






## Boosting market appeal: Exploring the impact of nutritional claims on popular Italian dietary cereal product

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### ARTICLE INFO

#### Keywords:

Cereal-based product  
Rusk  
Hedonic price model  
Food claims  
Food safety  
Food sustainability  
Food traceability

### ABSTRACT

This study examines the intricate interplay between nutritional claims and consumer purchasing behaviour in the Italian rusk market. Rusks, obtained by double baking sliced loaf bread, are a staple of the Italian breakfast, generating annual revenues of EUR 225 million. With the growing focus on more health-conscious food choices, especially after COVID-19, health-related claims on food labels have a greater impact on consumers. Utilizing the hedonic pricing method, the study decomposed rusk market value based on specific product characteristics, revealing how quality attributes and nutritional aspect influence price. Data collected from major retail chains yielded 1438 observations, showing a positive correlation between price and factors such as brand, format, ingredients formulations and nutritional or sustainability claims. Results show that among analyzed regulated nutritional claims: "no added sugars," "high in protein," and "low salt content" exhibit the highest premium price, highlighting consumers' willingness to pay more for products perceived as healthy, as well as for enriched products or those made with alternative flours. Conversely, in a very heterogeneous context and a highly competitive market, reduced ingredient formulations and traditional recipes result in discount prices. The research demonstrates that clear and transparent health-related communication promotes informed purchases. This study suggests that producers adopting differentiation strategies focused on nutritional quality and the use of food claims can enhance product appeal and positively influence consumer purchasing decisions, thereby increasing their market share in a dynamic market.

## 1. Introduction

### 1.1. Background information

The relationship between nutrition and health has been long recognized, dating back to the ancient Greek philosopher Hippocrates, who famously stated, "Let food be the medicine and medicine be the food." This concept has recently gained renewed attention due to the Global Nutrition Report, which highlights the prevalence of malnutrition-related diseases such as diabetes and obesity in both low-and high-income countries. Initiatives like the Food As Medicine (FAM) program in the USA aim to promote healthier dietary choices to improve overall health outcomes [1,2].

In terms of market context and consumer behaviour, the contemporary food market is characterized by pronounced product heterogeneity. This is evident in the overwhelming variety of items on store

shelves, including numerous offerings within the same product category that display diverse and distinct attributes. This competitive landscape necessitates food companies to adopt differentiation strategies by emphasizing unique features such as nutritional quality, source of raw material, and sustainability. These strategies aim to capture consumer attention and position brands more effectively in the market. The extensive product heterogeneity influences consumer perceptions in terms of utility and usability, often introducing disadvantages associated with increased product complexity, but which sees in the hedonic price method a quantitative approach to evaluate multiple product attributes and how this complexity can deter purchasing decisions [3,4].

However, the food market is also marked by significant information asymmetry, how formalized in economics terms by George A. Akerlof in 1970. Sellers often possess more knowledge about product information than buyers, who are at a disadvantage position, particularly concerning "credence" attributes, i.e. qualities that cannot be verified by consumer

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<https://doi.org/10.1016/j.jafr.2025.101751>

Received 4 December 2024; Received in revised form 10 February 2025; Accepted 17 February 2025

Available online 18 February 2025

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even after purchase and thus rely on trust in product labelling [5]. This imbalance amplifies the influence of marketing, which plays a critical role in shaping purchasing decisions. Unfortunately, these decisions are often driven by emotional factors, which can lead to outcomes that are unsustainable from a health perspective [6–8].

With respect consumer awareness, recent studies, particularly following the COVID-19 pandemic, show growing consumer attention to food product labels with claims on health [9,10]. As an example of this phenomenon, the rusks market experienced significant growth during the pandemic, with an increase in consumption linked to home breakfasts. An Italian sector report of 2021 highlighted that generic rusks saw a 2.8 % increase in volume and a 3.4 % increase in value respect previous year, representing 36.9 % of the market value. In contrast, whole wheat rusks remained stable, indicating a preference for classic and enriched variants. Enriched rusks experienced a 13.4 % growth in volume and a 33.4 % increase in value, with their average price rising by 17.6 % [11]. This segmentation is crucial to understand how quality attributes influence consumer choices and, consequently, market prices. This increased interest is driven by the desire to make more informed choices and focus on health prevention [12,13]. Nutritional claims on food products play a crucial role in this context, influencing consumer purchasing decisions and willingness to pay for products perceived as healthier. Despite the challenges of information asymmetry and the potential for misinterpretation, health and nutritional claims remain valuable tools for both consumers and producers. For producers, these claims can enhance product appeal and financial performance, while for consumers, they are essential in making healthier and more informed food choices.

Despite the growing awareness of the healing power of food, consumers often face confusion due to the variability of claims made by food products. In this context, institutional oversight of health claims on food is crucial to ensure that they are supported by scientific evidence, thereby preventing consumers from being misled and undermine their ability to make informed and healthier decisions [14,15]. In Europe, health and nutritional claims are regulated by EU Regulation 1924/2006 for guarantee that authorized claims are clear, evidence-based and not misleading to consumers, careful supervision is the responsibility of EFSA and the European Commission [16,17]. In according to article 2, paragraph 2 of EU Reg. 1924/2006, nutritional claims highlight a food's beneficial properties related to its energy content or the content of specific nutrients or other substances, such as "low fat" or "no added sugars". In contrast, health claims imply a relationship between a category of food and health, highlighting the beneficial effects of the product on health, for example, "helps maintain normal cholesterol levels" [18].

### 1.2. Existing literature and impact on consumer behaviour

The effect of health and nutritional claims on food market has been analyzed in the literature, where research has shown that they significantly impact consumer purchasing decision. For [19] nutrition and health claims were considered the most relevant information on packaging, a priority for 87 % of consumers. These preferences however may be modified for specific product categories, or for product-extrinsic features such as brand, price, and communication strategy [20]. Food choices are driven primarily by sensory functions, but familiarity, nutritional knowledge and use influences healthier food choices [21]. Studies like [22,23] demonstrate that claims can positively influence purchasing attitudes, particularly when linked to innovative functional ingredients or products with less appealing sensory characteristics. Conversely [24], research on protein bars indicates that nutritional or health claims do not significantly affect product acceptance in terms of sensory or emotional appeal, with taste, flavour, and texture being the primary preference drivers, especially among younger consumers. This inconsistency highlights a major issue: the understanding of these claims. If not presented uniformly and clearly, nutritional or health

claims can confuse less experienced consumers who might misinterpret the information [25–27]. Despite these challenges, a greater consistency in nutritional information and an easier information of them, could improve public health, addressing issues like obesity, particularly childhood obesity [28]. While some consumers may make healthier choices based on nutrition claims, others may misinterpret these claims, potentially increasing overall food consumption and energy intake, thus counteracting obesity prevention efforts [29]. The support of nutritional expert, who knowing FAM definition, they can help consumers to make healthier choices and avoid being tricked by marketing tools [30]. However, claims on label remain valuable tools for both consumers and producers. Producers use them strategically to enhance product appeal and financial performance [31]. On the consumer side, health claims are a crucial aspect of food choice values (FCVs), influencing purchasing choices and willingness to pay for healthier and safety foods, a trend intensified by the COVID-19 pandemic [32–34].

