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INVESTIGACIÓN

Study of the perception and the acceptability of mayonnaise ingredients among Mexican consumers and its global preference

Estudio de la percepción y aceptabilidad de los ingredientes de mayonesas en consumidores mexicanos y su preferencia global

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ABSTRACT

Introduction: Due to the interest in healthcare through the diet, there is an increase in the reformulation of products to reduce their fat content. The mayonnaise is a dressing product recognized by its high content of fats (75 %); the reduction of fat content implies the use of additives that can be perceived as harmful and are poorly acceptable by the consumers. The objectives of this study were to study the perceptions and the acceptability of the ingredients used in mayonnaise, as well as the global preference of these products.

Methodology: The preferences of traditional and low-fat mayonnaise were studied using a survey applied to 303 participants. The perception and acceptability of ingredients (on a scale of 1 – 5) was determined with focus groups of 12 participants.

Results: The selection of mayonnaise was based on the nutritional content (in women) and on a specific commercial brand (in men) ($p < 0.05$). The low-fat content and the ingredients from natural sources are perceived as healthy characteristics of the product (64 % and 27 % from the total of the participants, respectively). The 18 – 29 years old participants demonstrated more interest in products with probiotics, while the people from 51 – 60 age range preferred ingredients from natural sources ($p < 0.05$). The ingredients with familiar names such as egg yolk, vinegar, lime juice, spices, and mustard showed high acceptability scores (> 4 acceptability score).

Conclusions: The low fat- mayonnaise is the most demanded in the market. However, there is interest in mayonnaise containing ingredients with natural sources or supplemented with probiotics. The perception and the acceptability of the ingredients are positively influenced by its nature (simple names) and origin (from natural sources).

Keywords: Feeding Behavior; Food Ingredients; Condiments; Food Additives; Food, Formulated

Entry terms: acceptability; natural ingredients; dressing; product design

RESUMEN

Introducción: Debido al interés del cuidado de la salud a través de la dieta, se ha incrementado la reformulación de productos para reducir su contenido de grasa. Un producto reconocido por su alto contenido de grasa (75 %) es la mayonesa; la reducción de grasa requiere el uso de diferentes aditivos que pueden ser percibidos como dañinos y son poco aceptados por el consumidor. Los objetivos de esta investigación fueron estudiar la percepción y la aceptabilidad de los ingredientes utilizados en mayonesas, así como la preferencia de dichos productos.

Metodología: Se diseñó y aplicó una encuesta a 303 consumidores de mayonesa para determinar sus preferencias en productos tradicionales y reducidos en grasa. Para determinar la percepción y aceptabilidad (en escala de 1 – 5) de los ingredientes, se llevaron a cabo grupos de enfoque integrados por 12 participantes.

Resultados: La tendencia de elección de mayonesas fue con base en su contenido nutrimental (en mujeres) y en una marca comercial específica (en hombres) ($p < 0.05$). El bajo aporte de grasa y el uso de ingredientes de fuentes naturales se percibieron como características saludables del producto (64 % y 27 % del total de participantes, respectivamente). Los participantes entre 18 – 29 años mostraron un mayor interés en la suplementación con probióticos, mientras que las personas de 51 – 60 años prefirieron productos con ingredientes de fuentes naturales ($p < 0.05$). Los ingredientes con nombres conocidos como la yema de huevo, vinagre, jugo de limón, especias y mostaza mostraron calificaciones altas de aceptabilidad (> 4 de aceptabilidad).

Conclusiones: Las mayonesas con bajo contenido en grasa son las más demandadas en el mercado. Sin embargo, existe interés en mayonesas que contengan ingredientes de origen natural o suplementadas con probióticos. La percepción y la aceptabilidad de los ingredientes están positivamente influenciados por su naturaleza (nombres simples) y origen (de fuentes naturales).

Palabras clave: Conducta Alimentaria; Ingredientes Alimentarios; Condimentos; Aditivos Alimentarios; Alimentos Formulados

Entry terms: aceptabilidad, ingredientes naturales, aderezos, aditivos alimentarios, diseño de productos.

KEY MESSAGES

- The mayonnaise healthiness is related to the low-fat content in the product.
- Women select the mayonnaise product based on the nutritional content, while men prefer a specific commercial brand.
- The Mexican population from 41 – 50 years old is interested in using natural ingredients in the product, while young people (18 – 29) are interested in probiotics.
- There is a lack of knowledge among the Mexican population regarding the ingredients used in mayonnaise. Still, they are interested in increasing their understanding of the origin and function of the ingredients in the product.

INTRODUCTION

Nowadays, consumers' demand trends focus on preventing diseases and enhancing their well-being through diet. These thoughts have increased the development of healthier food products such as organic foods or natural ingredients (natural-based foods) ¹. This fact has popularized both food products ² and it is predicted that their total market value could reach 47 billion dollars in the following years ³. From this perspective, the economic potential of innovation in this area is considered an opportunity niche for the food industry.

