization was established by calculating the absolute and relative weight of the "HOW" items, according to Equations 5 and 6. The definition of values for each technical characteristic was performed by the team.

$$AW_{ji} = \sum_{j=1}^{m} \sum_{i=1}^{n} AV_{ji} \quad (5)$$

where, AWji: was the absolute weight of the technical requirement referring to the ij-th item (dimensionless); AVji: was the absolute value of the relation referring to the i-th attribute of the customer requirement with the j-nth technical requirement (dimensionless); m: was the technical requirements items; and n: was the required quality attribute.

$$RW_{ji} = \left(AW_{ji} \times \left(\sum_{j=1}^{m} AW_j \right)^{-1} \right) \times 100 \quad (6)$$

where, RWji: was the relative weight of the technical requirement referring to the j-th item, in %; and AWji: was the absolute weight of the technical requirement referring to the j-th (dimensionless) item.

In step 7, the analysis of interdependence was carried out, correlating the technical requirements "HOW" versus "HOW". The correlation expresses, from the team's point of view, the influence that one characteristic had on the others, positive or negative. Correlation intensities were classified as: strongly positive (++); positive (+); negative (-); strongly negative (--); and nonexistent ( ).

3. Results and discussion

In step 1, according to the meetings with the project team, 25 attributes of customer requirements were defined, and based on them the preliminary questionnaire was developed and applied to a sample group of 20 randomly selected individuals. Based on the answers, adjustments were made, and the final version had 23 attributes of customer requirements, divided into five primary items: (1) sensoriality and pleasure, which included nine attributes; (2) healthiness and well-being, four; (3) convenience and practicality, seven; (4) reliability and quality, one; and (5) sustainability and ethics, two. The minimum sample size, according to Cochran[21], corresponded to 179 individuals, with 95% confidence.

With the questionnaire and the number of samples defined, step 2 was carried out through a survey to obtain the importance rating (IR) referring to the customer requirement attributes. A total of 558 interviews were carried out, 342 face-to-face and 216 online, of which 543 (97,0%) were considered valid, excluding those with more than two unanswered items. Among the total considered as valid, 170 (30,5%), a value very close to the minimum sample size, were selected through exploratory factor analysis and clustering, thus constituting the group of target consumers. This group was characterized by the importance given to the attributes of healthiness and speed in preparation, characteristics mentioned by Casini et al.[23] as a growing consumption profile, which reinforces the choice. The individuals that made up the sample of this target consumer group have, for the most part, completed higher education, worked outside the home, did not have time to prepare a more balanced diet, were interested in sports and considered healthy eating as an important factor. Of those interviewed, 54,1% were women. The results regarding the importance rating (IR mean) for the secondary level attributes (customer requirement "WHATs") and for the values of the sales argument (SA), absolute (AW) and relative weight (RW%) referring to the planned quality are presented in the Table 1.

Table 1. Importance rating (IR), sales argument (SA), absolute (AW) and relative (RW%) weights for the required quality attributes

Attributes		IR mean	Planned quality		
Level			SA	AW	RW %
Primary	Secondary				
1. Sensory and pleasure	1.1 Soft when biting	3.5	1.0	3.5	4.2
	1.2 Mild seasoning	3.8	1.0	3.8	4.5
	1.3 Defined flavor	4.0	1.0	4.0	4.8
	1.4 Pleasant smell	4.2	1.0	4.2	5.0
	1.5 Nice color	3.3	1.0	3.3	3.9
	1.6 Offering pieces of ingredients	2.8	1.5	4.2	5.0
	1.7 Presenting ingredients that do not fall apart	3.1	1.0	3.1	3.7
	1.8 Homogeneous broth	3.1	1.0	3.1	3.7
	1.9 Creamy broth	3.1	1.0	3.1	3.7
2. Healthiness and well-being	2.1 Be favorable to health	4.6	1.0	4.6	5.5
	2.2 Does not contain gluten	2.4	1.2	2.8	3.3
	2.3 Does not contain lactose	2.2	1.5	3.3	3.9
	2.4 Presenting healthy ingredients	4.5	1.5	6.8	8.1
3. Convenience and practicality	3.1 Attractive label	2.6	1.5	3.8	4.5
	3.2 Easy-to-open packaging	2.9	1.0	2.9	3.5
	3.3 Offer additional cutlery	1.4	1.0	1.4	1.7
	3.4 Easy to carry/carry	2.2	1.0	2.2	2.6
	3.5 Fast cooking	2.8	1.0	2.8	3.3
	3.6 Long shelf life	2.7	1.0	2.7	3.2
	3.7 Be easy to prepare	3.4	1.2	4.2	5.0
4. Reliability and quality	4.1 Offering clear information about the product on the label	4.4	1.0	4.4	5.3
5. Sustainability and ethics	5.1 Low environmental impact	4.2	1.2	5.0	6.0
	5.2 Affordable price	3.7	1.2	4.4	5.3

