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The From Tradition to Functionality Gastronomic Innovation: The Integration of Quinoa into Turkish Cuisine and Its Contribution to Gastronomy Tourism

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ABSTRACT

The widespread adoption of healthy eating trends is increasingly heightening the importance of functional foods and special dietary models in the fields of gastronomy and tourism. This study aims to examine the integration potential of quinoa, referred to in the literature as the "golden grain," into traditional Turkish cuisine from the perspective of a gluten-free diet and functional food. Designed within an applied qualitative research framework, the study involved the researcher's practical application of quinoa in traditional Turkish dishes over approximately four years as a data collection method. Document analysis was also employed as a research method, and the findings were evaluated using a thematic analysis approach. In the gastronomic innovation dimension of the study, complex traditional symbolic dishes such as stuffed meatballs (içli köfte), Gaziantep lahmacun, Gaziantep yuvalama, and tarhana soup as well as köfte (meatballs), kısır (bulgur salad), pilaf, salad, cake, and crepe, were reformulated with quinoa to create integration and functionality matrices. The findings reveal that the dough binding and elasticity issues arising from quinoa's gluten-free nature can be overcome with supportive ingredients such as psyllium husk powder, corn semolina, and buckwheat flour. Furthermore, these adaptations profoundly strengthen the protein, dietary fiber, and essential amino acid profiles of the recipes. In conclusion, quinoa enables traditional recipes to be adapted for celiac patients and vegan individuals without spoiling their authentic flavor identity; it carries the potential to create value-added and a competitive advantage in the tourism sector by offering healthy, innovative, and sustainable menu alternatives for food and beverage and accommodation businesses.

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Introduction

In recent years, the growing importance of the concept of healthy living at both the individual and societal levels has had a direct impact, particularly on dietary habits. Warnings issued by international health organisations, including the World Health Organisation (WHO), regarding healthy diets and sustainable nutrition have led individuals to make more informed choices regarding their food preferences. In this context, demand for natural, functional and unprocessed foods has increased significantly (WHO, 2022; Martirosyan & Singh, 2015; Alzuhairi & Doğan, 2021). These developments have reshaped not only individual dietary practices but also food production, food and beverage services and the understanding of gastronomy.

Given the inherently multidisciplinary nature of gastronomy, it necessitates the integrated consideration of agriculture, chemistry, and nutrition sciences (Kavak et al., 2025; Yıldız, 2025); moreover, the growing prevalence of healthy eating trends directly influences gastronomic tourism, transforming the dining experience from a purely taste-oriented activity into a holistic lifestyle experience shaped by health, sustainability, and locality. This situation presents new opportunities, particularly in terms of destination marketing, gastronomic product diversity and health-focused service models (Hegarty, 2011). It is driving businesses to increase both the variety and quality of their products (Daliri & Lee, 2015).

Turkish cuisine is a significant source of functional foods, thanks to its rich variety of dishes and agricultural produce (Cirisoglu & Olum, 2019; Alzuhari & Doğan, 2021). Grains are widely used in many types of dishes, such as soups, pilafs, meatballs, stuffed vegetables, desserts and salads, with wheat and bulgur in particular forming the centrepiece of traditional recipes (Karaman & Ceyhun-Sezgin, 2021; Kasar, 2021). However, the vast majority of traditional dishes contain gluten, which limits options for coeliac patients and individuals requiring a gluten-free diet.

Modern healthy eating trends are increasingly driving demand for gluten-free, nutrient-rich alternative products, making the development of gluten-free versions of traditional recipes a priority.

The growing trend towards healthy, gluten-free and vegan diets has made it essential to reimagine the iconic dishes of Turkish culinary culture with alternatives that are suitable for healthy and gluten-free eating. In this context, quinoa, which stands out for its functional properties, is attracting attention as a valuable alternative food for individuals with gluten-free and vegan dietary requirements, thanks to its high protein and dietary fibre content, balanced essential amino acid profile and low glycaemic index (Repo-Carrasco-Valencia et al., 2010; Vega-Gálvez et al., 2010). The Food and Agriculture Organization describes quinoa as a "strategic and ideal food." It provides essential nutrients in a balanced way and contains beneficial bioactive compounds such as saponins, phenolic compounds, and phytosterols (Zeyneb et al., 2021; Guo et al., 2025). The integration of quinoa into Turkish cuisine aims both to enhance nutritional value and to support innovative and functional product diversity in the field of gastronomy. Within the scope of this study, traditional dishes such as içli köfte, lahmacun, Gaziantep yuvalaması and tarhana soup have been reinterpreted using quinoa; the aim was to develop gluten-free alternatives whilst preserving the dishes 'original flavours. In this way, suitable options are provided for individuals with specific dietary requirements, and a contribution is made to the development of a diverse range of functional, high-nutritional-value and innovative products in the field of gastronomy.

Method

In this study, a qualitative research approach has been adopted with the aim of conducting an in-depth examination of the use of quinoa—referred to as the 'golden grain'—in the field of gastronomy. The central research question is how quinoa is positioned within a gastronomic context and, in particular, how it can be integrated into Turkish cuisine. Accordingly, the study has been designed within the framework of direct applied research methodology. Document analysis was chosen as the data collection method for this study. This method was selected because it enables the body of knowledge found in existing literature to be evaluated from a systematic and critical perspective. Data sources were obtained from databases with high academic credibility, namely Google Scholar, Scopus, Elsevier, ULAKBİM and DergiPark. During the data collection process, a comprehensive search was conducted using key concepts such as 'quinoa','gluten-free diet', functional foods and 'gastronomy'. Furthermore, the use of quinoa in traditional Turkish cuisine—which forms the main theme of this study—has been explored through applied research methods over a period of approximately four years (from 2022 to the present) by the researcher in their own kitchen. Applied research involves the experimental application of knowledge that has been or is being generated. Trials are continued until the existing application reaches the desired or achievable level. In these studies, the development process is paramount (Karasar, 2014).

Over the course of four years, in the experiments conducted by the researcher, each recipe was repeated 2–5 times with the aim of developing the formulation closest to the original recipe in terms of both flavour and texture. The quinoa and flour varieties used in the study were sourced from the Talya Foods brand.

The formulations for regional products such as içli köfte, Gaziantep yuvalaması and Gaziantep lahmacun were developed by the researcher, who is from Gaziantep, drawing on traditional recipes that have been used by his family for many years. In this context, particularly for stuffed meatballs and Gaziantep yuvalaması—where the production technique is complex and the product texture is of great importance—ingredients such as boiled potato, egg, maize semolina, buckwheat flour and rice flour were utilised to enhance the dough's binding properties and prevent crumbling and breaking during cooking. In the outer mixture of the stuffed meatballs, whole quinoa was used instead of the fine bulgur traditionally used in the formulation, and maize semolina was used instead of wheat semolina. One of the most important quality criteria for stuffed meatballs is that the outer mixture does not crack during cooking and retains its integrity without crumbling. To ensure this characteristic, three different trials were conducted. In the first trial, quinoa and maize semolina were used in a 1:1 ratio in the outer coating formulation; however, significant crumbling of the product was observed during the cooking process. In the second trial, boiled potatoes (2 pieces) were added to the dough mixture, an ingredient not included in the original recipe. As a result of this, it was observed that the problems of crumbling and cracking during cooking were reduced; however, it was found that the addition of boiled potatoes had a negative effect on the product's characteristic flavour profile and reduced its sensory acceptability. In the third trial, the quantities of maize semolina and boiled potatoes were adjusted, thereby ensuring the preservation of the product's integrity whilst also achieving a formulation closest to the traditional flavour and texture characteristics of stuffed meatballs (Table 3).

