

Abstract

Dissertation topic: **Using a multi-criteria approach to evaluate the quality of a food product using Yerba Mate as an example**

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Quality management, as one of the research areas in the practical stream of sciences management and quality sciences, includes in its scope of topics, among others, theoretical considerations and empirical research using methods and techniques for improving product quality. Research undertaken within the practical stream is also directed at consumer determinants of quality and the formation and evaluation of quality throughout the product life cycle, including food. Knowledge of the characteristics of products that determine the so-called technical quality is one of the most important factors related to the consumer, influencing the formation of requirements and expectations of food. Hence, consumer-oriented research, which includes in its scope the identification of their expectations and requirements, seems to be crucial. Research in this area is important and legitimate, all the more so that the requirements of modern consumers for food are changing over time and depend on many factors, including socio-demographic, economic, environmental or socio-cultural, as well as individual preferences and attitudes. Monitoring these changes and adjusting management strategies to meet the dynamically evolving demands of consumers can make it possible to better tailor product assortments and increase consumer satisfaction.

The modern market for food products is characterized by a growing interest among consumers and producers in plants that contain bioactive compounds in their composition, including compounds with antioxidant activity. An example of such a plant is the Paraguayan holly (*Ilex paraguariensis* Saint Hilaire, *Aquifoliaceae*), known to consumers as the product Yerba Mate, the subject of this dissertation.

Yerba Mate is one of the most popular products in South American countries (Argentina, Brazil, Paraguay and Uruguay), which is also gaining popularity in other regions of the world, including Poland. The stimulating effect of Yerba Mate determined by its high caffeine content, customarily called *matina*, as well as the high antioxidant activity of bioactive compounds, influences consumer behavior and their inclination to purchase this product. Consumers determine their requirements for the quality of Yerba Mate in various aspects – not only with

regard to its stimulating effect and health-promoting properties, but also with regard to, for instance, safety, organoleptic characteristics, packaging appearance or price. The degree to which these requirements are met can affect consumer perceptions and acceptance of the product to varying degrees. It is therefore important to identify consumer requirements for Yerba Mate, as well as to take measures to popularize the product and in-depth knowledge about it, since, due to the aforementioned properties, it can be an interesting substitute for both tea and coffee.

One of the quality management methods for identifying and classifying requirements for a product into six categories (M – must-be, O – one-dimensional, A – attractive, I – indifferent, R – reverse and Q – questionable), the degree of fulfillment of which affects consumer satisfaction or dissatisfaction to varying degrees, is the Kano method. Due to its universal nature, this method can be applied to various types of products and services. However, based on a critical analysis of the literature on the subject, it was found that most of the research conducted to date has included its application of the Kano method to improving the quality of industrial products and services in the broadest sense. In contrast, limited application of the Kano method to improve the quality of food products, including Yerba Mate, was observed, identifying a cognitive gap in this area.

The quality of Yerba Mate, like other food products, is multidimensional in nature and can be evaluated in multi-criteria ways. The evaluation of Yerba Mate quality has been the subject of research by many authors both in Poland and around the world, but the combination of consumer research, including the Kano method with physicochemical studies, represents a novel approach to the issue under analysis and fills an identified research gap.

In response to the identified cognitive and research gap, the paper proposes a multi-criteria approach to assessing the quality of Yerba Mate products, integrating the Kano method and consumer behavior assessment, in addition to the analysis of selected objective quality differentiators, such as volatile organic compounds (VOCs) and bioactive compounds. Following this trend, the main objective of the study was to develop a food product model that considers the relationship between objective quality criteria and subjective criteria of consumer evaluation using the example of Yerba Mate.

In addition, the paper formulates four specific objectives:

C1: Categorization of requirements to a selected food product by applying the Kano method.

C2: Determination of the impact of categorized requirements to a selected food product on consumer behavior.

C3:Assessment of the quality of Yerba Mate in the context of the determination of selected physicochemical parameters considering the consumer evaluation of quality.

C4:Identification of Yerba Mate quality characteristics necessary for classification in areas related to authenticity.

Moreover, a search of the available literature on the subject did not indicate a clear answer on possible ways to identify the origin and assess the authenticity of Yerba Mate. This issue is undoubtedly important for the modern consumer, who often follows sustainable consumption patterns and pays attention to issues of product adulteration. Food authenticity is one of the important requirements of consumers and one of the new dimensions of food quality, and therefore should be taken into account in the framework of food product quality management. Therefore, research has been undertaken in this area as well.

The structure of the dissertation is divided into three main parts. The first, the theoretical one, includes content on food quality and its definition in various dimensions, the instruments of quality management and its application to the improvement of food products, as well as the theory of consumer behavior. The second part of the work includes the methodological assumptions of the study and a diagram of the research procedure used. The empirical part, in turn, presents the results of the research and their discussion. The dissertation includes six chapters corresponding to the main objective and complementary specific objectives of the work.

The application of the Kano method, in pursuit of the first specific objective of the work, made it possible to identify and categorize 28 consumer requirements for Yerba Mate, concerning: organoleptic characteristics (taste, smell, appearance of the brew and the dried product), the possibility of multiple brewing of Yerba Mate, product safety understood as the absence of contaminants harmful to health, product performance (stimulating, health-promoting, slimming), brand, price and country of origin, content of various types of additives, method of production or method of closing the package.