Source: Original search results

According to the scale adopted for the IR, mean values greater than 4.0 were considered very important (5); greater than 3.0 up to 4.0 important (4); greater than 2.0 up to 3.0 some importance (3); greater than 1.0 to 2.0 little importance (2); and zero to 1.0 not important (1). Five attributes, 21,7% of the total, obtained values above 4.0 and, with this, they could be considered as critical to meet the needs of customers, which, in descending order, were: 2.1- to be favorable to health; 2.4- presenting healthy ingredients; 4.1- offering clear information about the product on the label; 1.4- pleasant smell; and 5.1- low environmental impact. The first two attributes were associated with the primary level, healthiness and well-being, and the third with offering clear information about the product on the label. Nine attributes (39.1%) had average values classified as important, i.e., values above 3.0 to 4.0. Only one (4.3%) was considered unimportant, with a mean value of 1.4. The distribution of the degree of importance for the attributes of quality, needs and desires of the customers is presented in Figure 2.

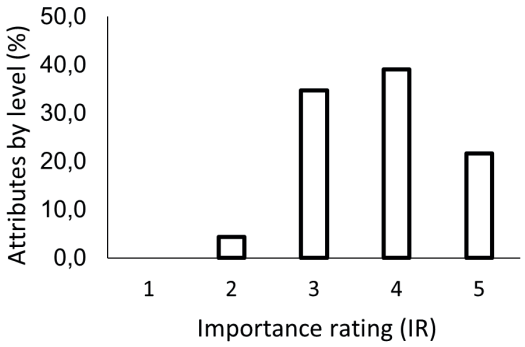

Figure 2. Mean values obtained (%) for the secondary level attributes and classified according to the scale of the importance rating (IR)
Source: Original search results

In step 3, planned quality, in which the product concept was established, the sales argument (SA) reflected the team's opinion regarding the benefit that each attribute could present as a highlight in relation to competitors. Among the 23 attributes, five were classified as strong; of these, only one was classified as very important according to the scale for IR: 2.4- presenting healthy ingredients.

Based on the importance rating, step 2 of the matrix (house of quality), and the sales argument, an item of step 3, the values of absolute and relative weights were calculated. The five priority attributes for product development were, in decreasing order of relative weight (RWi%): 2.4- presenting healthy ingredients (8.2%); 5.1- low environmental impact (6.0%); 2.1- be favorable to health (5.6%); 4.1- offering clear information about the product on the label (5.3%); and 5.2- affordable price (5.3%). The item 5.2, affordable price, replaced item 1.4, having a pleasant smell, due to the influence of the sales argument in the formation of planned quality values.

These five attributes, out of a total of 23, were responsible for 30.4% of the relative weight (RW%) of the planned quality. The attribute 4.1, offering clear information about the product on the label, was increasingly required by consumers who were interested in knowing about processing techniques and food composition[24], in addition to the clean label helping to choose healthier products[25]. The affordable price attribute was considered with average SA because the team understood that, even if the price to be fixed was above the market, it was possible to use the favorable benefit/cost ratio as a strategy associated with the concept of healthiness and practicality, thus establishing a differential in relation to traditional products. Machado et al.[26] highlighted that the market had pricing policies for convenience products to influence consumers by price and achieve large sales volumes.