To create novel food formulations for developing these types of products, experts in this field have emphasized studying potential sources of functional compounds such as antioxidants, hydrocolloids, probiotics, and soluble fiber (prebiotic) ⁴. However, to successfully land these commodities it is crucial to understand the consumers' preferences, especially those related to sensory attributes, ingredients, and additives used in the product ^{5,6}.

One of the most known seasoning products used in several food dishes such as salads, sandwiches, hamburgers, among others, is the mayonnaise ⁷. The conventional mayonnaise formulation (regular mayonnaise) consists of oil (up to 75 % of the product), vinegar or lime juice as acidulant, egg yolk as an emulsifier, and some flavorings such as sugar, salt, and pepper. Even though most people consume this product, the customers' awareness about the negative impact on the health of excessive consumption of fats has increased, leading to the elaboration of low-fat mayonnaise ^{8,9}.

Some sensorial disadvantages of low-fat mayonnaise are the texture modifications, mouthfeel, oiliness sensation, and flavor ⁸. For this reason, the use of specific additives such as emulsifiers (egg yolk, lecithin, and modified starches) and thickener agents (guar gum, xanthan gum, and cellulose), among others are necessary to provide the desired sensorial attributes as well as physical stability ⁹. The main alternative ingredients for low-fat mayonnaise production are biopolymers such as non-digestible polysaccharides (pectin, sodium alginate, glucomannans, mucilage, and starches), and proteins, mainly whey protein, isolate or microparticulate ¹⁰⁻¹⁶. However, understanding the nature and function of the ingredients in the product is determinant for the consumer's acceptability ¹⁷.

This work aims to study the perspective among mayonnaise Mexican consumers about their preferences, and their perception and acceptability of the ingredients used in this product.

METHODS

The methodology of this work was divided into two sections: the first part studied consumer preferences using a structured survey. Secondly the perception and acceptability of different ingredients in regular and low-fat mayonnaises were studied by focus groups.

Recruitment of participants

The selection of participants for the survey of consumer mayonnaise (regular and low-fat mayonnaise) preferences was carried out by convenience following the inclusion criteria: age (older than 18 years), being a regular consumer of mayonnaise, and nationality (Mexican).

In the case of the focus groups, the recruitment of the participants was based on an eligibility survey using Google Forms. This survey was shared on social media such as Twitter and Facebook. The inclusion criteria included age (18 – 65 years old), being a usual consumer of mayonnaise, not being related to the food industry, gastronomy or culinary sciences, nutrition, or medical sciences, and being willing to attend the interviews (focus groups). In addition, all participants signed an informed consent document before answering the surveys.

Survey structure

The survey had a total of three sections (Table AM1, <https://www.renhyd.org/index.php/renhyd/article/view/1620/971>); the first part of the questionnaire (section 1) consisted of general information about the participants. Sections 2 and 3 were related to the frequency of product intake, product preferences, and consumer preferences for new low-fat mayonnaise⁸. The survey was developed in Google Forms platform and shared on social media (Twitter and Facebook).

Focus groups structure

The focus group was divided into three sections. Section 1 corresponded to the general knowledge of the mayonnaise product. Section 2 was focused on the perception of synthetic and natural additives. Finally, the third section was planned to get information

about the consumers' acceptability of additives in the products. The main reported ingredients in mayonnaises (regular and low-fat mayonnaise) were compiled from commercial products (product's brand is not shown) and research articles¹⁰⁻¹⁶. The participants were asked to classify the ingredients in naturalness perception (from 0 – 100 % being 100 % completely natural),

healthiness (1 = least healthy to 5 = healthiest), and acceptability (1 = non-acceptable to 5 = completely acceptable). The sessions were conducted via Zoom meetings with a duration of 45 min and the sessions were recorded for transcription^{6,18}.

Ethics committee approval

The Research and Ethics Committee from Health Sciences Department in the “Universidad de Las Americas Puebla” approved the protocol for the surveys and focus groups of this work on May 4th, 2021 (document number P-001).

Statistical analysis

The survey results were analyzed by calculating the percentage of answers for each question. Next, a chi-square independence test ($\alpha = 0.05$) was used to determine associations of the data in sections 2 and 3 (excluding consumption frequency) with the participant’s age and gender. Afterward, the ingredients classification data were analyzed using one-way ANOVA ($\alpha = 0.05$). Finally, a Tukey’s multiple comparison test ($\alpha = 0.05$) was applied to find statistical differences among the ingredients scores. The statistical analyses were done in Microsoft Office Excel 365 with Real Statistics Resource Pack¹⁹. The artwork was processed with Matplotlib (v. 3.4.2) in Python 3.8.1 using Spyder 5.1 in Anaconda Navigator for Windows (v. 2.0.4).