### 1.3. Objectives and significance

Although there are studies that recognize nutritional claims among the attributes that influence the demand and WTP of food products in different countries [35,36] and how they can also influence the supply side, as measured in Spanish and Chinese dairy sector [37,38] or fruit beverages products in Italy [39]. Instead, no research examines the effects of nutritional or health claims on the price market for baked-cereal products in Italy. Cereal products are the basis of global nutrition and improving their nutritional quality could enhance public health, considering their role in healthier and more sustainable dietary patterns [40]. This study aims to fill this gap by analysing the impact of nutritional claims on consumer purchasing behaviour, particularly in the context of the Italian market for rusks, a cereal-based product generally recognized as dietary and healthy. Due to the nutraceutical potential of cereal-based products rich in bioactive compounds, such as fiber and antioxidants, these products play a significant role in reducing cardiovascular risks, improving gastrointestinal health, and preventing chronic diseases, which aligns with consumer demand for minimally processed and health-promoting foods [41,42].

Rusks is a popular Italian dietary cereal product obtained by double baking sliced loaf bread, which explains the etymology of the Italian term "fette biscottate". In Italy, rusks are a staple of the Italian breakfast, often consumed with hot beverages and alongside other cereal-based products. The rusk market generates annual revenue of EUR 225 million [43]. Recent growth in the rusk market is driven by socio-economic factors and trends favouring long-shelf-life, easy-to-prepare, and health-oriented products, including organic, whole grain, and enriched options [36,44,45]. In response, large-scale retail (GDO) has expanded its offerings with specific characteristics to meet diverse consumer needs. Established brands and artisanal producers have increased their rusk production, focusing on selected ingredients and traditional processes. Competition has intensified, with private labels offering similar products at lower prices, achieving positive quality results and increasing market share [46,47].

Various studies have used rusks as basis for fortified products with high nutritional value, indicating a significant market presence across various cultures. These products, made with ingredients like flax seeds, finger millet, chia seeds, black rice, and proso flour, become exceptionally healthy due to their low glycemic index, high fiber content, and reduced levels of fats and sugars [48–54]. Moreover, when enriched with zinc, iron, calcium, vitamins A, D, B12, thiamine, riboflavin, niacin, and folic acid, they can become functional therapeutic products, useful for supporting malnourished children in the world's poorest areas [55].

In our study, we hypothesize that the presence of regulated nutritional claims significantly influences consumer preferences and market prices. We also aim to identify the most effective marketing strategies employed by leading brands in this sector. Specifically, this research aims to evaluate the monetary value associated with the presence of

quality attributes and nutritional aspects communicated through claims. It is well established that, in a perfectly competitive market for food products, the selling price is influenced by the price-quality relationship, which is important for both raw materials and processed products [56, 57]. Therefore, the hedonic pricing method is an appropriate methodology for achieving this goal, as it helps us understand how different product characteristics, such as brand, format, ingredients, and nutritional claims, influence selling prices and perceived consumer value. Given that rusks are often perceived as a diet food, attributes such as nutritional features are expected to significantly impact product prices. In other words, the goal of this approach is to determine the extent to which consumers are willing to pay a premium for health-related attributes. In this perspective, this research is significant as it addresses the gap in understanding how claims affect both consumer behaviour and market dynamics in the Italian rusk market. Additionally, this study contributes to the broader discourse on nutrition and public health by highlighting the importance of clear and evidence-based health claims.

The article is structured as follows: the next section will detail the methodology employed in the study, including the hedonic pricing analysis used to assess the impact of nutritional claims on market prices. Following this, we will present the results of our analysis, discussing the implications for both consumers and producers. Finally, we will conclude with recommendations for future research and practical applications of our findings in the Italian bread industry.

## 2. Methods and materials

### 2.1. Basic theory and functioning

The hedonic pricing method theory, developed by Lancaster and Rosen [58,59], is an econometric technique that estimates the market value of specific characteristics or services associated with a complex good by breaking it down into individual attributes. In our study, we applied this method to assess the market value of specific characteristics in food products, relying on market transactions involving differentiated goods. This approach infers the value consumers assign to each characteristic from observable market transactions, such as selling prices [60]. The method is highly adaptable to various market contexts and product categories due to its regression analysis flexibility. Originally applied to durable goods like housing, it has been extended to other sectors, proving effective in decomposing the values of complex goods [61,62]. Numerous studies, including our own, have applied the hedonic method to food products to determine the monetary trade-offs individuals are willing to make for specific characteristics, particularly in terms of quality and sustainability [37–39,56,63–65]. By incorporating this method in our research, we gained valuable insights into how different attributes of food products influence consumer preferences and market values, aiding future innovations in food design and processing.

According to the economic theory, the price of a good is a function of its characteristics. In a context of perfect competition from differentiated products, the market price is the sum of the implicit prices of each attribute. The hedonic method uses multivariate regression to isolate the effect of each characteristic on the price, where the coefficients represent the marginal value assigned by consumers. The hedonic price function is:

$$\text{Price} = f(C) + \epsilon \quad (1)$$

Where: “C” represents product characteristics, and “ $\epsilon$ ” captures the unexplained price variation not explained by the characteristics included in the model. To improve the precision of the estimate, choosing the appropriate functional form is necessary to adopt the form that can evaluate better the characteristics of food goods. In this term among five possible options: linear, logarithmic, log-linear, Box-Cox or other transformations; the log-linear transformation, appears to be the most suitable choice [66]. The log-linear form is particularly effective as it

enhances adherence to the normality assumption, which is crucial for the validity of regression models. By transforming the dependent variable (price) into its logarithmic form, this approach helps mitigate issues such as skewness and extreme values, making the distribution of the residuals closer to a normal distribution, a key assumption for the proper application of the regression model. As a result, the log-linear form enhances the robustness of the regression analysis, improves precision by interpreting coefficients as percentage changes in price, reduces the influence of outliers, controls for heteroscedasticity, and generally boosts the quality and reliability of the estimates. The model is specified as follows, where  $\ln P$  represents the logarithm of the price:

$$\ln \text{Price} = f(C) + \epsilon \quad (2)$$

However, the method requires a large, representative data sample and careful selection of variables to address challenges like endogeneity and collinearity, ensuring valid and interpretable results in the context of food markets.