Additionally, it was indicated how the degree of fulfillment of each requirement affects the degree of their satisfaction and dissatisfaction. Consumer requirements were assigned to the following categories: must-be (1 requirement), one-dimensional (1 requirement), attractive (7 requirements), reverse (5 requirements) and indifferent (14 requirements). However, requirements categorized as questionable were not indicated.

The analysis of the results of the survey using the Kano method was supplemented by a multivariate statistical analysis, which enabled the possibility to assess the influence of sociodemographic factors (gender, age, education level, place of residence, income level)

on respondents' perceptions of requirements for Yerba Mate. It was shown that the gender of Yerba Mate consumers is a factor that statistically and significantly affects the differential categorization of requirements. Based on this relation, the assumptions of two Yerba Mate models were developed. One model responds to the requirements of men and the other to those of women. Due to the identified differences in the perception of requirements for Yerba Mate, 14 requirements were included in the product model aimed at men, and 19 for women. In both models, requirements categorized as: must-be, one-dimensional, attractive and reverse, i.e. the most relevant to a given group of consumers, were included.

In turn, based on the analysis of the results of the evaluation of consumer behavior and opinions towards Yerba Mate, the relationships between the perception of a given requirement, determined using the Kano method, and consumer behavior related to the choice of this product, which was the second specific objective of the study. It was found that among the factors determining the choice of a given product, the requirements that were simultaneously identified as the most important to consumers were the mandatory, one-dimensional, attractive and opposing features. Because of the importance of these qualities to consumers, they were included among the assumptions for the designed Yerba Mate model. Considering the results obtained, it was shown that Yerba Mate's fulfillment of must-be requirements (the possibility of multiple brewing of Yerba Mate) and attractive requirements (e.g., stimulating effect and health-promoting effects, brand, price and country of origin) influences the choice of a given product, while the presence of qualities categorized as the reverse (e.g., bitter taste and dust content) in a product may cause its disqualification in the opinion of consumers.

The survey on consumer behavior and opinions also targeted non-consumers of the product, and analysis of the responses made it possible to identify barriers affecting the reduction of Yerba Mate consumption and factors that could encourage potential consumers to consume the product. This formed the basis of formulated guidelines for Yerba Mate distributors wishing to expand the group of potential consumers.

The results obtained by the Kano method were also complemented by physicochemical studies, consisting of the determination of volatile organic compounds (VOCs) in dried Yerba Mate by GC-MS gas chromatography and bioactive compounds present in the infusions of this product by high-performance liquid chromatography. The physicochemical evaluation of selected Yerba Mate products was key to analyzing and interpreting the subjective requirements of consumers through objective quality discriminators, thus achieving the third specific objective of the work. Other consumer requirements included in the Yerba Mate model

were evaluated based on an analysis of the current state of knowledge and the results of a consumer behavior survey.

The indicated interrelationships enabled to achieve the main goal by designing the author's model of Yerba Mate, which in the work is understood as a model product with characteristics that meet consumer requirements to the highest degree. In order to quantify the designed model, a formula was also proposed, which is an attempt to measure the degree of fulfillment of all consumer requirements included in the product model.

What is more, the physicochemical test results obtained were analyzed in the context of identifying Yerba Mate quality characteristics necessary for classification in areas related to authenticity. Chemical compounds that distinguish Yerba Mate products in terms of country of origin were searched for, which allowed the fourth specific objective of the work to be realized. The analysis of volatile organic compounds and the profile of bioactive compounds did not make it possible to determine clear criteria that distinguish Yerba Mate by country of origin, however, several trends were observed that can provide a basis for setting a direction for further research in this area. It was found, that to precisely determine the criteria for assessing authenticity it would be necessary to increase the research sample and expand the scope of physicochemical tests, as well as to perform macroscopic and microscopic and microbiological tests.

In the food products industry, it is very crucial to identify the needs and requirements of consumers, however, for food manufacturers, objective quality parameters are definitely more clear and easier to interpret. Subjective evaluation provides a lot of valuable information about consumer perceptions of a food product, but it is less precise and ambiguous for producers and marketers to interpret. Therefore, it is crucial to combine these studies and identifying the relationship between consumers' subjective requirements and objective quality criteria. The combination of the Kano method with the evaluation of selected physicochemical quality parameters of Yerba Mate provides an original solution to the scientific problem in this study, as the subjective requirements of consumers were analyzed and interpreted using objective quality criteria.

The analysis of the dissertation results and the identification of the relationship between subjective consumer evaluation criteria and objective quality criteria formed the basis for the positive verification of three and the falsification of one of the research hypotheses.

Conducting innovative research on the integration of the Kano method with the objective evaluation of selected quality parameters of a food product, using Yerba Mate as an example, is a contribution to the development of the discipline of management and quality sciences

and may provide a basis for undertaking similar research in relation to other food products. In addition, the results presented in the study and the conclusions formulated in the paper have an applied value, as they can provide valuable guidance for producers and marketers planning marketing activities and expanding their assortment in response to the requirements of current and potential consumers. What is more, conducting research and promoting knowledge about Yerba Mate can also contribute to increasing consumer awareness of this product as a potential substitute for coffee or tea. The issues indicated above confirm the applicability of the obtained research results in both economic and social spheres.

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