RESULTS

Consumer preferences

A total of 343 subjects participated in the selection of this study; 40 of them were excluded because they were not usual consumers of the product (mayonnaise). Therefore, the final sample size was 303 participants: 184 women (60.5 %) and 119 men (39.5 %). The distribution of participants range of age was as follows: 48.7 % from 18 – 29 years old, 20.7 % from 30 – 40 years old, 14.5 % from 41 – 50 years old, 11.8 % from 51 – 60 years old, and 4.27 % with more than 60 years old. The survey results summary and Chi-square test are shown in Figure 1 and Table 1, respectively.

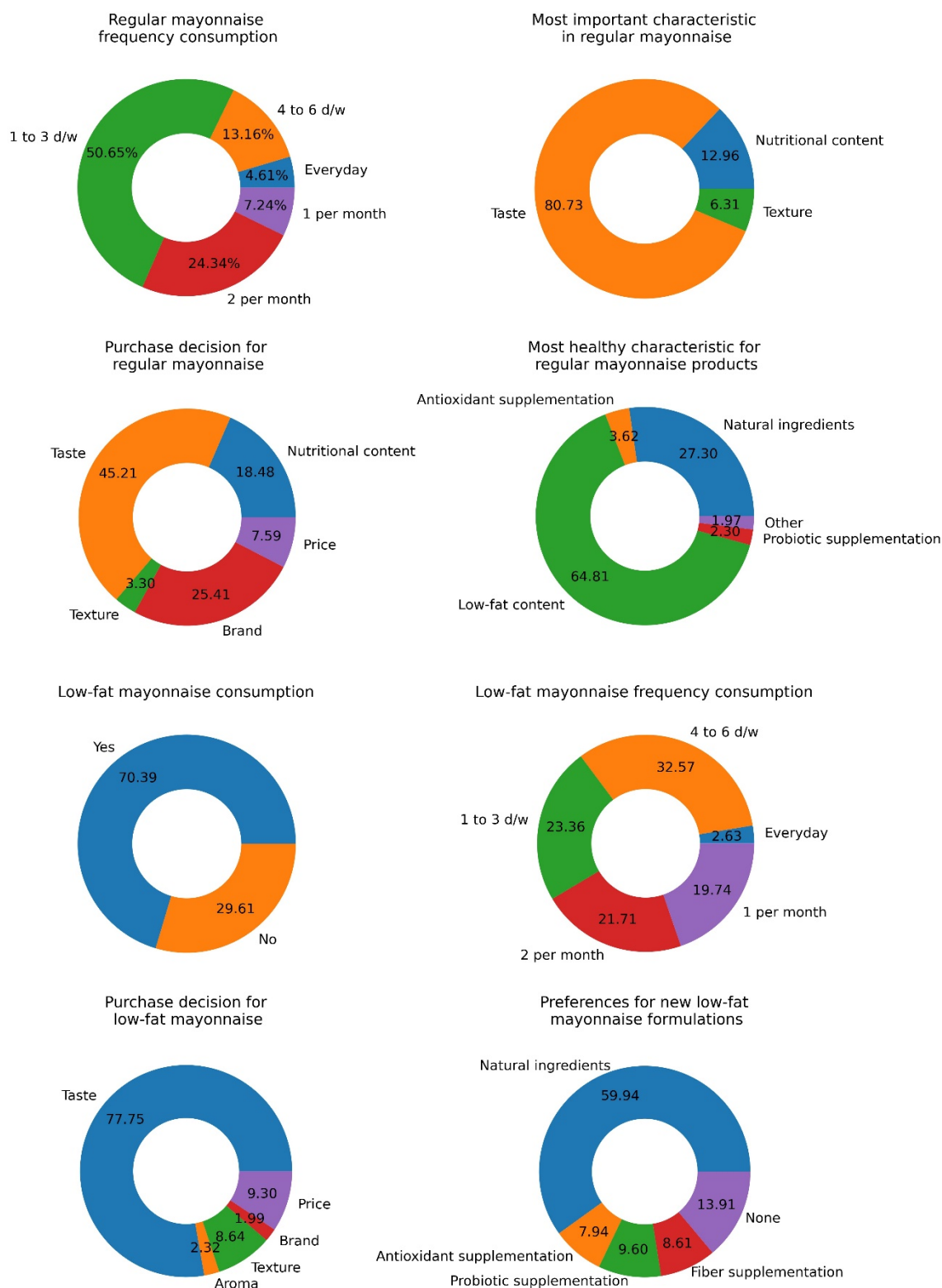


Figure 1. Preferences of mayonnaise consumers. The results are expressed in percentage (%); all results < 1 % are not shown in the graphics. Days per week = d/w.