### 2.2. Data gathering

Between June and July 2024, we collected detailed data on brand, format, ingredients, health claims, and prices of rusks available in the Italian GDO. The choice of this product was made due to its characteristics as a dietary item, where nutritional and health aspects are considered crucial for both consumers and producers. Thus, we selected the main rusk-producing companies in Italy based on 2022 and 2023 revenue data. These companies generally fall under ATECO codes 10.72 and 10.73, covering bakery products and cereal-based foods as depicted in Table 1 [67]. ATECO stands for "Attività Economiche", which is Italian for "Economic Activities". It is a classification system used in Italy to categorize different types of economic activities for statistical and administrative purposes. The ATECO codes are similar to the NACE "Nomenclature of Economic Activities" codes used in other European countries.

The Italian rusk market is dominated by major national and international brands with annual revenues close to or exceeding EUR 100 million (1st to 6th in market share), alongside numerous companies, including private labels, that intensify the competitiveness of the sector. Based on the revenue factor, the brand attributes within the sample were categorized into four distinct variables. The first variable, designated as

**Table 1**  
List of rusks producers in Italy by revenue (top 11)

Producer Companies	Product line brand	Revenue (million euro/year)	ATECO Code	Reference year
Barilla S.p.A.	<i>Mulino Bianco</i>	3.400	10.73	2023
Newlat Food Group S.p.A.	<i>Delverde</i>	730	10.61	2022
San Carlo Gruppo Alimentare S.p.A.	<i>San Carlo</i>	343	46.38	2023
Galbusera S.p.A.	<i>Galbusera</i>	278	10.72	2022
Colussi S.p.A.	<i>Misura</i>	263	10.72	2023
Grissin Bon S.p.A.	<i>Grissin Bon</i>	95	10.72	2023
Pastificio F.lli Cellino S.p.A.	<i>F.lli Cellino</i>	71	10.73	2023
Monviso Group S.r.l.	<i>Monviso</i>	57	10.72	2023
Probios Spa società benefit	<i>Probios</i>	27	46.21	2023
Biscotti P. Gentilini S.r.l.	<i>Gentilini</i>	23	10.72	2023
Brioche Pasquier Italie S.r.l.	<i>Brioche Pasquier</i>	20	10.72	2023

Source: Gathered from <https://www.ufficiocamerale.it/> (last accessed on November 14, 2024).

“Main Leader”, corresponds to the entity holding the 1st force within the sector. The second variable, labeled “Other Leaders” encompasses companies positioned between the 2nd and 6th force. The third category referred to “Other Brands” pertains to other companies that falls beyond the 6th. Finally, the fourth variable “Private Labels”, is defined to include product that are identifiable within this classification [68].

To ensure representative data for the entire national context, data collection was conducted on the e-commerce platforms of 15 Italian distribution chains, covering the country’s five main geographical areas: North-East, North-West, Central, South, and Islands [69,70]. The choice to use e-commerce platforms is due to their offer of easy and free access to a large volume of data, overcoming the logistical challenges associated with in-store data collection. The selected chains have virtual stores with assortments and prices comparable to their physical counterparts, and the data collection focused on products only available for in-store pickup to avoid delivery costs. Data were collected by simulating purchases in cities within these macro-areas. In addition, to ensure a comprehensive and significant representation, both high-density (like Milan and Naples) and low-density provinces (like Belluno and Nuoro) were included in each macro-area as summarized in Table 2. This approach allows for broad and representative coverage of the entire Italian territory. For allowing to the best representation of the country’s food market, the chains were selected based the distribution among cities according to geographic presence and sales formats, including hypermarkets, supermarkets, convenience local stores, and discount stores.

### 2.3. Dataset and econometric model

The dataset includes 1438 observations of rusks, providing detailed information on prices and product characteristics, primarily gathered through label analysis. Key attributes reported include brand, sales format, packaging material, type of flour, use of sourdough, organic or Italian wheat, and nutritional claims such as "Source of Fiber," "Source of Protein," and "Palm Oil Free." These attributes selected on product features can be easily gathered by reading product labels, as they involve information that is easily accessible and understandable, even by

**Table 2**  
Italian provinces and the distribution chains selected.

Geographical Area	Provinces	Population density (inhabitant/km <sup>2</sup> )	Distribution chain
Nord East	Venice	348	Conad, Coop, Lidl, Gruppo Selex
	Belluno	53	Carrefour, Coop, Lidl, Others
Nord west	Milan	2067	Carrefour, Coop, Esselunga, Eurospin, Lidl, Gruppo Vegè
	Verbano-Cusio-Ossola	77	Carrefour, Conad, Coop, Esselunga, Lidl
Centre	Rome	807	Carrefour, Conad, Coop, Esselunga, Eurospin, Lidl, Gruppo Selex, Gruppo Vegè
	Rieti	72	Carrefour, Conad, Coop, Eurospin, Lidl, Gruppo Selex
Sud	Naples	2672	Conad, Eurospin, Lidl, Gruppo Selex, Gruppo Vegè
	Isernia	69	Conad, Coop, Eurospin, Gruppo Vegè, Others
Islands	Palermo	257	Conad, Eurospin, Lidl, Gruppo Selex, Others
	Nuoro	39	Conad, Coop, Eurospin, Gruppo Vegè, Others

Source: ISTAT, 2023 – Gathered from <https://demo.istat.it/app/?l=it&a=2023&i=POS> (last accessed on November 14, 2024).

reading the product’s ingredient list. Among these, some have been widely used in applications of the hedonic price method to food products where the price dynamics in relation to product features has been demonstrated [37–39,56,63–65]. In dataset the inclusion of products involved only industrial rusk, with toast-like form and double baked, long shelf-life and sold in packaging with a descriptive label. Gluten-free products were excluded in dataset to avoid data dispersion, due to their generally higher price and more different product characteristics. Other attributes include are environmental sustainability claims and enrichment with ingredients like cereal flour, seeds, chocolate and fruit (Table 3). This comprehensive dataset enables detailed market analysis of rusks, evaluating the impact of each attribute on price and consumer willingness to pay. Based on Table 3, equation (2) becomes:

**Table 3**  
Attributes and variables description.

Attribute	Variable	Typology	Description
<b>Dependant variable</b>			
Unit price		Continuous	Unit price expressed in EUR per kg
<b>Independent variables</b>			
Sales brand		Categorical	
	Private Labels	Dummy	Yes = 1; No = 0
	Main Leader	Dummy	Yes = 1; No = 0
	Other Leaders	Dummy	Yes = 1; No = 0
	Other Brands	Dummy	Yes = 1; No = 0
Sales format		Categorical	
	Greater than 400 g	Dummy	Yes = 1; No = 0
	Less than 400 g	Dummy	Yes = 1; No = 0
Packaging multipack (single-serve)		Dummy	Yes = 1; No = 0
Packaging material		Categorical	
	Paper	Dummy	Yes = 1; No = 0
	Plastic	Dummy	Yes = 1; No = 0
Type of flour		Categorical	
	Soft wheat >50 %	Dummy	Yes = 1; No = 0
	Whole grain flour >50 %	Dummy	Yes = 1; No = 0
	Other cereal flours >50 %	Dummy	Yes = 1; No = 0
Sourdough	Use of sourdough	Dummy	Yes = 1; No = 0
Organic wheat	Use of organic wheat	Dummy	Yes = 1; No = 0
Italian wheat	Use of Italian wheat	Dummy	Yes = 1; No = 0
(EU Reg. 1924/2006)	Rich in fiber/High in fiber	Dummy	Yes = 1; No = 0
	Source of fiber	Dummy	Yes = 1; No = 0
	No-added sugar	Dummy	Yes = 1; No = 0
	Lactose-free	Dummy	Yes = 1; No = 0
	Source of proteins	Dummy	Yes = 1; No = 0
	Source of vitamins or minerals	Dummy	Yes = 1; No = 0
	Lower fat content	Dummy	Yes = 1; No = 0
	Lower salt content	Dummy	Yes = 1; No = 0
	With extra virgin oil	Dummy	Yes = 1; No = 0
	Without palm oil	Dummy	Yes = 1; No = 0
	Certified “Okay Vegan” or alike	Dummy	Yes = 1; No = 0
	100 % plant-based ingredients	Dummy	Yes = 1; No = 0
	Sustainable	Dummy	Yes = 1; No = 0
	Packaging Sustainable	Dummy	Yes = 1; No = 0
	Production	Dummy	Yes = 1; No = 0
	Other grain flours <50 %	Dummy	Yes = 1; No = 0
	Whole grains or seeds	Dummy	Yes = 1; No = 0
	Fruit or chocolate	Dummy	Yes = 1; No = 0

$$\begin{aligned} \ln P = & \alpha + \beta_1(\text{sales brand}) + \beta_2(\text{sales format}) + \beta_3(\text{single-serve}) \\ & + \beta_4(\text{packaging material}) + \beta_5(\text{type of flour}) \\ & + \beta_6(\text{sourdough}) + \beta_7(\text{organic wheat}) + \beta_8(\text{Italian wheat}) \\ & + \beta_9(\text{nutritional claims}) + \beta_{10}(\text{other claims}) \\ & + \beta_{11}(\text{vegan product}) + \beta_{12}(\text{sustainability claims}) \\ & + \beta_{13}(\text{enriched product}) + \epsilon \end{aligned} \tag{3}$$

Regarding the estimation methodology, the econometric model was constructed and estimated using the Ordinary Least Squares (OLS) method with STATA software. This method is suitable for our case because it is widely used in econometrics to estimate the relationships between variables while minimizing the sum of squared residuals (the differences between observed and predicted values). By doing so, OLS provides optimal and robust estimates with reduced collinearity and variance, if the key assumptions (such as linearity, independence, and homoscedasticity) hold. Additionally, OLS is particularly effective in addressing potential multicollinearity issues in models with multiple predictors, as often applied in the context of food markets [3,66]. After estimating the  $\beta$  coefficients obtained through the OLS regression, it is necessary to apply the adjustments in accordance with the methodologies proposed by Halvorsen and Palmquist (1980) and Kennedy (1981) to accurately measure the marginal prices of each attribute in percentage terms and the implicit prices. These adjustments are critical to account for the non-linear relationships in the log-linear model and to ensure consistent and unbiased estimation of the price effects, particularly when dealing with both continuous and categorical variables [71, 72]. In particular, Kennedy approach provides a correction to estimate the percentage impact (PI) of a dummy variable on the dependent variable (e.g., prices) by considering the estimated variance of the associated coefficient  $\beta_i$  as expressed in equation (4)

$$PI = 100 \cdot \left( e^{\left( \beta_i - \frac{1}{2} \text{var}(\beta_i) \right)} - 1 \right) \tag{4}$$

Therefore, the application of these adjustments is essential for an accurate assessment of implicit prices and marginal effects in a hedonic price analysis context, allowing appropriate implications of the results to be made in the market under consideration as done in other work as [39,73].

### 3. Results

#### 3.1. Descriptive statistics

The analysis of the descriptive statistics for the 1438 observations in the rusk dataset highlights significant price variability associated with the analyzed attributes (Table 3). As shown in Fig. 1, the distribution is strongly skewed, with many products concentrated in the 4–6 EUR/kg range, below the average price of 8.18 EUR/kg. Other observations are present in the peak between 15 and 18 EUR/kg, while products priced above 20 EUR/kg are less frequent, reaching a maximum of 33,25 EUR/kg. The high standard deviation indicates a wide price distribution, as confirmed by the asymmetry of the histogram, with a predominance of more affordable and standard products, as expected for this product category.

Significant results of price variability associated with the analyzed attributes (Table 4) are observed, particularly in relation to nutritional claims, sustainability, and the use of alternative flours or enriched products, which emerge as the main drivers of premium pricing. These findings provide a solid foundation for hedonic price analysis, allowing for the quantification of the implicit value attributed to each characteristic.