A total of four trials were conducted to achieve the distinctive flavour and texture characteristics of Gaziantep yuvalama. In the first trial, it was determined that the boiled potatoes used in the dough formulation had a negative effect on the product's characteristic taste; consequently, they were completely removed from the formulation in subsequent trials. In the second and third trials, various adjustments were made to the ratios of rice flour, quinoa flour and maize semolina; based on the results obtained, the final formulation was established in the fourth trial. One of the most important quality criteria assessed in Gaziantep yuvalama is the product's texture. The prepared products were subjected to a steaming process prior to cooking; during this process, the products' ability to retain their texture and maintain their integrity without disintegrating were key evaluation criteria. In addition, the products' characteristic aroma and flavour properties were also taken into account in sensory evaluations (Table 3).

The aim of the research into developing a gluten-free Gaziantep lahmacun was to preserve the key quality criteria of the traditional product; flavour, dough thinness and elasticity.

The most significant technical challenge in gluten-free dough products is the lack of sufficient elasticity in the dough. In four separate trials conducted for this purpose, the first experiment used only quinoa flour and 1 tablespoon of psyllium husk powder; however, serious tearing occurred during the rolling process and the product's flavour was deemed unsatisfactory. In the second trial, quinoa flour and buckwheat flour were used in a 1:1 ratio, with 1 tablespoon of psyllium husk powder added; although an improvement in the dough's workability was achieved, the desired result in terms of flavour was not obtained. In the third trial, the buckwheat flour to quinoa flour ratio was increased to 2:1, and the same amount of psyllium husk powder was used. This formulation was found to be more successful in terms of flavour, but the tearing problem persisted during dough rolling. In the final trial, whilst the flour ratios were kept constant, the amount of psyllium husk powder was doubled, thereby achieving a significant increase in the dough's elasticity, and no tearing was observed during rolling. The product obtained after baking was assessed as the gluten-free formulation closest to traditional Gaziantep lahmacun in terms of both sensory characteristics and structural quality (Table 3).

The development of a gluten-free formulation of tarhana soup—which is widely consumed in Turkish cuisine, particularly during the winter months, for its health benefits—took longer than other product development projects due to the time required for the fermentation process. In this context, during the summer of 2025, the researcher preserved the basic raw materials used in traditional flour tarhana production—such as strained yoghurt, red peppers, tomatoes, tarhana herb, dried onions and various spices—whilst substituting wheat flour with a 1:1 mixture of quinoa flour and buckwheat flour. The production process was based on the traditional method of preparing Uşak tarhana, and the resulting tarhana dough was left to ferment for two weeks. Following fermentation, the dough was spread out on clean cloths and dried in the shade; it was broken up at regular intervals to achieve a granular texture and was subsequently ground. After grinding, the product was dried for a further two days and stored in glass jars. To prepare the soup, similar to the traditional flour tarhana recipe, three tablespoons of gluten-free tarhana were mixed with approximately 2.5–3 cups of meat or chicken stock and cooked. It was determined that the characteristic aroma, flavour and consistency expected of tarhana soup were successfully achieved thanks to the garlic powder added during the cooking stage (Table 3).

Boiled whole quinoa has been used in gluten-free formulations of traditional Turkish dishes such as köfte (meatball), pilaf and kisir, which hold an important place in Turkish cuisine. The researcher drew on their previous experience when developing the quinoa köfte formulation, and following a series of trials, the second formulation was selected as the final recipe. In the first trial, the mixture became too watery due to the high amount of grated carrot used, and the meatballs fell apart during cooking. In the second trial, the amount of carrot was reduced and the amount of flour increased, resulting in a more suitable consistency; the structural integrity of the product was preserved and more successful results were achieved in terms of flavour (Table 3).

Two trials were conducted during the development of the chicken quinoa pilaf formulation, resulting in a successful product. In the first trial, quinoa—washed thoroughly in plenty of water 4–5 times—was used in place of the bulgur in the classic bulgur pilaf recipe. However, sensory evaluations revealed that the distinctive aroma and flavour of the quinoa were distinctly noticeable in the pilaf. Consequently, in the second trial, the grated zest of half a lemon was added during cooking. The results of this iteration showed that the quinoa aroma was balanced, and the product was found to be more acceptable in terms of flavour and appearance; the formulation was deemed successful in its final form (Table 3).

In the gluten-free adaptation of classic kisir and bulgur salad products, cooked quinoa was used in place of bulgur. During the development of the quinoa kisir formulation, the traditional recipe was retained in the initial trial, with only the bulgur being replaced by cooked quinoa. However, sensory evaluations revealed that the tomato paste was not compatible with the distinctive flavour profile of the quinoa. Consequently, in the second formulation, the use of tomato paste was discontinued, and the quinoa was boiled in beetroot juice to ensure the product's characteristic appearance. The quinoa, which had taken on a deep red colour and was then cooled, was combined with the other ingredients to prepare the product. This approach resulted in higher acceptability in terms of both sensory characteristics and appearance. In the bulgur salad formulation, bulgur was replaced directly with boiled quinoa, and the distinctive taste of the quinoa was balanced through the addition of aromatic herbs and lemon. Consequently, successful results were achieved in terms of appearance and flavour—criteria that play a significant role in consumer acceptance—for both products (Table 3).

In the development of a gluten-free and nutritionally enhanced alternative to the cake formulation in the dessert category, quinoa flour was used as the primary flour source, with functional and natural ingredients chosen in place of the white flour and refined sugar found in traditional recipes. Three different formulations were tested in order to achieve the desired sensory and structural properties. In the first formulation, quinoa flour and carob flour were used in a 1:1 ratio, with dates and banana added as sweeteners. However, it was determined that due to the low viscosity of the resulting dough, the product failed to achieve sufficient volume after baking, its internal structure remained excessively moist, and it was deemed unacceptable in terms of appearance, texture and flavour. Furthermore, the dominant aroma of carob flour negatively affected the product's sensory quality. In the second formulation, the amount of carob flour was reduced and raw cocoa was added instead; however, sensory evaluations revealed that the dominant carob aroma persisted and the desired porous, spongy structure did not form in the cakes. In the third formulation, the carob flour content was reduced to one-third of the quinoa flour, and coconut flour was added to enhance the dough's water-holding capacity and structural stability, in addition to the use of raw cocoa. Following the observations and assessments carried out, it was determined that this formulation yielded the most successful results in terms of volume, texture, appearance and taste, and it was accepted

as the final formulation that meets the targeted product specifications (Table 3).