Table 1. Chi-square independence test for association of sex and age range with the consumer preferences.

Parameter	Sex			Age range		
	χ^2	p-value	Cramér's	χ^2	p-value	Cramér's
			V			V
Most important characteristic in regular mayonnaise	7.84	0.049*	0.16	14.87	0.248	0.12
Purchase decision in regular mayonnaise	15.81	0.003*	0.22	20.78	0.186	0.13
Most healthy characteristic in a low-fat mayonnaise	3.57	0.311	0.10	5.76	0.927	0.08
Purchase decision in a low-fat mayonnaise	3.87	0.422	0.11	13.62	0.626	0.10
Consumer preference for new low-fat mayonnaise formulations	4.06	0.397	0.11	28.53	0.027*	0.15

Asterisks (*) represent significant association ($\alpha = 0.05$). Sex = Female and male. Age range = 18 to 29, 30 to 40, 41 to 50, 51 to 60, more than 60 years old.

The Mexican residents registered in the surveys were from: Yucatan (n = 141), Puebla (n = 47), Quintana Roo (n = 22), Mexico City (n = 19), Campeche (n = 14), Oaxaca (n = 12), Mexico state (n = 10), Veracruz (n = 9), Guadalajara (n = 7), Baja California Sur (n = 4), Morelos (n = 2), Zacatecas (n = 2), Monterrey (n = 2), Chiapas (n = 2), Hidalgo (n = 1), Queretaro (n = 1), Colima (n = 1), Tabasco (n = 1), Tamaulipas (n = 1), Tlaxcala (n = 1), San Luis Potosi (n = 1), and Aguascalientes (n = 1).

Regarding the regular mayonnaise, the most important features were the taste (79 %) and the nutritional content (12.9 %). For the purchase decision, the chi-squared test showed that women select the regular mayonnaise based on the product's nutritional content, while the men tend to purchase a specific commercial brand ($p < 0.05$). Like the regular mayonnaise, the taste was the most important characteristic (74 %) in low-fat mayonnaise.

It was determined that the low-fat content and ingredients obtained from natural sources in the formulations (64 % and 27 %, respectively) are perceived as healthy characteristics of mayonnaise (regular and low-fat mayonnaise). Furthermore, for new low-fat mayonnaise products, the most demanded formulation was a combination of low-fat content with ingredients from natural sources (59 %), especially for people from 51 to 60 years old ($p < 0.05$), while young participants (18 to 29 years) showed more interest in probiotics supplementation ($p < 0.05$).

Focus groups: ingredient perception

Thirty-nine participants were part of the recruitment; fifteen did not fulfill the inclusion criteria. Therefore, only 12 participants were included in the study (the other 12 subjects did not attend the scheduled meetings). Three groups of four participants ($n = 12$) were formed and categorized by age (group 1: 18 – 29 years old; group 2: 30 – 49 years old; group 3: 50 – 65 years old).

It was observed that the population is poorly informed about the nutritional content of the mayonnaises (especially for the fat content). The main use of mayonnaise among the participants was in salads, sandwiches, breaded fish and chicken, in “elotes” (boiled corn), hot dogs, hamburgers, tuna salads, and nuggets.

The 18 – 29 years old showed a predominant preference (willingness to consume) for ingredients from natural sources (natural ingredients) because they associate them with positive effects in health (prevention of diseases). On the other hand, the people from 50 – 65 years old expressed no problems with synthetic ingredients. On the contrary, they associated the natural ingredients with tasteless products and short shelf-life (susceptible to spoilage). Nevertheless, they also mentioned that all that comes from natural sources could be potentially healthy for humans.

The natural and synthetic perception results are shown in Figure 2. The egg yolk, lime juice, salt, and sugar were the ingredients with a higher natural perception (100 %), followed by spices, citric acid, vinegar, whey protein isolate, and mustard (70 – 90 %). On the other hand, the organic acids (sorbic acid and lactic acid), emulsifiers, thickening agents, preservatives, and flavorings were predominantly perceived as synthetic ingredients.