Regarding the brand, private labels present lower average prices

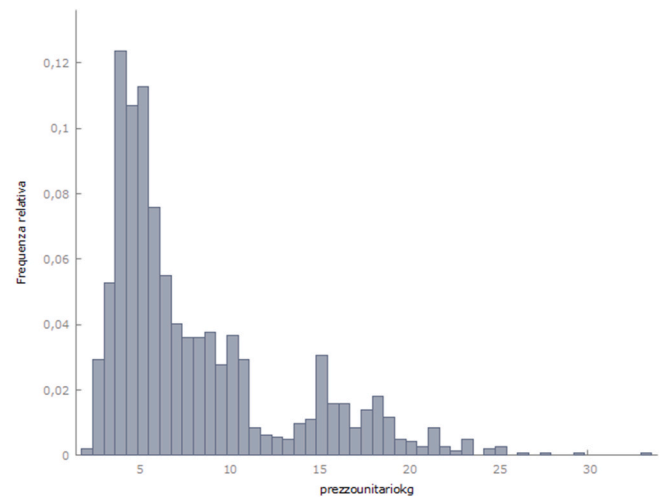


Fig. 1. Relative frequency distribution of the unit price EUR/kg  
Source: Our Elaboration – Unit price (“prezzounitariokg”) in relative frequency distribution (“Frequenza relativa”).

with smaller standard deviations compared to other brands and market leaders, which show greater variability. Interestingly, it is the other brands that have higher average prices. These findings provide valuable insights into the competitive structure of the market and the strategic positioning choices adopted by various players. Market leaders enjoy a strong competitive advantage, capable of influencing purchasing decisions, particularly in the food sector, where segment leaders—such as in pasta, coffee, and baked goods—have a significant impact. In the baked goods and bread substitutes sector, the influence of the leading brand in Italy is particularly strong, holding a quarter of the market’s offerings and exerting a substantial impact on national consumer culture [74,75]. Regarding the format, as expected, products with larger formats present a significantly lower average price compared to smaller formats, while the presence of single-serving packs does not seem to entail the expected surcharge for better convenience and longer shelf life. About packaging materials, distinguishing between paper and plastic, reflects the growing consumer focus on environmental sustainability and the increasing preference for more ecological and recyclable packaging [76,77]. In our dataset, paper packaging has a higher average price (EUR 9.62/kg) compared to plastic (EUR 7.37/kg), likely due to the perceived greater environmental sustainability associated with paper. Despite having significantly different distribution percentages, soft wheat flour and whole wheat flour do not show major price differences, at difference to use of alternative flours to wheat, such as spelt and rye, or specific wheat cultivars like Senatore Cappelli and Kamut. For these products, the minimum price significantly increases to EUR 6.97/kg, raising the average to EUR 13.25/kg, almost double that of the sample. This difference may be attributed to the more difficulty in the supply of raw materials, as well as the high nutritional value recognized to products with these alternative flours. Products with sourdough show a lower average price (EUR 6.58/kg), while those with Italian wheat are above the general average (EUR 10.27/kg), reflecting a possible added value perceived by consumers, followed by organic products (EUR 9.46/kg). Both attributes seem to be linked to a premium pricing position recognized in other products. Regarding the nutritional claims recognized by the European regulations and have been found on the labels of rusks sample, among them, claim “no added sugars” (EUR 10.42/kg) or “reduced fat content” (EUR 11.27/kg) show a propensity for higher prices compared to those with generic claims like “source of fiber” (EUR 7.65/kg) or “lactose-free” (EUR 5.82/kg). Attributes like “lower salt content” and “High in fiber” or “Source of proteins” are positioned in between. This could indicate a greater willingness to pay for attributes perceived as directly linked to health. Products with the

**Table 4**  
Descriptive statistics of attributes and corresponding variables.

Attribute & Variables	Number of observations	Price (EUR per kg)			
		Minimum	Maximum	Average	Standard deviation
Whole sample	1438	2.16	33.25	8.18	5.04
Sales format					
Greater than 400 g	251	2.16	10.98	4.33	1.86
Less than 400 g	1187	3.32	33.25	9.00	5.12
Packaging material					
Paper	518	3.74	24.92	9.62	4.38
Plastic	920	2.16	33.25	7.37	5.20
Packaging multipack (single-serve)					
No	922	2.16	26.67	7.82	4.42
Yes	516	2.73	33.25	8.83	5.93
Brand					
Private Labels	311	2.16	23.25	5.26	3.68
Main Leader	371	3.17	26.67	8.27	5.72
Other Leaders	445	3.32	18.45	8.21	4.45
Other Brands	311	2.72	33.25	10.98	4.48
Type of flour					
Soft wheat >50 %	1090	2.16	33.25	8.37	4.89
Whole grain flour >50 %	299	2.95	26.67	6.66	4.96
Other cereal flours >50 %	49	6.97	24.92	13.25	4.77
Organic wheat					
No	1332	2.16	33.25	8.08	5.12
Yes	106	4.91	21.48	9.46	3.58
Sourdough					
No	1342	2.16	33.25	8.30	5.05
Yes	96	2.91	20.36	6.58	4.60
Italian wheat					
No	1113	2.16	33.25	7.57	4.91
Yes	325	2.95	24.92	10.27	4.91
Nutritional claims (EU Reg. 1924/2006)					
Rich in fiber/High in fiber	528	2.95	33.25	8.76	5.76
Source of fiber	142	3.32	21.48	7.65	4.30
No-added sugar	97	4.81	33.25	10.42	5.16
Lactose-free	130	3.32	14.95	5.82	2.05
Source of proteins	142	4.53	33.25	7.89	4.82
Source of vitamins or minerals	219	3.07	14.30	5.96	2.50
Lower fat content	235	4.17	33.25	11.27	5.87
Lower salt content	56	4.03	20.36	8.33	4.32
Vegan product					
Certified "Okay Vegan" or alike	1095	2.16	33.25	6.93	4.59
100 % plant-based ingredients	101	7.83	33.25	11.44	4.21
Other claims					
With extra virgin oil	869	2.58	33.25	7.86	4.91
Without palm oil	83	4.97	23.25	11.19	5.14
Sustainability claims					
Sustainable Packaging	448	3.74	18.45	9.33	4.11

**Table 4 (continued)**

Attribute & Variables	Number of observations	Price (EUR per kg)			
		Minimum	Maximum	Average	Standard deviation
Sustainable Production	293	3.17	14.86	6.34	1.67
Enriched product					
Other grain flours <50 %	331	2.58	33.25	11.28	5.87
Whole grains or seeds	342	3.74	26.67	10.84	5.79
Fruit or chocolate	229	7.83	26.67	16.28	3.86

certified claim "Vegan Okay" or alike reach an average price of EUR 11.44/kg, higher than products with 100 % plant-based ingredients recipes (EUR 6.93/kg). Vegan-friendly recipes were carefully verified on the sample by reading the mandatory ingredient list present on product. This gap to the benefit of more active communication of information reflects the impact of certification presence or targeted branding activities. Other descriptive results show that products without palm oil represent 60 % of the references, a common characteristic with little influence on the average price. The 6 % that contains extra virgin olive oil shows a significantly higher average price (EUR 11.19/kg) despite a higher standard deviation. Products with sustainable packaging show an average price of EUR 9.33/kg, higher than the general average, confirming the importance of sustainability in consumers' value perception. Products enriched with fruit or chocolate reach the highest average price among enrichments (EUR 16.28/kg), doubling the overall sample average price. A similar trend, though with a reduced impact, is seen for enrichment with other flours, seeds, and cereals.