A thematic analysis approach was adopted for the analysis of the data obtained. Within this framework, the findings derived from the literature were categorised and interpreted under specific themes (nutritional value, health effects, gastronomic applications, etc.). The aim of this process was to classify and interpret the data in such a way as to identify meaningful patterns.

In the practical aspect of the study, traditional dishes (such as içli köfte, lahmacun, Gaziantep yuvalaması, tarhana soup, etc.) were reinterpreted by substituting bulgur and wheat flour with quinoa flour and grains, with the aim of highlighting the potential use of quinoa in Turkish cuisine. Thus, the study was approached from a gastronomic innovation perspective, analysing quinoa's interaction with and adaptability to the existing food culture. This research aims both to contribute to the development of alternative food options for individuals with specific dietary requirements and to provide theoretical and practical insights aimed at increasing the variety of functional and innovative products in the field of gastronomy.

Conceptual Framework

General Characteristics of Quinoa as a Functional Food

Functional foods are defined as foods containing biologically active components that provide health benefits beyond basic nutrition and help reduce the risk of disease (Roberfroid, 2000). Rich in prebiotics, probiotics, antioxidants, vitamins and minerals, these foods play a significant role in strengthening the immune system and preventing chronic diseases (Martirosyan & Singh, 2015; Hasler, 2002). Growing awareness of healthy living has increased demand for functional foods; this has contributed to the widespread adoption of such products in the fields of gastronomy and health tourism (Kaur & Das, 2011). Quinoa has also been used in traditional medicine for various medical purposes, such as reducing inflammation, acting as a painkiller, preventing urinary tract infections, providing supportive treatment for fractures and internal bleeding, and repelling insects (Poonia et al., 2024).

Quinoa, which originated in the Andes Mountains some 7,000 years ago, is classified as a 'pseudo-cereal 'and has been cultivated by local communities for centuries using sustainable agricultural practices (Poonia et al., 2024; Abugoch, 2009). Factors such as global climate change and drought affecting grain production have increased interest in quinoa—which has long been consumed in the US and European countries—in Turkey as well (Bertero & Ruiz, 2008; Jacobsen & Stolen, 1993). Quinoa seeds are regarded as a 'complete food 'due to their high nutritional value; whilst offering a suitable alternative for coeliac patients and individuals with gluten sensitivity due to their gluten-free nature, they also serve as an important source of protein and carbohydrates for vegans and those following a plant-based diet. In light of these characteristics, quinoa is frequently described in the literature as the "grain of the 21st century" and the "golden grain" (Poonia et al., 2024; Tan & Temel, 2019). In particular, its rich content of lysine—a limited amino acid—provides a balanced amino acid profile, a characteristic that makes quinoa a high-quality plant-based protein source (Nowak et al., 2016; James, 2009). As the saponins found in the seed coat of quinoa—compounds that have a protective effect against pathogens—give the seeds a bitter taste, the seeds must be soaked in water for a certain period before consumption and then rinsed thoroughly several times with plenty of water (Mora-Ocacion et al., 2022; Dağ & Özkan, 2019; Keskin & Evlice, 2015; Quispe-Fuentes et al., 2012).

The Use of Quinoa in the Food Industry and Tourism

Quinoa is regarded as a 'strategic food 'due to its rich nutritional content and resilience to harsh environmental conditions; it stands out as a valuable raw material with significant potential for the food industry, gastronomic tourism, agrotourism and the food and beverage sector (Bazile et al., 2015; Ruiz et al., 2014). In the food industry, partially replacing wheat flour with quinoa flour in bakery products enhances the nutritional value by increasing the protein, dietary fibre and bioactive compound content of the products. Although the absence of gluten in its composition limits the direct use of quinoa in bread production (Vilehe et al., 2003; Ahamed et al., 1998), it is noted that quinoa flour can be used up to approximately 20% in bread production and up to 50% in pastry products (Tang et al., 2015). For example, it has been demonstrated that adding 5–20% quinoa flour to lavash bread improves its sensory properties whilst increasing its protein, fibre and mineral content, and that use at a 20% level in particular makes the product a healthier alternative (Akturfan & Yalçın, 2025).

In plant-based meat products, quinoa is used as an ingredient that enhances nutritional value and improves the product's textural stability; it plays a significant role in the development of vegan and functional products (Wang et al., 2015; Atef et al., 2014). Furthermore, quinoa proteins and starch are being evaluated in functional food and health applications, playing an effective role in the transport and preservation of bioactive compounds (Pineli et al., 2015; Pino-Ramos et al., 2015).

From a tourism perspective, in the case of Chile, quinoa farming is integrated with the cultural heritage of the Aymara, Spanish-descended and Mapuche communities and is being developed within the framework of agrotourism; unique tourism models are being created, supported by walking trails and hands-on production experiences (Bazile et al., 2011). Similarly, in Turkey, quinoa can be integrated into gastronomy and health tourism through traditional culinary practices, thereby creating a sustainable model that supports local development whilst also increasing the variety of functional products. In the beverage sector, quinoa-based milk and fermented products are emerging as healthy alternatives (Lorusso et al., 2017; Pineli et al., 2015). Growing trends towards plant-based diets and environmental concerns are increasing the importance of plant-based beverages as sustainable options in the gastronomy and tourism sectors (Lopes et al., 2020; Lorusso et al., 2017; Pineli et al., 2015). The lightly fermented 'chicha 'drink, particularly in Inca culture, is a historical example of this (Lim, 2013).

The fact that quinoa contains all essential amino acids, is of a quality comparable to milk protein, and is gluten-free makes it a valuable source for individuals with special dietary requirements (Valcarcel Yamani & Silva Lannes, 2012). In the culinary field, thanks to its neutral flavour, it enhances the nutritional value of products such as bread, pasta, pancakes, biscuits, cakes, crackers, rice and salads without overpowering the character of traditional flavours (Demir, 2014; Kaya, 2010; Bhargava et al., 2006; Valencia-Chamorro, 2003).

The Use of Quinoa in Traditional Turkish Cuisine

The literature contains various studies on the use of quinoa and alternative plant-based sources in traditional Turkish cuisine. In their study entitled 'The Use of Quinoa in a Fusion Cuisine Approach', Doğdubay et al. (2017) successfully adapted quinoa to traditional dishes such as kadınbudu köfte, stuffed vine leaves, sütlaç, şekerpare and ezogelin soup. Similarly, Sezgin and Şanlıer (2019) have developed various recipes using quinoa for dishes characteristic of Turkish cuisine, such as salads, kısır, cakes, biscuits and stuffed peppers.

As part of efforts to diversify the range of gastronomic products, the use of plant-based alternatives for vegans and coeliacs is also becoming increasingly widespread. In studies where traditional milk-based desserts (kazandibi, keşkül, sütlaç) have been prepared using coconut milk (Şimşek et al., 2020), quinoa milk, almond milk (Özkaya et al., 2020) and other plant-based milks such as cashew milk (Öztabak, 2024); as well as in studies where vegan panna cotta was made using oat milk (Vatandost & Karaçeper, 2024) and where dishes such as soup and halva were served gluten-free using amaranth (Onur & Sezgin, 2024), consumers reported positive sensory outcomes and high levels of satisfaction.