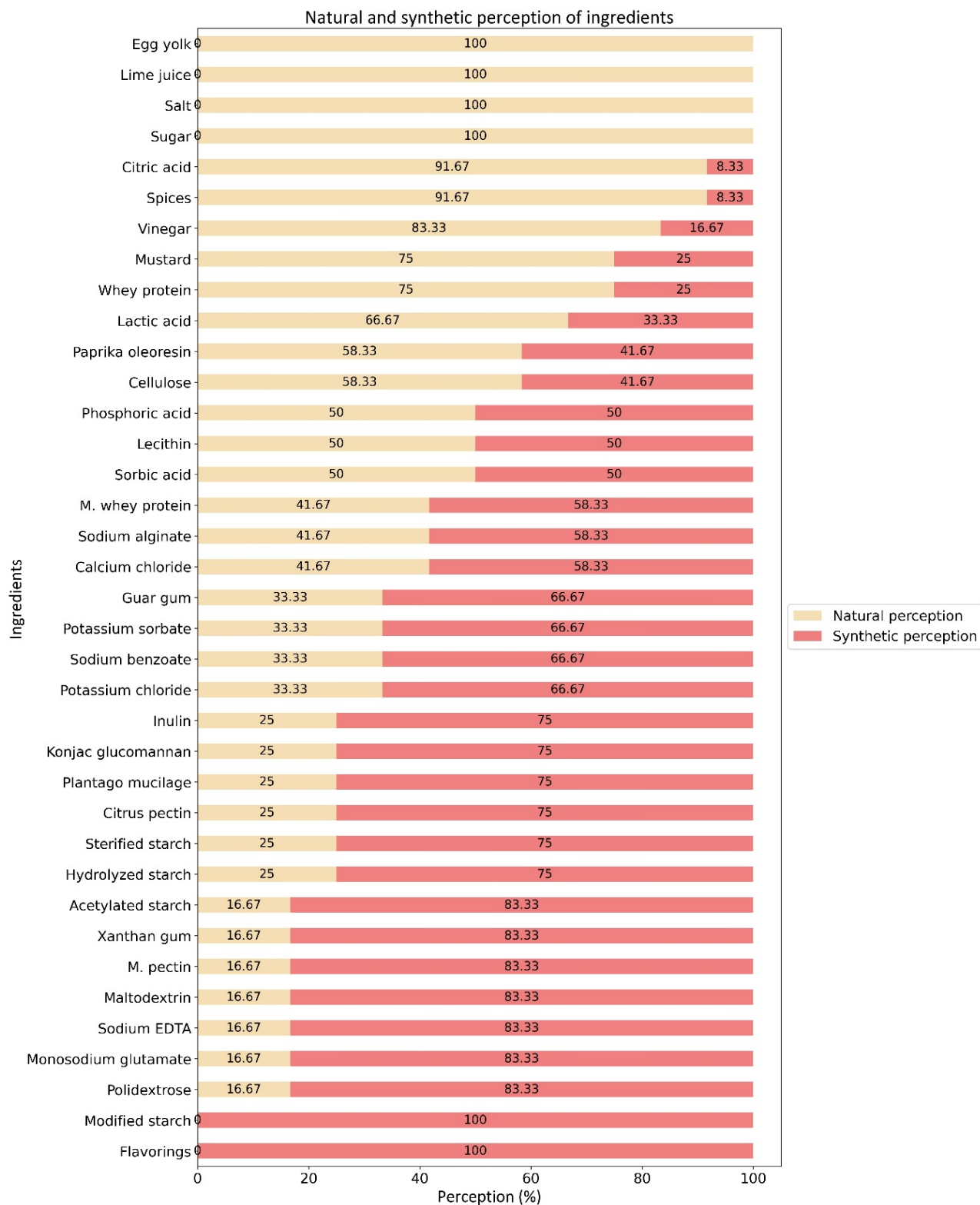


Figure 2. Natural and synthetic perception of the additives used in mayonnaise. M. whey protein = microparticulate whey protein. M. pectin = microparticulate pectin.

No significant difference ($p>0.05$) between emulsifier's nature and healthiness were found (Figure 3). However, the overall rating was higher for lecithin, egg yolk, and whey protein (3 – 3.8) than the rest of the emulsifiers. The lime juice demonstrated significantly higher scores ($p<0.05$) than phosphoric and lactic acid. The flavoring ingredients showed no difference among them ($p>0.05$); however, the higher ratings were obtained for spices (4.2), mustard (3.5), and salt (3.1). There was a prevalent unhealthy perception (~2.5 of healthiness rating) for preservatives (EDTA, potassium sorbate, and sodium benzoate) and thickening agents (2.58 – 3.33).

Regarding the acceptability scores (Figure 4), the results indicated that egg yolk was the most accepted emulsifier ($p<0.05$), followed by the whey proteins and lecithin, which showed slightly better scores than the modified starches ($p>0.05$). The lime juice and vinegar's acceptability were significantly higher ($p<0.05$) than phosphoric acid. The salt, spices, and mustard had significantly higher acceptance ($p<0.05$) than potassium chloride, paprika, or monosodium glutamate regarding the flavoring ingredients. Despite the low healthiness score observed in preservatives, their general acceptability was good (3.1 – 3.25). The most accepted thickening agents were cellulose and guar gum (>3.25 of acceptability) than the rest of these ingredients; however, there was no significant difference ($p>0.05$).