**3.2. Ordinary Least Squares (OLS)**

Following the sample analysis for the estimation of the hedonic price, the OLS model was applied through the log-linear regression described in section 2.3, with the encoding of the variables as shown in Table 3. This includes almost all dummy variables, which helps reduce multicollinearity in the model. The regression yielded excellent model performance values as depicted in Table 5. Specifically, the R<sup>2</sup> index of 0.82 indicates that the econometric model is statistically valid for explain the variance in the sample.

In Table 6 are presents the results of the econometric model estimation, where many explanatory variables are statistically significant. Main results shows that brand, sales format, raw material, nutritional or health claims and enrichment of products generate a significant premium price.

**Table 5**  
OLS model.

Statistic	Value	Statistic	Value
Mean of dependent variable	1944	Sum of squared deviations of dependent variable	0,543
Sum of squared residuals	74,226	Standard Error of regression	0,229
R <sup>2</sup>	0,824	Adjusted R-squared	0,821
F (28, 1408)	236,759	P-value (F)	0,000
Log-likelihood	90,041	Akaike criterion	-122,082
Schwarz criterion	30,756	Hannan-Quinn criterion	-65,021

Note: Dependent variable: log\_Unit Price Robust standard errors adjusted for heteroscedasticity.

**Table 6**  
Estimation results of the econometric model.

	Coefficient (p-value)	Standard Error	T-Ratio	Marginal effect <sup>a</sup>	Elasticity PI (%) <sup>b</sup>	Implicit price (£/kg) <sup>c</sup>
<b>Constant</b>	1740 (***)	0,046	37,525	–	–	–
<b>Brand</b>						
Other Leader	Baseline					
Private Labels	–0.134 (***)	0.036	–3.740	–12.58	–12.64	–1.04
Brand Leader	0.310 (***)	0.040	7.826	36.40	36.29	2.97
Other Brands	0.343 (***)	0.033	10.523	40.91	40.84	3.34
<b>Sales format</b>						
Greater than 400 g	Baseline					
Less than 400 g	0.303 (***)	0.019	16.221	35.45	35.42	2.90
<b>Packaging material</b>						
Plastic	Baseline					
Paper	–0.113 (***)	0.035	–3.182	–10.66	–10.72	–0.88
<b>Multipack (single-serve)</b>						
No	Baseline					
Yes	–0.014 (0.544)	0.023	–0.608	–	–	–
<b>Type of flour</b>						
Soft wheat >50 %	Baseline					
Whole grain flour >50 %	0.041 (*)	0.025	1.628	4.21	4.18	0.34
Other cereal flours >50 %	0.575 (***)	0.044	13.027	77.71	77.55	6.34
<b>Organic wheat</b>						
No	Baseline					
Yes	0.072 (*)	0.040	1.813	7.46	7.37	0.60
<b>Use Sourdough</b>						
No	Baseline					
Yes	–0.125 (***)	0.030	–4.201	–11.75	–11.83	–0.97
<b>Use Italian wheat</b>						
No	Baseline					
Yes	–0.097 (***)	0.027	–3.565	9.24	–9.28	–0.76
<b>Nutritional Claims</b>						
Rich in fiber/High in fiber	0.007 (0.767)	0.025	0.296	–	–	–
Source of fiber	0.080 (**)	0.027	2.999	8.27	8.24	0.67
No-added sugar	0.138 (***)	0.034	4.084	14.84	14.77	1.21
Lactose-free	–0.118 (***)	0.036	–3.300	–11.17	–11.22	–0.92
Source of proteins	0.388 (***)	0.037	10.387	47.37	47.27	3.87
Source of vitamins or minerals	0.013 (0.581)	0.023	0.552	–	–	–
Lower fat content	–0.043 (0.243)	0.037	–1.167	–	–	–
Lower salt content	0.234 (***)	0.039	6.062	26.41	26.32	2.15
<b>Vegan product</b>						
Certified “Okay Vegan”	0.060 (*)	0.040	1.503	6.20	6.11	0.50
100 % plant-based	–0.389 (***)	0.021	–18.748	–32.26	–32.27	–2.64
<b>Other claims</b>						
With extra virgin oil	0.268 (***)	0.039	6.809	30.79	30.68	2.52
Without palm oil	–0.098 (***)	0.020	–4.778	–9.32	–9.34	–0.76
<b>Sustainability claims</b>						
Sustainable Packaging	0.106 (***)	0.030	3.559	11.19	11.14	0.91
Sustainable Production	–0.217 (***)	0.024	–9.021	–19.47	–19.49	–1.60
<b>Enriched product</b>						
Other grain flours <50 %	0.154 (***)	0.021	7.429	16.59	16.57	1.35
Whole grains or seeds	0.095 (***)	0.020	4.739	9.92	9.90	0.81
Fruit or chocolate	0.684 (***)	0.023	29.914	98.18	98.13	8.03

**Note:** Dependent variable = Log Unit Price; Significance: \*\*\* (p-value ≤0,01); \*\* (p-value ≤0,05); \*(p-value ≤0,1).

<sup>a b c</sup> are shown only if the coefficients have significance.

<sup>a</sup> According to Halvorsen and Palmquist (1980) marginal effect is calculated as  $100 \times (e^{\beta} - 1)$ .

<sup>b</sup> According to Kennedy (1981) percentage impact (PI) is calculated as  $100 \times (e^{\beta - 0.5\text{var}\beta} - 1)$ .

<sup>c</sup> Implicit price is calculated as average price of 8.18 £/kg and the price effect according to Kennedy’s approach.

## 4. Discussion

### 4.1. Interpretation and comparison of the results

The results of the hedonic price regression highlight several significant factors influencing the unit price of the analyzed food products. The regression, performed using the OLS method and considering the logarithmic transformation of the price, identified numerous price-related attributes. Now, analyzing the results individually expressed with the Percentage of Impact (PI) on Table 6, we can highlight how the effect of the presence/absence of an attribute in the rusk market can be quantified. Respect to brand, using Other Leader (from 2nd to 6th forces in market share) as baseline: the “Brand Leader” and “Other Brands” exhibits a percentage premium price, of 36.29 % and 40.84 % respectively. This is likely because, compared to the mass market, the main brand benefits

from strong territorial presence and its commercial and consumers impact, while smaller brands focus on offering higher product quality that is recognized in price. Private labels have confirmed their competitive position, as measured by the descriptive statistics and predicted by literature, with a discount price of –12.64 %. Other relevant factors are format and material of packaging where as expected, smaller formats command a premium price (35,42 %), while the use of more packaging through single-serving portions of 4 slices or fewer does not lead to a significant price shift (not significant). Unlike the use of paper material, which generates a discount price (10.72 %) contrary to expectations and findings from studies on consumers’ willingness to pay for green packaging [76,77] the rusk market does not appear to attribute significant economic value to the sustainability of the material.