In this context, the use of quinoa not only provides suitable gastronomic options for individuals with specific dietary requirements but also creates a valuable foundation for developing functional and innovative alternatives in the menus of food and beverage and accommodation establishments by enhancing the nutritional profile of symbolic dishes from Turkish cuisine.

Results

Using an applied research methodology, data obtained from experiments conducted personally by the researcher over a period of approximately four years, as well as recipes developed by various researchers and cited in literature within the scope of this study, were examined. The data obtained were evaluated and grouped under five main themes: the general characteristics of quinoa, its use in gastronomy, its health benefits, its integration into Turkish cuisine, and its potential for innovation. The data obtained has been presented below, stripped of literature reviews, and based directly on product components, production techniques and the science of gastronomy.

Theme 1: Nutritional Properties

The use of quinoa in place of traditional wheat, rice and bulgur in the recipes outlined in the data has fundamentally transformed the macro- and micronutrient profiles of the final products. Whilst the naturally gluten-free nature of quinoa, used in both grain and flour form, constitutes the products 'key functional characteristic, it has been found that its high dietary fibre content contributes to a sense of satiety. Furthermore, thanks to the balanced profile of essential amino acids in the quinoa used in the recipes, the dishes have been found to achieve a robust protein profile. In practice, it has been established that the process of soaking quinoa in water and rinsing it multiple times to remove the saponin compounds on the seed's outer surface which cause bitterness improves the products 'flavour profile and directly enhances their suitability for dietary use.

The comparative values presented in Table 1 demonstrate that the integration of quinoa into traditional wheat- and bulgur-based dishes is not merely an attempt to provide a gluten-free substitute. It serves as a fundamental element in validating the strategy of creating innovative and functional gastronomic alternatives suitable for specific dietary requirements (coeliac, vegan) by maximising the protein quality, dietary fibre content and essential amino acid balance of the products, as evidenced by their nutritional components. The nutritional contents of quinoa and other cereal products are presented in a comparative table in Table 1.

Table 1. Comparison of the nutritional components of quinoa and common cereals

Ingredients	Quinoa	Wheat	Maize	Oats	Buckwheat	Rice
Protein (g/100 g)	11.3-18.9	10-18	7.8-11.2	12.1-14.1	11-17	7-8
Starch (g/100 g)	53.2-73.4	60-75	66-78	41-53	60-70	70-80
Fibre (g/100 g)	7.7-18.59	1.14	1.4-2.2	8.8-13.4	3.4-6.5	0.2-0.9
Lipid (g/100 g)	4.0-7.09	2-2.5	4.1-12.3	4.4-7.2	2-3	1.3-1.8
Phenolics (mg/100 g)	30.3-202	46-134	60-460	320	70.4-124	48-467
Flavonoids (mg/100 g)	36.2-288	102	260	380	387	13.49-169.22
Phytosterol (mg/100 g)	0.3-180	70-92	43.6	35-49	60	13.62-52.71
Saponin (mg/100 g)	2-244	-	-	0.02-0.05	-	-

Source: Mu et al., 2023

Table 1 illustrates the superior nutritional profile of quinoa compared to grains commonly used in traditional Turkish cuisine, such as wheat, rice, maize and oats. As shown in Table 1, quinoa has a higher protein and dietary fibre content than other types of grain. Whilst the protein content of wheat, which forms the centrepiece of traditional recipes, ranges from 10–18 g/100 g, and that of rice from 7–8 g/100 g, the fact that quinoa's protein content falls within the 11.3–18.9 g/100 g range indicates that it directly enhances the macronutrient quality of adapted

recipes. In particular, its rich composition in lysine a limited amino acid provides a balanced amino acid profile, a characteristic that makes quinoa a high-quality plant-based protein source (James, 2009; Nowak et al., 2016). This demonstrates that when traditional dishes such as stuffed meatballs, lahmacun, tarhana soup and Gaziantep yuvalaması are formulated with quinoa, they not only become gluten-free but are also enriched in terms of essential amino acid balance.

In terms of fibre content, quinoa's high dietary fibre content ranging from 7.7 to 18.59 g/100 g offers a distinct functional advantage when compared to traditional alternatives such as wheat (1.14 g/100 g) and rice (0.2–0.9 g/100 g). The fact that the incorporation of quinoa, as noted in the findings section, imparts a property that supports satiety is directly attributable to this high fibre content. Furthermore, the presence of bioactive components in quinoa, such as phenolics (30.3–202 mg/100 g) and phytosterols (0.3–180 mg/100 g), stands out as quantitative data reinforcing the functional food qualities of products such as yuvalama and tarhana.

One of the most distinctive nutritional components in Table 1 is its saponin content (2–244 mg/100 g). This component, which is not found in wheat, rice or maize, reflects a characteristic feature of quinoa. It contains saponins, which are found in the seed coat of quinoa and have a protective effect against pathogens.

As these compounds give the grain a bitter taste (Mora-Ocacion et al., 2022; Quispe-Fuentes et al., 2012; Keskin & Evlice, 2015), the seeds must be soaked in water for a certain period before consumption and then rinsed thoroughly several times with plenty of water (Dağ & Özkan, 2019). Consequently, this data demonstrates that the intensive washing processes applied to remove bitterness, as described in the 'Gastronomic Use 'theme, are not coincidental but have a scientific and biochemical basis.

Theme 2: Culinary Uses

Quinoa's neutral and mildly aromatic profile allows it to blend seamlessly into local dishes without overpowering their characteristic and dominant flavour profiles. Quinoa has demonstrated comprehensive culinary versatility, being used across a wide range of dishes from hot soups (tarhana) to cold salads (quinoa tabbouleh), from main courses (chicken and quinoa pilaf, Gaziantep yuvalama) to baked goods and desserts (quinoa pancakes, cake). However, due to its gluten-free nature, it has been observed that quinoa alone cannot provide sufficient elasticity and textural stability in dough-based and binding-intensive outer coatings (e.g., stuffed meatballs, lahmacun, quinoa meatballs and Gaziantep yuvalama). Consequently, it was found that only by supplementing the formulations with additional binding components such as buckwheat flour, fenugreek powder, maize semolina, boiled potato, and egg was it possible to achieve a successful formulation that prevents cracking and disintegration during cooking (boiling/frying).

The fact that quinoa can be used in a wide range of products, from baked goods to fermented beverages, offers significant potential in both the food industry and the gastronomy sector. Accordingly, the various applications of quinoa in the food industry and the gastronomy sector are presented in Table 2.