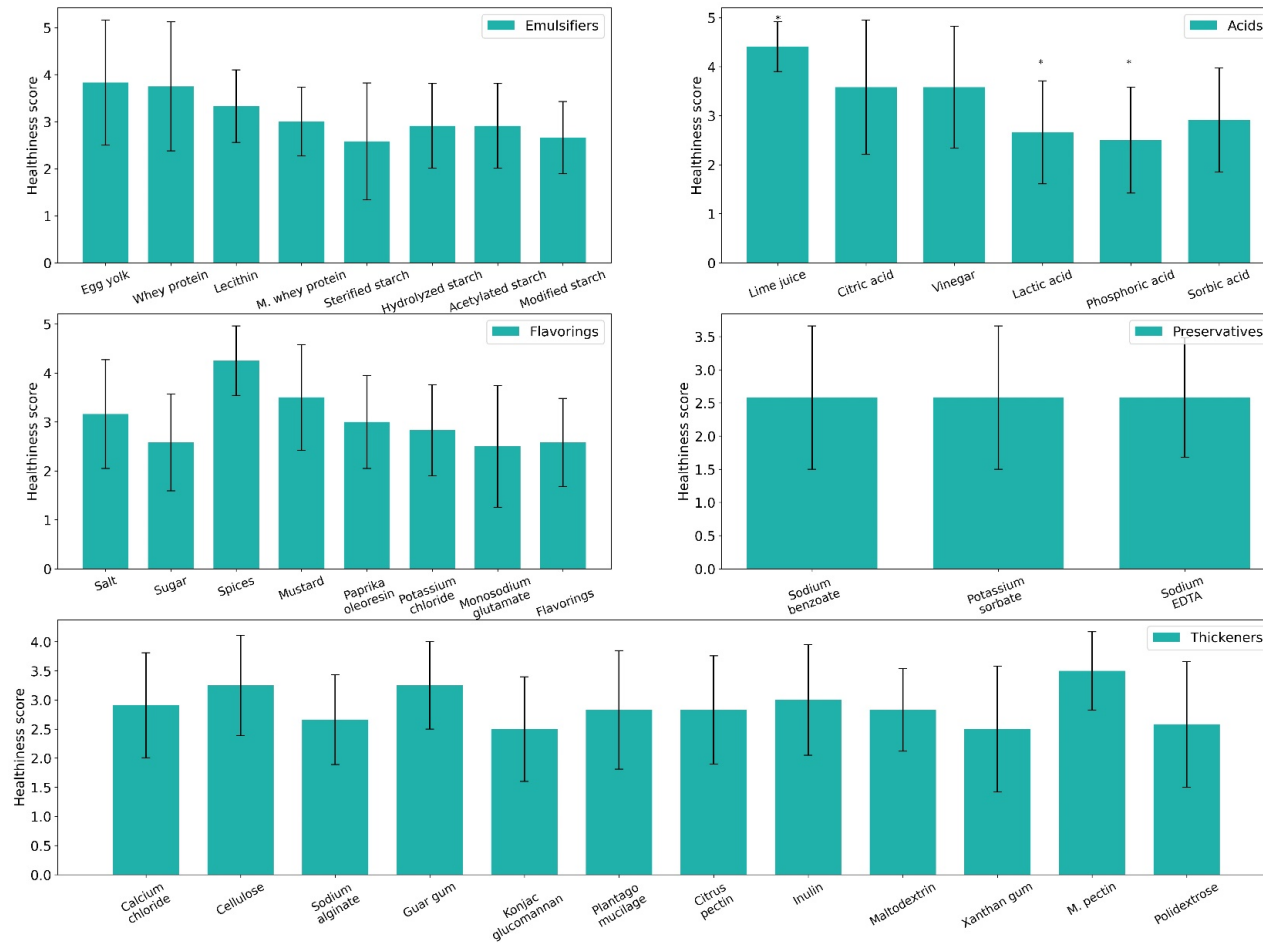


Figure 3. Healthiness scores (1 = least healthy to 5 = healthiest) of the additives used in mayonnaise. M. whey protein = microparticulate whey protein. M. pectin = microparticulate pectin. Asterisk (*) indicates a significant difference ($p < 0.05$) using a Tukey's multiple comparison test ($\alpha = 0.05$).