The conversion of the customer's voice into technical characteristics (requirements) of the product carried out by the team resulted in 32 requirements, “HOWs”, from the 23 attributes of the required quality, “WHATs”, step 4 of the house of quality. The team then identified the cause-effect relationship between technical characteristics and customer requirements, process referring to step 5. Based on these values and the relative weight (RWi%) of each required quality item, the final value for each relationship was determined, step 6 of the matrix. The results of the relationship for each technical requirement were added and the weights, absolute and relative, calculated, thus allowing to obtain the classification, in order of importance, for the projected quality (Figure 3).

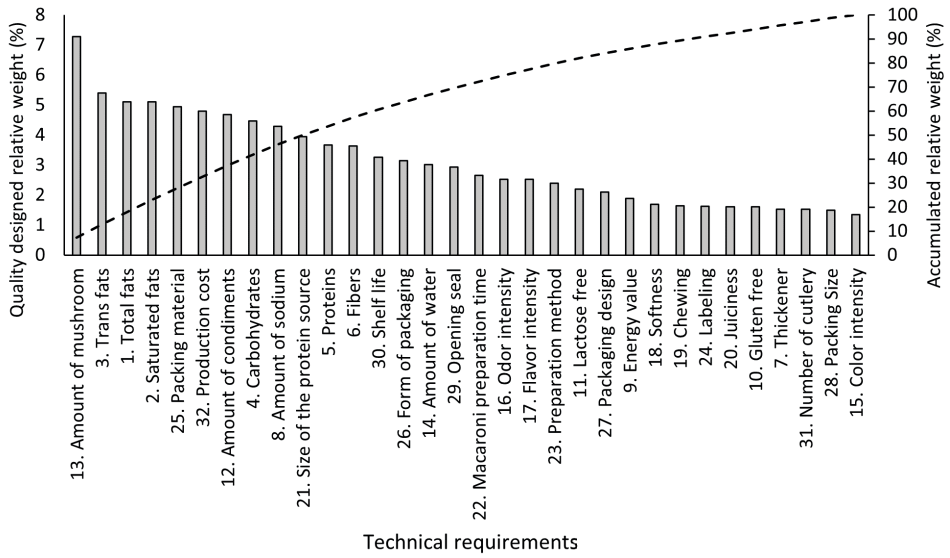

Figure 3. Relative weights (RW%) of technical requirements
Source: Original search results

The technical requirement that stood out the most was the amount of protein, with 7.3%. The option chosen as a protein source was the shiitake mushroom (*Lentinula edodes*), which, to date, was not used in products of this nature, being described as a macrofungus with a desirable complex flavor and with medicinal properties for the prevention of diseases[27]. The team established that the expected amount to be inserted was 13 grams of shitake per 80 grams of packaging. This requirement was associated with 15 attributes of customer requirements, 12 with a strong relationship, corresponding to 70.2% (RWi%) and meeting four of the five attributes considered as priorities, except for item 5.1, low environmental impact. The evaluation of interdependence by the team indicated that the amount of protein, mushroom, had a strong positive correlation with four requirements associated with taste, odor, color and juiciness (Figure 4).