Table 2. Different Applications of Quinoa and Its Functional Benefits

Area of Application	Functional Benefits	References
Baking	It increases protein, dietary fibre and bioactive compounds; it is suitable for gluten-free and low-GI products; with appropriate formulation and fermentation, volume and textural losses can be reduced.	Ruales & Nair, 1992; Ahamed et al., 1998; Repo-Carrasco & Serna, 2011; Tang et al., 2015; Schober, 2009
Plant-Based Meat Products	It enhances nutritional value, improves textural stability and reduces oxidative degradation; it can produce vegan sausage-like textures in high yields; it offers strategic applications for cases of energy and protein deficiency.	Felix et al., 2015; Atef et al., 2014; Wang et al., 2015
Functional Products	It facilitates the transport and preservation of bioactive compounds; it contributes to healthcare applications through controlled release.	Pineli et al., 2015; Uncu et al., 2017
Plant-Based Milks	It is high in protein and contains a balanced amino acid profile; it offers a functional alternative with a low glycaemic index and an acceptable taste.	Pineli et al., 2015; Lorusso et al., 2017
Gastronomy	Thanks to its neutral flavour, it can be used in both sweet and savoury recipes; it enhances the nutritional value of bread, pasta, pancakes, biscuits, cakes, crackers, rice and salads, whilst preserving their traditional flavour.	Valencia-Chamorro, 2003; Bhargava et al., 2006; Demir, 2014; Kaya, 2010
Packaging and Innovative Products	Environmentally friendly; enhances mechanical strength; provides encapsulation and emulsification for bioactive agents; these are transparent films that require no modification. When combined with biopolymers, they produce biodegradable and durable films; they are suitable for environmentally friendly and innovative food systems.	Atef, 2014; Valencia-Chamorro, 2003; Pajak et al., 2019

According to Table 2, the various uses of quinoa and its functional benefits are evaluated, with particular focus on its culinary applications and functional properties.

- Its role in the bakery sector: Thanks to its high protein and dietary fibre content, quinoa not only enhances the nutritional value of bakery products but also, due to its

naturally gluten-free nature, provides a safe formulation base for people with coeliac disease and those with gluten intolerance. As highlighted in Table 2, the use of appropriate fermentation and formulation techniques to address the issue of quinoa's inability to form an elastic dough on its own minimises losses in volume and texture. As highlighted in Table 2, the use of appropriate fermentation and formulation techniques to address the issue of quinoa's inability to form an elastic dough on its own minimises losses in volume and texture.

- Plant-based meat products and functionality: In today's world, where vegan and vegetarian dietary trends are growing rapidly, quinoa serves as a key component that enhances textural stability in plant-based meat alternatives (such as in the production of vegan sausages). In addition to positively extending shelf life by delaying oxidative degradation, it positions itself as a strategic solution to malnutrition issues through its rich protein-energy profile. The fact that quinoa is a component that both enhances nutritional value and improves the product's textural stability makes it highly significant in the production of functional foods.
- Functional products: Quinoa proteins and starch are used in encapsulation technologies not only for food consumption but also to facilitate the delivery, preservation and controlled release of bioactive components (such as vitamins or antioxidants) in medical and health-focused products.
- Plant-based milk and beverage sector: For consumers seeking to reduce their consumption of animal milk, quinoa is an extremely powerful functional beverage alternative due to its content of all essential amino acids and its low glycaemic index. It imparts an acceptable, neutral flavour to beverages, making them easier to consume.
- Gastronomic integration: Quinoa's distinctive neutral and mild flavour allows it to enrich the nutritional profile of traditional recipes (whether sweet or savoury) without overpowering their unique character. From bread to rice, and from crackers to salads, it facilitates gastronomic innovation whilst preserving classic flavours across a wide range of products.
- Packaging and innovative eco-friendly systems: Perhaps the most innovative non-food application of quinoa lies in the packaging industry. When combined with biopolymers, components derived from quinoa enable the production of transparent, mechanically robust and eco-friendly packaging films that are easily biodegradable in nature. Furthermore, these films are also suitable for advanced food engineering applications such as the encapsulation of bioactive agents and the stabilisation of emulsions.

Theme 3: Adaptability to Turkish cuisine

It has been found that the symbolic dishes of traditional Turkish cuisine, which are considered complex in terms of preparation techniques, are highly suitable for the incorporation of quinoa. The use of variations of quinoa flour and quinoa grains in place of traditional bulgur and rice flour in the dough components of içli köfte and Gaziantep yuvalaması; and the use of a mixture of buckwheat and quinoa flour in lahmacun dough, has successfully preserved the form and identity of traditional flavours. As a result of the experiments conducted by the researcher over approximately four years, the method of reinterpreting traditional Turkish flavours using quinoa, the list of ingredients, the techniques used during preparation, and photographs of the products taken by the researcher following the experiments are presented in Table 3.

Table 3. Traditional Turkish Dishes Reformulated with Quinoa

Product Group	Traditional Dish	Quinoa-based formulation	Production Technique	A Product Image Reimagined with Quinoa
Main Course / Starter	İçli Köfte	<u>Outer Dough:</u> 1 cup whole quinoa 1/2 cup cornmeal 1 boiled potato 1 egg, 2 tbsp buckwheat flour, 2 tsp Antep paste 1 tsp salt and black pepper <u>For the Filling:</u> 300g mixed beef and lamb mince 2 red onions 1/2 cup walnuts 1 tsp Antep paste 1 tsp salt and black pepper 1 tsp red chilli powder	If possible, prepare the filling the day before and leave it in the fridge. For the filling, sauté the minced meat and onion. For the outer layer, boil the quinoa grains—which have been thoroughly rinsed 4–5 times in plenty of water—then cool and mix with the other ingredients for the outer layer. A walnut-sized portion of the outer mixture is taken, hollowed out like a stuffed vegetable, filled with thoroughly cooled filling, and sealed. It is then deep-fried and served.	