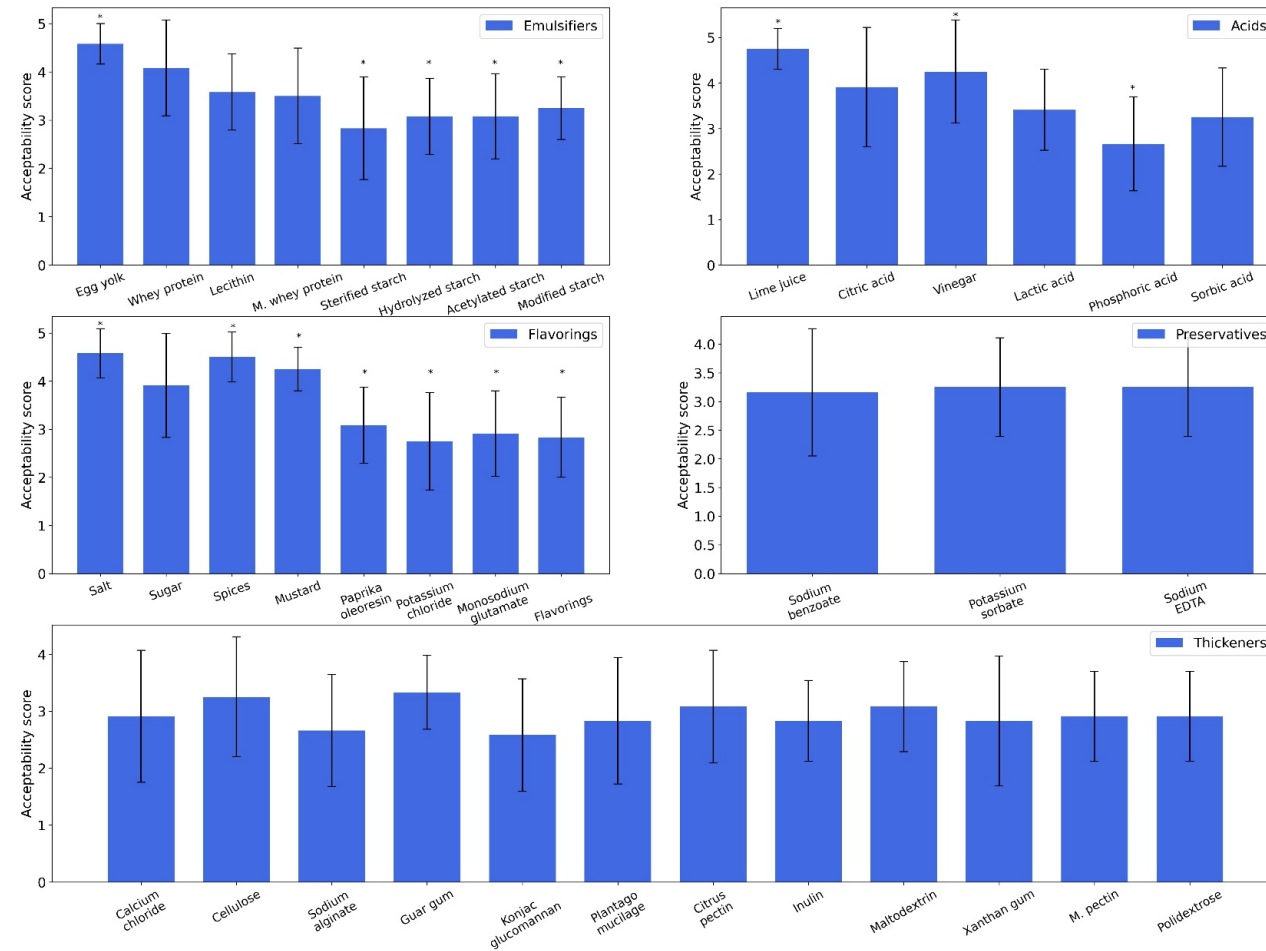


Figure 4. Acceptability scores (1 = non-acceptable and 5 = completely acceptable) of the additives used in mayonnaise. M. whey protein = microparticulate whey protein. M. pectin = microparticulate pectin. Asterisk (*) indicates a significant difference ($p < 0.05$) using a Tukey's multiple comparison test ($\alpha = 0.05$).



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Overall, the participants self-stated a poor knowledge regarding the ingredients' names and functions used in the product. Additionally, all participants showed interest in learning about those ingredients' features, and it was mentioned that this information should be in the frontal part of the packages.

DISCUSSION

The main findings of the present study showed that low-fat content mayonnaise is still in demand in the market. Besides, there is interest in formulations with natural ingredients or supplemented with probiotic bacteria. However, the acceptability of the ingredients among the consumers was highly influenced by the perception of healthiness given by the nature of the ingredients (natural or synthetic).

Nowadays, there is an increase in the popularity of food products added with probiotics (especially in social media networks) due to their health-promoting function, for instance, their role in preventing colon cancer²⁰. This fact could explain the preferences of young participants (18 – 29 years old) for these types of products,

To date, some of the probiotics reported in mayonnaise dressings are *Lactobacillus acidophilus*, *L. casei*, *Bifidobacterium bifidum*, and *B. infantis*^{21–23}. The beforementioned strains usually are present in dairy products; they are well known for their gastrointestinal positive properties, such as promoting the gut microbiota equilibrium, reducing constipation problems, and protecting against some pathological microorganisms (i.e., *Salmonella spp*)²⁴.

