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FACTORS AFFECTING THE DESIGN OF CHEESE PACKAGING: A COMPREHENSIVE REVIEW

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Abstract. This study examines key elements in cheese packaging design within the highly regulated food industry, providing insights to inform packaging designers' strategic decisions. Focusing on pre-packaged cheese products, the research identifies 67 evaluation criteria and analyzes 372 market samples using qualitative content analysis, clustering, hierarchical clustering and multiple correspondence analysis (MCA). The findings highlight cheese density as the most critical determinant of packaging attributes, with material selection, form and visual elements - such as realistic imagery and color choices - closely linked to cheese type, fat content and brand identity. Given the complexities of transitioning locally sourced cheeses into mass production and retail, along with the necessity of cold chain management, packaging emerges as a crucial factor in preserving product integrity and consumer appeal. This study uniquely integrates technical and graphic design aspects, addressing the high variability and similarities in cheese packaging. Although limited to the Turkish market, with 18% of analyzed products being imported, the research offers a foundational perspective for industry professionals, highlighting the need for ongoing evaluation in response to shifting consumer preferences and market dynamics.

Keywords: *Packaging design, cheese packaging, design criteria, market research, packaging analysis, industry standards.*

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1. Introduction

At its essence, packaging design encapsulates a creative process that shields the product, establishes a connection with consumers, captivates attention through its form and graphic elements, conveys product attributes, influences product cost and retail price and profoundly impacts user experience. A survey of existing literature highlights the pivotal significance of studies focused on food packaging within the realms of food technology and design. Emphasis is placed on functions that cater to diverse environmental conditions and prioritize aspects encompassing preparation, usage and presentation. Within these dimensions, food packaging emerges as a meticulously crafted product, combining materials and forms to withstand various variables, aiming to provide protection throughout the production-consumption-storage continuum. Simultaneously, it assumes the mantle of an advertising unit, leveraging its presentation format to captivate consumers and acting as a communication conduit for disseminating information about its contents.

The primary aim of this research is to identify priority criteria for food packaging designers in the design process, thereby defining innovation and competitive advantage. To achieve this goal, the dairy sector was examined in terms of distinctive product characteristics and the associated packaging requirements. To limit product diversity, the study focused on the cheese category within the dairy sector. This focus allows for a more effective understanding and identification of key elements throughout the packaging design process, from production requirements to consumer interaction and disposal across the product's lifecycle. In this context, aesthetic, functionality, sustainability and market standards essential for cheese packaging were thoroughly examined, establishing criteria to guide designers in developing innovative and competitive products.

The Turkish Food Codex (1997) plays a crucial role in standardizing these features, ensuring consumer health and safety by establishing criteria for packaging and labeling. The codex organizes guidelines to address differences in durability, storage, transport, usage conditions and product lifespan arising from various production methods. According to the codex, the food item must remain inaccessible unless the packaging is altered or opened. Mandatory information, including labeling and marking rules, must be presented clearly and legibly, using appropriate colors and sizes for optimal readability. Details on materials in contact with food are published in a separate regulation, aligned with EU standards. The Turkish Food Codex Cheese Communiqué (2015) provides detailed labeling information, including cheese naming, attributes and readability. Notably, if only one type of milk is used in cheese production, the animal's name and image may be displayed; otherwise, such visuals are prohibited. Cheeses exhibit unique textures, densities and moisture characteristics that are attributable to their diverse production methods. Efforts are underway to standardize the production, maturation, storage and distribution processes of cheeses (ranging from white cheese to regional varieties like Portuguese and Hatay cheeses) using various materials and techniques to preserve taste, freshness and textures for retail presentation (Akgün & Mutluer, 1993). Within an industry that is open to change and innovation, packaging plays a crucial role.

Several vital factors delineate the rationale behind selecting cheese packaging:

- Industrial Nature: Cheese, being an industrial product, plays a pivotal role in its selection for this study.
- Historical Context: The historical background within the industry further contributes to the significance of cheese packaging as a subject of examination.
- Diverse Product Array: The abundance of product variety, encompassing density, fluidity, form and other characteristics, warrants attention in this study.
- Innovation Potential: The openness of the cheese industry to the development of new products underscores the relevance of studying its packaging.
- Specific Product Requirements: The specialized demands of maintaining a cold chain, ensuring proper storage and indicating expiration dates throughout the production-to-sales process amplify the importance of cheese packaging.
- Visual Appeal and Sales Significance: The visual appeal of cheese packaging on the shelf, for both display and sales purposes, adds another dimension to its significance.
- Versatility in Material Usage: The adaptability of cheese packaging for the use of various materials further justifies its selection for analysis.