Among the most influential variables, the use of alternative cereal flours (77,55 %), likely due to the difficulty in sourcing these flours

(spelt, rye, Kamut, etc.) and their recognized nutritional importance, allowing consumers to pay a premium price. The difference between whole wheat flour and soft wheat was not that large (4,18 %), likely due to the widespread market presence of whole wheat products, which has reduced the price difference over the years. Interestingly, the use of sourdough shows a discount price (-11.83) despite being recognized as an added value by the market. This trend is probably due to the recipe's simplification, similar to the 100 % plant-based recipe, which leads to a discount price of -32.27. These products exclude eggs, milk, powdered milk, and butter, resulting in a real cost difference between plant-based and animal-based raw materials. The minimal processing of these products, combined with their perception as simpler and more authentic, likely contributes to this price difference. In this context, the importance of communication activities is evident, as the use of a vegan-friendly claim, such as Vegan Okay, a third-party certification, commands a premium price (+6.11 %). Towards the health-related attributes, the presence of nutritional claims regulated by EU 1924/2006 of "No added sugars", "Source of proteins" and "Lower salt content" have the highest premium prices of 14.77 %, 47.27 % and 26.32 % respectively, suggesting the perceived value of these characteristics from consumer that influence their daily assumption. However, not all variables considered significantly impact the price. For example, the claim "lower fat content" and the indication "source of vitamins and minerals" do not show significant effects, with coefficients close to zero and non-significant p-values. Similar situation regarding the nutritional claims "high in fiber" and "source of fiber." Specifically, the claim "high in fiber" appears non-significant, with an effect close to zero, while the claim "source of fiber" is associated with a premium price of 8 %. This difference, even though the "high in fiber" claim requires a minimum fiber content of 6 g per 100 g compared to 3 g per 100 g for the "source of fiber" claim, can be explained by several factors. First, the presence of fiber, particularly for bread-like products, is well-known to consumers. Over time, this familiarity may have diluted the premium price effect of the "high in fiber" claim, similar to what has been observed for whole-grain products, which naturally contain fiber. Additionally, products labeled "source of fiber" may offer producers more versatility in creating a wider variety of products. This flexibility in product design could allow producers to better meet consumer preferences for taste and innovation. Lastly, an analysis of descriptive statistics suggests a possible reduced supply elasticity for "high in fiber" products, which may already be positioned in a premium segment. This positioning is often linked to other distinctive attributes, such as enrichment with specific ingredients, which may have mitigated the direct impact of the claim on the premium price. These findings can open the way for further research to explore the role of consumer behavior and marketing strategies in determining the economic value of these specific nutritional claims also in different baked products. For other our outcomes we point out that the Italian origin of the wheat and the use of organic wheat affect the price in opposite verse: positive for organic (+7.37) and negative for Italian wheat (-9.28).

Overall, the results confirm the importance of perceived quality and sustainability attributes, such as the use of Extra Virgin Olive oil (EVO), the enrichment of product (with chocolate or fruit) and sustainable packaging, which are positively associated with the price by 30.68 %, 98.13 % and 11.14 % respectively. In this direction, our results resonate with findings from various studies in literature. While health-related claims play a crucial role in influencing consumer decisions, the effectiveness can vary based on sensory attributes and the clarity of information presented. To draw comparisons with similar articles [22,23], suggests that these claims positively influence purchasing attitudes, particularly when connected to innovative ingredients. This is supported by Refs. [34,78] that indicate how COVID-19 pandemic has prompted consumers to prioritize health-oriented foods, thus increasing demand for products with claims. In this line [14,79], found that consumers exhibit a strong preference for products labeled with specific health claims, implying that these claims can significantly enhance product

appeal. However [24], noted that health claims might not significantly affect acceptance for products primarily driven by sensory characteristics, such as flavor and texture, especially among younger consumers. This inconsistency shows that while health-related claims can be persuasive, their effectiveness can vary with consumer demographics and product types. This indicates that while health-related claims can drive interest, producers must also consider sensory characteristics to appeal to a broad audience. Moreover, our findings also underscore the challenges associated with consumer understanding these claims. Misinterpretation of information due to inconsistent presentations can lead to confusion and impact dietary choices negatively. This is echoed in literature indicating that clearer nutritional information could help mitigate issues like obesity and assist consumers in making healthier choices [25–28]. Also, the inconsistent labeling and varied regulations across countries can lead to consumer confusion, mirroring the issues pointed out in this study. This supports the notion that clearer, standardized claim regulations can help consumers make more informed dietary choices and potentially reduce miscommunication.

#### 4.2. Private and public implications

The hedonic price analysis conducted in this study could offer useful suggestions for both private companies and public policymakers. Through market price analysis, this research suggest how certain product attributes significantly influence the selling price, which in turn, may reflects the dynamic equilibrium between supply and demand. By understanding these attributes, producers can better tailor their marketing strategies and align new product development initiatives with consumer preferences, especially those of a growing segment that prioritizes health and quality. However, consumer behaviour is also influenced by company actions and marketing strategies, creating a continuous cycle of mutual influence that requires careful consideration. This study highlights how sustainable and health-related attributes of cereal products can make a difference in capturing consumer preferences and willingness to pay. For example, the strong positive impact of claims like "source of proteins" or the use of other cereal flours suggests opportunities for brands to match specific dietary trends, such as high-protein or alternative grain-based diets, which are gaining traction in modern markets.