Product Group	Traditional Dish	Quinoa-based formulation	Production Technique	A Product Image Reimagined with Quinoa
Main Course	Gaziantep Yuvalaması	<u>Yuvalama's dough:</u> 200 g minced beef for raw meatballs 1 cup rice flour 3 tbsp quinoa flour 2 tbsp cornmeal 1 egg 1 tsp salt and black pepper Water for kneading <u>Other ingredients:</u> 500 g strained yoghurt 4 tbsp vegetable oil 1 tbsp quinoa flour 1 egg 300 ml beef stock 300 g boiled diced lamb shoulder 1 cup boiled chickpeas 1 tbsp dried mint 2 tsp salt	Place the yuvalama ingredients in a deep bowl and knead for 10–15 minutes. Shape into chickpea-sized balls. Steam the prepared yuvalama balls for 10–15 minutes. In a large saucepan, combine the strained yoghurt, egg, quinoa flour and 1 tbsp vegetable oil, and whisk thoroughly. Once it comes to the boil, add the meat stock, boiled chickpeas and diced meat, along with the yuvalama balls, and simmer over a low heat for 15–20 minutes until the flavours have blended. Heat 2–3 tbsp of oil in a small frying pan until very hot. Add the dried mint to the hot oil, stir, then drizzle over the yuvalama and serve.	
Baked Foods	Gaziantep Lahmacunu	<u>For Lahmacun's dough:</u> 2 cups buckwheat flour, 1 cup quinoa flour, 2 tbsp psyllium seed powder, 1 tsp salt and black pepper <u>Filling ingredients:</u> 300 g minced lamb 3 medium tomatoes 5–6 sprigs of fresh garlic, 1 bunch of parsley, 2 red peppers, 1 green chilli,1 tsp Antep tomato paste, 1 tsp each of salt, black pepper and chilli flakes	Place the dough ingredients in a bowl, knead them together and leave to rest for at least 2 hours. If possible, use a food processor to finely chop the peppers, tomatoes, parsley and garlic; then place all the ingredients for the filling in a bowl and mix until smooth. Take walnut-sized pieces from the rested dough, roll them out using a rolling pin, place the filling on top, and bake in an oven preheated to 240°C.d, and leave to rest for	
Main Course / Starter	Quinoa Meatballs	<u>Ingredients</u> 1 cup of cooked quinoa, 1 grated carrot, 1 egg, 2 tbsp buckwheat flour, 2 spring onions 1 clove of garlic ½ bunch of parsley, 1 tsp each of salt, turmeric, cumin and black pepper	The cooked and cooled quinoa and all the other ingredients are mixed thoroughly in a deep bowl, then shaped into patties with damp hands. Heat 2–3 tablespoons of oil in a flat frying pan; once the oil is hot, fry the patties on both sides. Serve hot.	
Main Course / Starter	Chicken Quinoa Rice Pilaf	<u>Ingredients</u> 1 cup whole quinoa 2 cups chicken stock Zest of ½ a lemon 2 boiled chicken thighs 1 tsp salt	Soak the quinoa in a bowl of water for about 4–5 hours. Rinse thoroughly under running water 3–4 times. Then, place it in a saucepan, add the chicken stock and grated lemon zest, and leave to simmer over a low heat. Serve with chicken thighs.	

Product Group	Traditional Dish	Quinoa-based formulation	Production Technique	A Product Image Reimagined with Quinoa
Soups	Tarhana Soup	Ingredients 3 tablespoons of tarhana made with quinoa flour and buckwheat flour (the tarhana was prepared gluten-free by the researcher by fermenting it for two weeks during the summer, similar to Uşak tarhana) 2.5 cups of stock 1 tsp garlic powder 1 tsp salt	Made with quinoa and buckwheat flour. First, pour the stock into a deep saucepan and add 3 tbsp of gluten-free tarhana, stirring well. Place the saucepan over a medium heat and continue stirring until it comes to the boil. Once it starts to boil, add the garlic powder and salt, then leave to simmer on a low heat for 3–5 minutes. It is left to ferment for 2 weeks and is prepared gluten-free.	
Salads / Starter	Quinoa Kısır	Ingredients 1 cup whole quinoa 1 medium beetroot 3–4 sprigs of spring onion and fresh garlic, ½ bunch of parsley, 5–6 fresh mint leaves, Juice of 2 lemons, 2 tbsp pomegranate molasses, 3–4 tbsp olive oil, 1 tsp each of salt, cumin, allspice and black pepper	First, soak the quinoa in a bowl of water for about 4–5 hours. Then rinse it thoroughly under running water 3–4 times. Boil the quinoa in beetroot juice. Once cooled, add the finely chopped herbs, spices and other ingredients, and mix well.	
Salads / Starter	Quinoa Salad	Ingredients 1 teacup of cooked quinoa, 4–5 sprigs of curly endive, ½ bunch of rocket, ½ bunch of lamb's lettuce, 3–4 spring onions, ½ bunch of parsley, 2–3 fresh mint leaves, Juice of 2 lemons, 3 tablespoons of olive oil, 1 tsp salt	Add the coarsely chopped greens to the pre-cooked quinoa and toss to combine. Then add olive oil and lemon juice and serve.	
Bakery / Dessert	Quinoa Cake	Ingredients 2 eggs 3 ripe bananas 5–6 pitted dates 3 tbsp quinoa flour 1 tbsp carob flour 1 tbsp raw cocoa 1 tbsp coconut flour 1 tbsp tahini 1 cup olive oil 1 sachet baking powder	First, place the ripe bananas and dates in a mixing bowl and mash them thoroughly. Add the egg and whisk until frothy. Add the tahini and olive oil and mix well. Sift the dry ingredients and add them to the wet mixture. Give it a quick stir a couple of times, then pour into a cake tin. Bake in an oven preheated to 160°C for 30–35 minutes.	
Bakery / Dessert	Quinoa Crepe	Ingredients 1 egg 1/2 teacup of milk 3 tbsp quinoa flour 1/2 tsp bicarbonate of soda	Whisk all the ingredients thoroughly in a bowl. Place a teaspoon of clarified butter in a preheated cast-iron pan and pour in the pancake batter. Cook on both sides.	

Table 3 systematically demonstrates how traditional Turkish dishes have been transformed into innovative, gluten-free alternatives using quinoa. As quinoa contains no gluten, it presents structural challenges—such as crumbling and breaking—particularly in dough-based dishes and coatings that require binding properties. Upon examining Table 3, it can be seen that in dishes with complex preparation techniques, such as stuffed meatballs and Gaziantep yuvalaması, quinoa flour is supplemented with additional binders—such as maize semolina, buckwheat flour, rice flour, boiled potato and egg—to overcome this textural disadvantage. Similarly, the inclusion of natural and functional thickening agents, such as ground fenugreek, in the formulation of Gaziantep lahmacun to achieve the dough elasticity provided by traditional wheat flour reflects gastronomic innovation in the product development process.

On the other hand, Table 3 shows that quinoa is not merely a structural substitute but also maximises the nutritional value of the products. The integration of quinoa and buckwheat flour into the traditional fermentation process of tarhana, the preparation of bulgur with boiled quinoa grains instead of bulgur, and the use of ingredients such as dates, carob flour and raw cocoa in place of refined sugar and flour in baked goods such as cakes are the most concrete examples of this. In summary, a strategic and practical framework is presented that details how traditional recipes can be transformed into functional, high-nutritional-value gastronomic products that meet specific dietary requirements, without compromising their characteristic flavours and forms.

Theme 4: The Health Dimension

As a result of the recipe adaptations derived from these applications, traditional wheat-based dishes—which would normally pose a risk to those with coeliac disease or gluten intolerance—have been made safe and suitable for consumption. In addition to traditional recipes containing red meat and chicken (such as lahmacun, içli köfte and yuvalama), the preparation of entirely plant-based recipes such as kısır and salad using quinoa has enabled the creation of special dietary menu alternatives catering to different consumer groups seeking functional nutrition. It has been established that these adaptations integrate traditional consumption habits with values of health and well-being.

Table 4 presents a matrix showing how iconic dishes of traditional Turkish cuisine have been reinterpreted using quinoa and adapted to suit health and specific dietary requirements.