In this study, the consideration is confined to products packaged explicitly for retail sale, ensuring that these products maintain their packaging integrity consistently throughout the producer-to-consumer journey. Consequently, products lacking

packaging or those packaged at the point of purchase, such as bulk foods, fall outside the purview of this research.

2. Food, Milk, Dairy Products and Cheese Packaging

Packaging design plays a strategic role not only in the basic functions of physical protection and product transportability but also in establishing the relationship between the brand and the consumer, shaping the user experience and guiding purchasing behavior. In this context, the visual, functional and semantic dimensions of packaging must be considered in interaction with consumer psychology. The theoretical framework of this study is structured around three fundamental models frequently used to explain the multi-layered nature of packaging design: Keller's Customer-Based Brand Equity (CBBE) Model, Norman's Emotional Design Theory and the Stimulus-Organism-Response (S-O-R) Model.

First, the CBBE model developed by Keller (2021) explains how brand-related associations are formed in the consumer's mind and the role these associations play in creating brand equity. Packaging is considered a communication tool that increases brand awareness, makes product identity visible and reinforces perceived quality. The basic visual elements of packaging, such as color, shape, graphics and typography, create positive and unique associations with the brand, thereby strengthening the consumer-brand relationship (Keller, 2021).

Secondly, Norman and Ortony (2003) examine design in the context of user experience at three levels: visceral, behavioural and reflective, emphasising that the relationship established with the product consists not only of functional but also emotional and semantic layers. Examples of this multi-layered experience include the use of colours in packaging design to create taste expectations, typography to evoke emotional associations or material choices that reference values such as trust and health (Norman & Ortony, 2003). This approach is particularly influential in packaging designs that centre on the user and appeal to sensory perceptions.

Finally, the S-O-R model, developed by Mehrabian and Russell (1974) and widely used in packaging research today, treats packaging as a ‘stimulus’, the consumer as an ‘organism,’ and the purchase decision as a ‘response’ to explain consumer behavior. This model suggests that packaging design (including colour, shape, graphic elements, material and sustainability messages) directly influences consumer perception, emotional responses and final behavior (MSI, 2020). In particular, the creation of mental images in consumers through visual stimuli and the combination of these images with brand associations to guide behaviour reinforces the role of packaging as a sales tool.

These theoretical approaches reveal that packaging is not merely a protective or transportable structure, but also a communicative, experiential and psychological product. Understanding the effects of elements used in packaging design on consumer perception and behaviour is essential for developing design strategies based on product-specific preferences and user profiles. Within this framework, a literature review was conducted, focusing on various variables, including visual elements, packaging materials, target audience-oriented preferences, brand and corporate identity, technology trends and sustainability. The relationships between consumer behaviour and cheese packaging are summarised in Table 1.