On the other hand, regarding the perspective of the population from 51 – 60 years old, their preference for natural ingredients is probably due to their concern for preventing chronic diseases through food. Especially because these types of diseases, such as obesity, high blood pressure, diabetes, among others, are increasing in Mexico and are closely linked to the diet²⁵.

In the case of the perception of the ingredients, the natural and synthetic compound perceptions were similar to reported results in yogurts⁶. However, in this study, the familiar names such as cane sugar, vegetable juice, and natural colorant (carmine) were recognized as more natural (natural perception = 8 on a scale from 1 – 10) compared to thickening agents (natural perception = 4 – 6), preservatives (natural perception = 4), and artificial colorants (natural perception = 2).

However, the natural perception does not always determine the healthy or unhealthy degree attributed to the ingredients. For example, in this study, some natural ingredients evaluated by the participants, such as egg yolk, sugar, and salt, showed a medium healthiness score (2.5 – 3.5). These results could be due to the association of these ingredients with the risk of cardiovascular diseases (by the cholesterol of egg yolk), overweight and diabetes in the case of sugar, and high blood pressure (caused by sodium chloride salt) ^{26–28}.

In the case of the unhealthy perception of thickening agents observed in our work, it agrees with a previous study of the healthiness perceived in different hydrocolloids ²⁹. The studied compounds by Varela and Fiszman ²⁹ included corn starch, gelatin, agar-agar, pectin, sodium alginate, modified starches (from tapioca, potato, and corn), guar gum, among others. All these ingredients were rated from 0 – 9 (where 0 was not healthy and 9 was very healthy). It was found that the perception of healthiness was lower when the name of the additive was long, hard to pronounce, unfamiliar, or non-understandable. For instance, hydroxypropylated distarch phosphate, carboxymethylcellulose, and modified starch had a grade of healthiness <4. Nevertheless, the healthiness perception was improved for ingredients with a specified origin (modified potato starch = 4) or familiar ingredients such as gelatin, agar-agar, pectin, corn starch (healthiness rate from 4.5 – 5.5).

In our case, the good acceptability for egg yolk, lime juice, whey protein, vinegar, salt, spices, mustard, and sugar, could be related to two factors. One of them is the correlation between the natural perception and acceptability of the ingredients ($r^2 = 0.55 - 0.69$) ⁶; and the other, the familiarity of the ingredient names and homemade food products (such as whey protein) ^{6,29}.

Due to the excellent acceptability of the natural ingredients, it could be suggested that the mayonnaises' labels should emphasize the origin of the ingredients, for example, providing the source of the thickening agents, emulsifiers, or pigments (roots, vegetables, pulses, cereals, among others). On the other hand, in the case of the preservatives, they present a challenge because most of them are synthetic compounds. Nevertheless, the people in this study demonstrated to be aware of the crucial role of these ingredients in preventing contamination. Therefore, this could open an opportunity for prioritizing natural compounds.

with antimicrobial activity such as mustard, essential oils, bacteriocins (antimicrobial peptides), phenolic compounds, among others ^{8,30}.

Limitations and strengths

This study presented some limitations; for instance, the survey and focus groups' sample size were small; thus, the rating of the perception of ingredients showed a high deviation. Nevertheless, it could be used as a reference for further studies with a larger sample size and incentivize more studies focused on the consumers' perceptions.

Despite these limitations, the results obtained could be helpful to manufacturers, start-ups, product designers, and marketing studies related to low-fat mayonnaise or salad dressings. Besides, the insights for declaring the ingredients' information in labels could be a possible strategy to increase the probability of success of the product, being useful not only in low-fat mayonnaises but also in any other product containing a different type of additives.

CONCLUSIONS

Low-fat mayonnaise is still one of the most demanded formulations because it is considered healthier than the regular product. This conception supports that the innovations in the low-fat mayonnaise formulation are still important. Furthermore, some of the possible formulations for new low-fat mayonnaises were using ingredients from natural sources and/or supplemented with probiotics, which could be directed at the young population or people from 51 – 59 years old. The limited knowledge about the ingredients among the consumers could be attempted in further research by creating scientific communications or educational content, with a broader range of ingredients and food products.

AUTHORS CONTRIBUTION

J.M designed the concept of the study, recruited participants, carried out the surveys and focus groups, analyzed data, and drafted the manuscript. D.B designed the concept of the study, designed the surveys, drafted, and corrected the manuscript. M.R drafted and corrected the manuscript.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest and agree with the manuscript.

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