Table 4. Matrix of Adaptations of Traditional Turkish Dishes for Health and Special Dietary Groups

Product / Recipe	Traditional Content and Health Risks	Quinoa-Based Functional Adaptation	Target Consumer Group and Nutritional Profile
İçli Köfte, Lahmacun, Yuvalama, Köfte (Hot meals containing meat)	Wheat flour, bulgur and rice (contains gluten; poses a high risk for people with coeliac disease).	The dough is made gluten-free by using quinoa flour, psyllium husk powder, maize semolina and buckwheat flour in the recipe.	People with celiac disease, those with gluten intolerance, and those who prefer a high-protein, low-glycemic-index diet.
Kısır and Salad Varieties (Plant-Based Cold Dishes)	Bulgur (Contains gluten; high in carbohydrates).	The bulgur is completely omitted from the recipe and replaced directly with cooked quinoa.	Vegans, vegetarians, those following a gluten-free diet, and wellness-conscious consumers seeking plant-based functional diets.
Tarhana Soup (Fermented Products)	Fermentation using traditional wheat flour (triggers gluten intolerance).	A special gluten-free fermentation process is carried out using quinoa flour and buckwheat flour.	Those looking for probiotics or prebiotics to support gut health, people with coeliac disease, and those following a gluten-free diet.
Cakes and Pancakes (Baking / Desserts)	Refined white wheat flour and refined sugar (high glycemic index, gluten risk and empty calories).	Quinoa flour is used instead of white flour; natural sweeteners such as dates, carob flour and bananas are used instead of refined sugar.	Those following a diet free from refined sugar, those adhering to a diabetic/low-glycemic index diet, and consumers of healthy snacks.

According to Table 4, the integration of quinoa into traditional cuisine is regarded as a multi-faceted strategic move, extending beyond mere ingredient substitution to encompass public health and culinary tourism. Grains are widely used in many types of dishes found in Turkish cuisine, such as soups, pilafs, meatballs, stuffed vegetables, desserts and salads, with wheat, rice and bulgur in particular forming the core of traditional recipesHowever, most traditional dishes contain gluten, which significantly limits the options available to celiac patients and individuals requiring a gluten-free diet. In this context, quinoa stands out for its functional properties; thanks to its high protein and dietary fibre content, balanced profile of essential amino acids and low glycemic index, it emerges as a valuable alternative food for those requiring a gluten-free and vegan diet.As can be clearly seen from the data in Table 4, it is possible to transform dishes such as pilaf, lahmacun or icli Köfte which have been shaped around wheat and bulgur for centuries into fully plant-based, gluten-free or functional products rich in essential amino acids, without losing their traditional identity and form. This transformation also holds commercial significance for the food and beverage sector and destination marketing. Modern healthy eating trends are increasingly driving demand for gluten-free and nutrient-rich alternative products, making the development of gluten-free versions of traditional recipes a priority.

Food&Beverage and hospitality businesses can appeal to consumer segments following healthy living and functional nutrition trends, whilst also enhancing gastronomic diversity, by incorporating quinoa-enriched products into their menus. Particularly in the tourism sector, offering high-nutrition value and gluten-free options can not only enhance guest satisfaction but also help businesses strengthen their innovative and sustainable product portfolios. Ultimately, this drives businesses to improve both the variety and quality of their products.

Theme 5: Innovation Potential

In the context of gastronomic innovation, it has been observed that recipes are being developed beyond their classic formulas, with quinoa being enriched using supportive and innovative functional ingredients.

For example, the use of psyllium husk powder as a thickening agent and to enhance elasticity in gluten-free lahmacun dough represents a notable gastronomic innovation. Similarly, the preference for high-nutritional-value ingredients such as carob flour, coconut flour, raw cocoa, tahini and dates in quinoa cakes, rather than refined flour and sugar, clearly validates the potential for functional product development. It has been established that this approach will pave the way for food and beverage businesses to create value-added and competitive menus that can respond to personalised healthy eating trends by diversifying their gastronomic product portfolios. Innovative approaches regarding the optimisation of ingredients and binders are detailed in the innovation matrix in Table 5.

Table 5. Quinoa-Focused Gastronomic Innovation and Functionality Matrix

Type of Innovation	Sample Recipe	Traditional Ingredient	Innovative and Functional Alternative	Reached Outcome / Functionality
Structural Bonding Optimization	Glutensiz Lahmacun	Wheat Flour	Quinoa Flour + Psyllium Husk Powder	The gluten-free structure is preserved whilst ensuring the dough remains elastic and increasing dietary fibre content.
	İçli Köfte	Bulgur, Wheat Flour, Semolina	Whole Quinoa + Buckwheat Flour + Maize semolina + Boiled Potatoes	A structure that does not crack or crumble during either the preparation or baking stages has been achieved, whilst preserving the gluten-free structure.
A Healthy Sweetener and Flour Substitute	Quinoa Cake	Wheat Flour+ Refined Sugar	Quinoa Flour + Carob Flour + Dates + Banana	The formulation, which contains no refined sugar, results in a low glycaemic index and a high mineral and fibre content.
Textural Stability and Thickening	Gaziantep Yuvalaması	Rice Flour / Semolina	Quinoa flour + Rice flour + Maize semolina	An improved amino acid profile and structural integrity that prevents disintegration during cooking are achieved.
Healthy and Functional Features	Gluten-free Tarhana Soup	Wheat	Quinoa Flour + Buckwheat Flour	A delicious gluten-free soup with a higher protein content than traditional soups
	Meatball	Minced meat + breadcrumbs / Wheat flour	Whole Quinoa + Buckwheat Flour	Gluten-free, as well as being suitable for vegans and vegetarians
	Quinoa Pilaf / Kısır / Salad	Bulgur/ Rice	Whole Quinoa	A gluten-free product with a low glycaemic index and a higher protein content

According to Table 5, the reformulation of traditional Turkish dishes using quinoa is not merely a substitution of ingredients, but a multi-faceted process of gastronomic innovation and functional optimization. Firstly, within the context of 'Structural Binder Optimization', the gluten-containing wheat flour that provides elasticity in traditional Gaziantep lahmacun has been replaced with quinoa flour, buckwheat flour and psyllium husk powder. This innovative move ensures the dough retains the flexibility required during baking whilst increasing the product's dietary fibre content, thereby successfully maintaining its gluten-free form.

Furthermore, a gluten-free version of içli köfte—one of the iconic dishes of Turkish cuisine—has been developed by substituting the bulgur, wheat flour and semolina traditionally used in the meatballs with cooked whole quinoa, buckwheat flour and maize semolina. A single boiled potato has also been added to the outer dough mixture to prevent the dough from crumbling and to ensure it retains its shape during cooking.

Secondly, in the 'Healthy Sweeteners and Flour Substitutes 'strategy, the example of the quinoa cake stands out as a departure from traditional dessert concepts. By completely eliminating the use of white flour and refined sugar found in classic baking recipes, high-nutritional-value, functional ingredients such as quinoa flour, carob flour, raw cocoa, banana and dates have been incorporated into the process. This has resulted in an innovative dessert profile that is free from refined sugar, has a low glycemic index, and is enriched with minerals and fibre.

Thirdly, under the heading 'Textural Stability and Consistency Improvement', the dough mixture for a complex dish such as Gaziantep yuvalaması, which carries a high risk of disintegrating during boiling, has been optimized. The traditional recipe's structure of rice flour and bulgur has been updated with a combination of quinoa flour, rice flour and maize semolina, thereby both enhancing the product's essential amino acid profile and achieving strong textural stability that ensures the dish retains its cooking resistance and shape.