Beyond marketing, the results encourage the integration of these claims with innovative technologies, such as blockchain to enables more secure and transparent communication, as confirmed by industry studies [80,81]. Attributes like "use of Italian wheat" or "sustainable production", which carry strong price premiums, could be further validated and communicated through blockchain systems. Additionally, the pressure of agri-food sector due to the increasing world population and demand for sufficient, safe, and high-quality food products can be facilitated by blockchain technology. This technology enhances supply chains efficiency by ensuring higher quality products with complete traceability from farm to table, while enabling the creation of immutable records of product origins and production methods, which fosters greater consumer trust [82]. However, implementing such systems comes with challenges [83,84]. Food producers, particularly small and medium enterprises (SMEs), often face high costs and logistical hurdles when adapting their technological infrastructure to blockchain systems. Additionally, there exists a significant knowledge gap among consumers regarding the benefits of these technologies, which may limit their perceived value [85,86]. To address these barriers, partnerships between private companies and public institutions could be instrumental. For instance, governments could provide financial incentives or grants to support the adoption of blockchain systems while simultaneously launching awareness campaigns to educate consumers on the added value of traceable and transparent food systems.

From a public perspective, the findings emphasize the importance of fostering policies that encourage sustainable and health-conscious food production. Claims related to sustainability, health or territorial

typicality enhancing market competitiveness and through specific food policies could lead to public health benefits. The use of certifications or clear claims regarding nutritional aspect can serve as a valuable tool. In the case of the vegan products in this study, an uncommunicated vegan recipe may lead to a discounted price; however, communicating the same product with certification can change the pricing trend. Addressing these gaps, public objectives could be further advanced not only through certifications but also by supporting private projects that promote sustainability, transparency, and health-oriented innovation. For example, governments and institutions could support solutions or programs that encourage the adoption of healthy practices, combined with clear communication strategies. These efforts would create a strong framework where public and private initiatives work together to meet consumer demands and achieve global sustainability goals. By leveraging insights from hedonic price analysis, stakeholders can address current challenges and capitalize on emerging opportunities to meet the evolving needs of modern food systems. The collaboration between private initiatives and public policies can foster a virtuous cycle of innovation, sustainability, and consumer satisfaction.

#### 4.3. Future research directions

Further research should expand beyond the attributes analyzed in this study, evaluating product labels sold in Italy, exploring them in more detail to understand the presence of some "anti-nutritional" additives, consumer awareness of these aspects when making their purchases, and their economic impact on the market. Only through a comprehensive understanding of these factors can marketing and production strategies be directed towards healthier, more conscious offerings that meet the needs of an increasingly health-conscious public. Despite the specific focus on the Italian rusks market, this study can offer insights for the international cereal sector, applicable to products like crackers, toast, and other bread substitutes. Among these, for example, the investigation could be expanded to include the gluten-free product segment, considering its significant growth and increasing consumer demand in recent years. This would provide valuable insights into the evolving preferences of health-conscious consumers and the impact of gluten-free options on market dynamics and pricing trends, like [87,88]. Also, future research should continue to explore the nuanced effects of nutritional claims and health claims as established by EU Regulation 1924/2006 in the European context, across different food categories and consumer demographics, facilitating a more holistic understanding of how health messaging impact purchasing dynamics.

## 5. Conclusion

The key aspect of food market is product diversification. Each brand tries to differentiate itself through specific product attributes that can vary from the type of flour used (refined, whole, organic, etc.), the presence of additional ingredients (flax seeds, bran, ancient grains), to nutritional claims such as "no added sugars" or "rich in fiber". This segmentation is crucial to understand how quality attributes influence consumer choices and, consequently, market prices. Understanding market dynamics and consumer preferences will be essential for producers aiming to successfully position themselves in this segment.

The results of this research provide a crucial overview of the factors determining the price variability of food products in our sample, highlighting the influence of quality, health, and sustainability factors. This study highlights the critical role of quality, sustainable and nutritional aspect in shaping consumer behaviour within the Italian rusk market, revealing substantial implications for both consumers and producers. As the increasing prevalence of dietary-related health issues amplifies consumer interest in nutrition, the ability of food products to communicate their health benefits effectively becomes paramount. The findings demonstrate that nutritional claims not only enhance product appeal but also significantly influence consumer willingness to pay, suggesting that

companies can leverage this information strategically to optimize their market performance. Different studies have demonstrated the significant role of nutritional claims includes their positioning on label packaging. Research suggests that clear and easily identifiable claims enhance product appeal and consumer trust, influencing purchasing decisions. Additionally, these can create a psychological "halo effect," where a single positive attribute leads consumers to assume other desirable qualities, such as better taste or higher quality. This effect is particularly strong in functional or fortified products, where perceived health benefits may outweigh considerations like price or brand loyalty [89–91]. In our study the robustness of the model, confirmed by the statistical significance of the coefficients and the consistency of the results with theoretical expectations, suggests that the regression model used is a valid representation of price dynamics in the food sector. Additionally, the label analysis revealed a significant presence of ingredients not traditionally used in rusk preparation but employed for technological reasons, such as powdered milk, egg products, sweeteners, emulsifiers, and additives with antioxidant or preservative functions. These ingredients, often associated with ultra-processed products, raise questions about the nutritional quality of these foods. Their growing prevalence in the food market, both in Italy and worldwide, has sparked concerns about potential health impacts, including obesity, diabetes, and cardiovascular diseases. The presence of such ingredients in rusks could compromise the nutritional benefits of the product described and analyzed in this study regarding health and nutritional claims. Although rusks may seem like a light dietary option, it is essential to read labels carefully to identify potentially harmful ingredients. Ingredients such as refined flours, palm oil, artificial sweeteners, and additives can compromise the perceived nutritional benefits of this food. Greater awareness of these components is essential for making healthier and more informed dietary choices. However, the confusion surrounding nutritional or health claims and the variability in their regulatory frameworks point to an urgent need for clearer communication and education for consumers. Ensuring that consumers can accurately interpret these claims will support informed purchasing decisions, contributing to better overall health outcomes. Ultimately, enhancing the clarity and accuracy of health-related claims will promote a healthier consumer base and enable producers to align better with evolving market demands for transparency and quality.

#### CRediT authorship contribution statement

**Francesco Di Cosola:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Alessandro Petrontino:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Michel Frem:** Writing – review & editing, Writing – original draft, Investigation. **Emanuela Tria:** Writing – original draft, Data curation. **Francesco Bozzo:** Validation, Supervision, Project administration, Funding acquisition, Conceptualization.

#### Declaration of interests

The authors have nothing to declare.

#### Funding sources

This study was carried out within the Agritech National Research Center and received funding from the European Union Next-Generation EU (Piano nazionale di ripresa e resilienza (pnrr)-missione 4 componente 2, investimento 1.4-d.d. 1032 June 17, 2022, cn0000022). This manuscript reflects only the authors' views and opinions, neither the European Union nor the European Commission can be considered responsible for them.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgments

Thanks are due to Enza Campanella for her administrative support.

## Data availability

Data will be made available on request.

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