Table 1. Literature review

Focus	Conclusion
Design Elements	Packaging form, color and graphics are essential graphic elements that influence purchasing decisions (Bone & France, 2001; Örücü & Tavşancı, 2001). While the most striking aspects in packaging designs during purchase are color, shape, visuals, lines and typography, visuals have the highest prominence share and it has been determined that color can affect other graphic elements (Wang *et al*., 2023). The ability to establish communication between the product and the consumer through packaging and ease of transport is a determining features that influence the purchase decision (Lindh *et al*., 2016). Packaging design creates a perception of quality in the consumer. Packaging photographs are significant for customers who make impulsive purchases (Wells *et al*., 2007). The typeface used in packaging can influence the perception of product taste. While round fonts tend to reinforce the perception of sweeter flavors, angular fonts are often paired with sour flavors (Velasco *et al*., 2014). In the dairy category, packaging design influences purchases by 90%. In cheese packaging, color and form are the most important factors influencing purchase decisions, while price, product quality, material, origin and brand are other key factors (Eldesouky & Mesias, 2014). Consumers prefer cheeses with plastic packaging, rectangular shapes, re-closing systems and unsliced, easy-to-open and close packages. Additionally, consumers were divided into three defined groups based on their cheese packaging choices: gender, frequency of purchase and family size (Eldesouky *et al*., 2016). In cheese packaging, consumers are sensitive to the type of product, its specific characteristics, ingredients and origin. In contrast, the search for healthy options, localization of foods and authenticity in packaging are also prominent (Horská *et al*., 2020).
Material	One of the most essential features of food packaging is to minimize interaction between the food and the packaging material (Dainelli *et al*., 2008). Consumers who prioritize food preservation tend to prefer vacuum packaging, with transparent being the most attractive color (Bou-Mitri *et al*., 2020). After vacuum packaging, glass products and tin packaging are prioritized as healthy and safe (Marsh & Bugusu, 2007; Swida *et al*., 2018). Materials play a central role in packaging functionality and have symbolic meanings that enhance the communicative power of food. Material choices are essential for aesthetics, marketing and positioning (Maffei & Schifferstein, 2017).
Target Audience	Families with children or elderly members tend to prefer plastic packaging with handles that are easy to hold. At the same time, the younger demographic may be more inclined to choose glass packaging for aesthetic and environmental reasons (Miller, 2019). Children are particularly interested in cartoon characters, celebrities and animals in packaging designs. Furthermore, as the consumer base diversifies, packaging becomes an essential element of brand image (Hill & Tilley, 2002). Products designed for children are often created with matching colors and flavors, animal figures, straightforward typography and lightweight forms and materials that are easy to handle, open and close (Elliott & Truman, 2020).
Brand and Corporate Identity	Packaging plays a vital role in advertising the product and communicating with the consumer. It is thought that the construction of design elements may influence consumers' behavioral and mental attitudes toward the brand (Wu, 2015). More than 73% of consumers place a great deal of trust in the packaging when making a purchasing decision and they also tend to prefer packaging that is visually appealing and appealing to the palate. Grocery-branded products can recognize their customer profile and establish a bond through packaging (Wells *et al*., 2007).
Technology and Trends	An analysis of consumer expectations regarding design reveals that these expectations are closely tied to new technologies and trends, particularly in sustainable, minimalist, unusual and fun packaging designs, as well as those incorporating augmented reality (İlisulu, 2019). Packaging graphics have become an increasingly important element in connecting with consumers, reflecting their style and making them feel special (Akengin *et al*., 2018). A healthy image in packaging may increase the desire to purchase, as visuals that express health can reinforce feelings of health and quality (Lidón *et al*., 2018; Van Birgelen *et al*., 2009).
Sustainability	In packaging design, several effective methods can be employed to create environmentally sensitive products with minimal environmental impact, conserve materials and promote sustainable packaging awareness among consumers. These methods include upcycled packaging (Fisher & Shipton, 2009; Lewis, 2012). Food packaging can convey messages, primarily through visual elements, encouraging consumers to recycle. Additionally, the functionality of packaging can enhance the perception of quality in consumers, transforming the packaging from a protective container into a communicative product (Nemat *et al*., 2019). One of the most frequently adopted sustainable strategies in cheese packaging is active or vacuum packaging, also known as modified atmosphere packaging, which can potentially extend the shelf life of cheese. Another strategy is to produce packaging from biodegradable materials (Spreafico & Russo, 2021).

As summarized in Table 1, the literature review on food packaging reveals a substantial emphasis on exploring consumer purchasing behaviors. Despite the primary functions of packaging revolving around food preservation and safety, consumer preferences prioritize the maintenance of freshness, content integrity and food preservation in conjunction with the durability of packaging materials. Notably, within the engineering domain, the growing significance of studies, particularly in the categories of milk, dairy products and cheese, is evident, emphasizing technical specifications in packaging. These endeavors aim to preserve product freshness, extend shelf life and facilitate the adaptation of local products to mass production through the use of novel technologies.

Within the domain of packaging design, the focal point gravitates toward products conceived through a user-centric lens. The emphasis lies in furnishing comprehensive information, engaging consumers and integrating diverse added values. However, a noticeable gap in the research landscape is the need for extensive studies that scrutinize the specific packaging requirements for various cheese categories and varieties. Furthermore, there needs to be more exploration concerning design elements that effectively cater to communication, sales, presentation and usage.