Finally, under the heading 'Health and Functional Properties', the researcher produced a gluten-free version of traditional tarhana during the summer of 2025 by fermenting the mixture for two weeks using buckwheat and quinoa flour in place of wheat flour, whilst keeping the other ingredients of the standard tarhana unchanged. The preparation stages for traditional tarhana soup were followed exactly. In terms of flavour, a gluten-free tarhana soup with the same taste as the original was produced. Similarly, in the preparation of dishes such as pilaf and kısır, which feature in traditional Turkish cuisine, grains such as bulgur and rice were replaced with boiled whole quinoa, resulting in an innovative gluten-free product variety with a low glycemic index and increased protein content.

In summary, Table 5 demonstrates that, thanks to the innovative use of quinoa in both natural and traditional culinary arts, it serves not only as a gluten-free alternative but also as a functional innovation tool that simultaneously enhances the textural, sensory and nutritional properties of products.

Discussion

The quinoa plant is able to adapt to arid and diverse environmental conditions thanks to its low water requirements, tolerance to salinity and resistance to pests. Owing to this adaptability, quinoa stands out as a suitable crop for cultivation in many countries with varying climatic and soil conditions. However, despite rising demand, the limited production capacity necessitates improvements in terms of productivity and production support (Poonia et al., 2024; Keskin & Evlice, 2015). In their study, Geren et al. (2014) examined the quinoa plant's adaptation to the Mediterranean climate and the effects of different sowing times on yield. The study highlighted the nutritional advantages of quinoa, such as its high protein content and gluten-free nature and noted its potential as a strategic alternative for Turkish agriculture. This potential could be harnessed by integrating quinoa farming with tourism and gastronomy; thereby providing a revenue-generating opportunity for local producers whilst offering visitors sustainable agricultural experiences and healthy, functional quinoa-based gastronomic products.

From the perspective of the food industry, quinoa stands out as a functional raw material that can be used in bakery products, plant-based meat alternatives, fermented beverages and plant-based milks. Its properties, linked to its protein and starch composition, provide a strategic advantage in gluten-free and low-glycemic-index products (Mu et al., 2023). As quinoa flour does not contain gluten, it is unable to form an elastic network structure; this leads to shortcomings, particularly in terms of gas retention capacity and dough rheology. For this reason, in baking applications, it is mostly used in blends with wheat flour, an approach that partially limits quinoa's functional potential (Enriquez et al., 2003). However, whilst the adaptation of quinoa to traditional products offers nutritional benefits, it does not always yield positive results in terms of sensory quality and structural integrity; issues such as texture and volume loss necessitate the careful optimization of usage ratios (Kaur and Das, 2011; Schober, 2009).

Akturfan and Yalçın (2025) reported that lavash bread enriched with quinoa flour had increased nutritional value and yielded acceptable sensory results. Similarly, Itusaka-Maldonodo et al. (2024) noted that pasta produced from 100% quinoa semolina offers a nutritious alternative for gluten-free diets due to its high protein and fibre content. However, whilst these studies highlight the nutritional benefits of quinoa, it should be borne in mind that the sensory characteristics and technological performance of these products are not always on a par with those of traditional products. Consequently, the success of quinoa use is linked not only to an increase in nutritional value but also to the ability to maintain the product's sensory and technological quality.

This study generally aligns with previous research in the literature on the integration of quinoa into traditional Turkish cuisine (Sezgin and Şanlıer, 2019; Doğdubay et al., 2017), demonstrating that traditional products such as lahmacun, içli köfte, yuvalama and tarhana can be reformulated using quinoa. The findings suggest that quinoa offers significant potential in terms of enhancing nutritional value and developing gluten-free products. However, the role of quinoa in food systems is not limited solely to its nutritional contribution; it is a multifaceted issue that must also be evaluated in terms of technological functionality and sensory quality. In particular, due to its lack of gluten, certain limitations may arise regarding elasticity and structural integrity in dough, which can sometimes make it difficult for products to achieve their traditional texture and flavour characteristics. For this reason, in most applications, using quinoa in combination with other ingredients rather than on its own contributes to achieving more balanced and successful results.

From the perspective of the gastronomy and tourism sectors, the inclusion of quinoa-enriched products on menus offers opportunities to respond to trends in healthy eating and to increase product diversity. However, for such products to be successfully implemented, factors such as sensory acceptability, cost, standardization and consumer expectations must be taken into account, alongside nutritional benefits. From this perspective, whilst quinoa holds significant potential in gastronomic innovation and

product development processes, it can be said that its effective use requires careful formulation and a multifaceted assessment.

Conclusion

Consequently, quinoa is regarded as a key ingredient in the development of traditional cuisine, both because it aligns with modern healthy eating trends (gluten-free, vegan and low-glycemic-index products) and because it has the potential to serve as a raw material that complements specific traditional flavour profiles. Its functional properties and nutrient-rich composition offer significant advantages, particularly in gluten-free product development processes; however, the conversion of these advantages into practical product success depends largely on formulation optimization. From the perspective of gastronomy businesses, incorporating quinoa-based products into menus presents opportunities to increase product diversity and respond to trends in healthy eating; however, the widespread adoption of these products is shaped not only by their nutritional benefits but also by their sensory acceptability and the extent to which they align with consumer expectations.

Given quinoa's wide range of applications, nutritional value and relatively sustainable production potential, it is expected to gain increasing importance within the food industry, gastronomy and health-focused dietary approaches. However, for this potential to be transformed into a strategic advantage, factors such as sensory quality, technological functionality and cost-effectiveness must be addressed collectively. In this context, whilst quinoa represents a valuable alternative from both a nutritional and product development perspective, it can be said that its effective use requires a multi-faceted assessment and a balanced formulation approach.

Based on the findings of the study, the following recommendations have been developed for the gastronomy and tourism industries:

- Food and beverage establishments can offer healthy and functional options by increasing the number of quinoa-based products on their menus. Adopting this approach will directly contribute to strengthening businesses 'innovative and sustainable product portfolios.
- The development of gluten-free alternatives to our traditional dishes with geographical indications could present significant opportunities for destinations in terms of marketing and product diversification, both within the gastronomy and health tourism sectors.

The limitations of the study are primarily related to the evaluation of examples of gastronomic innovation based on a limited number of recipes. The fact that the sensory and technical performance of quinoa in different recipes was not measured directly in a laboratory setting, and the absence of consumer acceptance analyses, are among the main limitations of the study. In this context, it is recommended that future studies be designed to include quantitative research based on experimental product development practices and sensory analyses. Given the limitations of this study, the following recommendations are made for the academic community and future scientific research:

- In future studies, sensory analyses should be conducted in a laboratory setting using the developed recipes, and consumer acceptance levels should be assessed using quantitative methods.
- Applied and experimental studies examining the integration of quinoa not only into staple foods but also into different food groups should be increased.

Declarations

Ethical Approval Certificate

This study did not involve any human participants or animals. Therefore, ethics committee approval was not required.

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