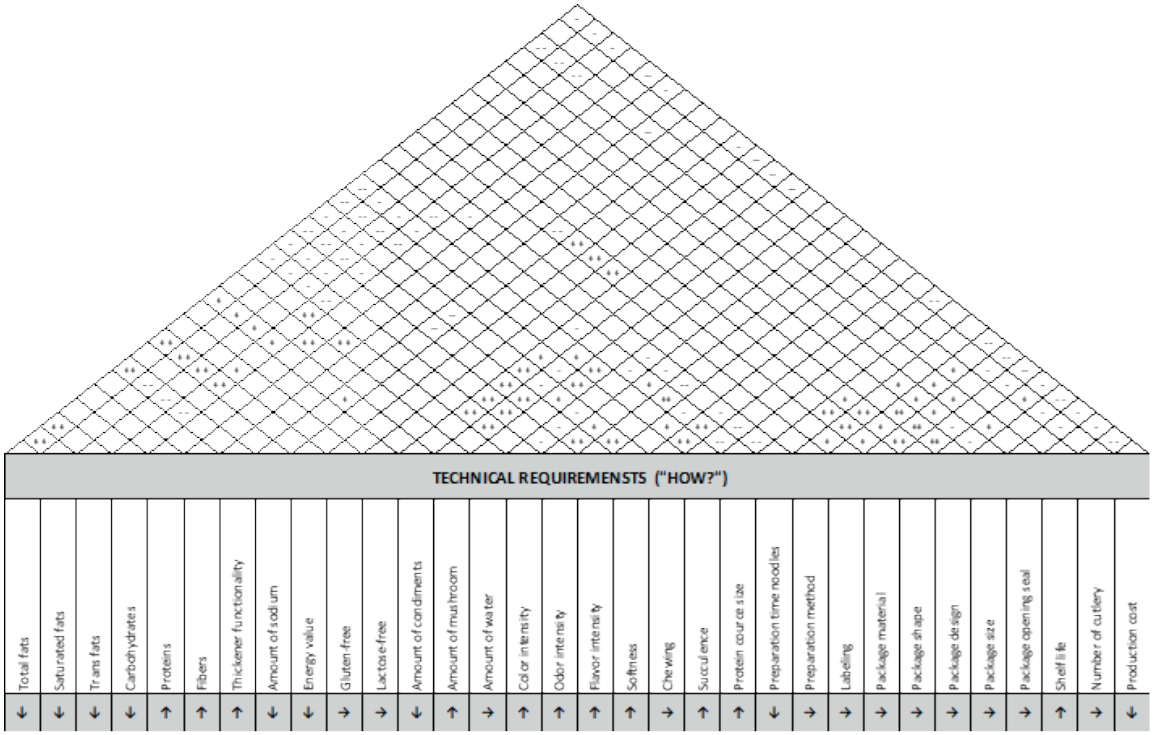

Figure 4. Matrix of correlation of technical requirements
Source: Original search results

The mushroom is an ingredient with nutritional and medicinal qualities[28]. Dried, it has an umami flavor, considered as the fifth flavor, along with saltiness, sweetness, bitterness and acidity, promoting the feeling of pleasure when eating. This sensation is attributed to the presence of free glutamate that enhances the taste of food[29]. However, a critical point of increasing quantity was the increase in production cost, strong negative correlation, affecting the required quality item 5.2, affordable price. Foods with better nutritional value, mainly with protein sources, such as mushrooms, cost more per calorie[30]. The price can be used as a sales argument highlighting the favorable benefit/cost ratio, due to the greater nutritional value. With this argument, it is possible to justify the higher price to be paid; if consumers perceive the product's superior quality as justifying a higher price, many are willing to pay more.

Fat contents (trans, total and saturated) occupied the second, third and fourth position in the classification of technical requirements and were associated with 22 attributes of the quality required by the customer, two of which were priorities and were related to healthiness and well-being: 2.1- be favorable to health; and 2.4- presenting healthy ingredients. The decrease in its contents, in addition to meeting customer requirements, had a positive impact on healthiness by reducing the technical requirement of energy value, but strongly affected flavor and chewing, by making it difficult to mechanically break the product. The packaging material, fifth in the ranking, was associated with ten items of planned quality, one of them a priority: having an affordable price. The material specified was thermal expanded polystyrene, considered to have a strong positive influence on the shape and design of the package, but affecting the price in a strongly negative way. The packaging material was one of the technical requirements highlighted by Waisarayutt and Tutiyapak[6] to meet the consumer's requirements of rice noodles, including ease of use.

Associated with hypertension, a chronic disease that affects millions of people, sodium is present in most industrialized products, including instant noodles. On the product proposal, the team reduced the amount of this technical characteristic by approximately 70% in relation to the traditional product, meeting the customer requirement's items related to healthiness and well-being. The reduction of the levels strongly affected the technical requirements of flavor intensity and smoothness in a strongly negative way. Harada-Padermo et al.[31] highlighted that the reduction of sodium could change the flavor, impairing the acceptance of the product by the consumer.

Conclusion

The addition of the mushroom met the health and flavor requirements of the product, but the quantity should be evaluated so as not to raise the price above values that impair the beneficial/cost ratio perceived by the customer. The target customer adopted in this study belonged to the market segment focused on the healthiness and practicality of the product, but other groups may be potential markets to be explored with different perceptions regarding the required quality.

The sharp reduction in the amount of sodium was positive to meet healthiness, but may reflect on the acceptance of the product by the customer due to the change in flavor.

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