In this context, the literature reveals that packaging design should be evaluated in terms of both its visual and functional qualities, as well as its effects on consumer psychology. Keller's (2021) Customer-Based Brand Value model emphasises that consumers' associations with a brand through packaging are decisive in terms of loyalty and purchase intention, while Norman and Ortony's (2003) emotional design approach argues that packaging offers not only an aesthetic or functional experience, but also an emotional one. The effects of visual elements such as colour, shape, graphics and typography on perception and taste expectations, as discussed in the literature, underscore this emotional context. On the other hand, within the framework of the S-O-R model, packaging plays a ‘stimulus’ role for the consumer; the form, material, sustainability and messages of the packaging shape perceptions and attitudes in the consumer's mind, which then translate into purchasing behaviour (response). The common point of these models is that they indicate that packaging is not only a physical product but also a multi-layered interaction tool with the user. Therefore, in line with the study's aim, it is crucial to examine the design strategies of cheese packaging not only in terms of its protective functions but also in terms of brand image, user experience, sustainability perception and communication competencies tailored to the target audience.

This study seeks to bridge this gap by delineating the creative latitude available to packaging designers within the cheese industry. It aims to comprehensively ascertain the nuanced packaging needs of different cheese types and varieties. It also explores design elements pivotal in fostering effective communication, enhancing sales, facilitating presentation and optimizing usage aspects.

3. Methodology

This study adopted a multi-method research design incorporating qualitative content analysis, visual analysis and case study approaches. The research aimed to reveal sectoral constraints and areas of creative flexibility by analysing the design elements, production scales, material preferences and packaging forms of cheese packaging.

The research is limited to pre-packaged cheese products of specific weights available for sale in major chain stores in Turkey. The sample was selected from products

featured on the websites of A101, Migros and Carrefour SA, which have the highest visitor traffic on digital sales platforms and 372 different cheese packaging designs were analyzed.

The A101, Migros and Carrefour SA supermarkets examined in the study are widespread chains in the Turkish retail sector that cater to various customer segments. A101 is positioned in the economic segment with its affordable prices and limited product portfolio. At the same time, Migros caters to the middle-upper segment with its wide product range and balanced brand distribution. CarrefourSA, on the other hand, is positioned in the premium segment, focusing on imported and gourmet products. The selection of these three supermarkets provides a strategic sample structure for comparing the diversity of cheese packaging across different price and quality levels. Additionally, the online sample has expanded the study's scope and ensured the timeliness of the data, as it directly reflects the current product variety and packaging design trends in the digital market. This allows for a more accurate and practical analysis of innovations in packaging design and sectoral dynamics.

Data Collection Process:

• Packaging images were collected from the digital platforms of chain supermarkets.

• Packaging was coded using a binary matrix method based on 67 sub-criteria, with the presence of each criterion marked as ‘1’ and its absence as ‘0’.

• Basic criteria were determined based on milk fat content, ripeness, packaging type and content information by the Turkish Food Codex.

• Repeating patterns in visual analyses were converted into thematic codes based on Schreier (2012).

• Packaging designs were evaluated based on criteria such as form, colour, transparency, material type and shape.

• Each criterion was visualised with a specific colour code and used consistently throughout the analysis.

The following statistical methods were used to conduct the analysis:

• Cluster Analysis

In the cluster analysis performed using SPSS software, the packaging was grouped according to similar characteristics. In the first stage, the data was reduced to two main clusters: 21.2% (79 products) of creamy density and 78.8% (293 products) of solid density cheese products.

• Hierarchical Clustering

In the hierarchical clustering analysis conducted using the AMADO Online platform, cheese packaging was divided into subgroups based on common characteristics and the co-occurrence relationships of the criteria were examined in depth. In the study, each sub-cluster was visualised using examples selected from the packaging images under examination, thereby concretising how the design elements appear in practice. This made the analysis results easier to understand and interpret.

• Multiple Correspondence Analysis (MCA)

The relationship between packaging criteria was visualised in three dimensions. The analysis, conducted using the ‘Prince’ library, related the criteria to predictor importance values higher than 0.2 through components.

This study systematically examines the visual, structural and functional aspects of packaging designs based on visual content analysis methods. Visual content analysis is a structured analysis method that enables the coding, classification and interpretation of

product visuals within predefined criteria, particularly in the fields of design, marketing and visual communication (Schreier, 2012; Rose, 2016). This method enables researchers to work with qualitative data derived from direct observation and to produce interpretations based on objective criteria.

Visual content analysis is particularly effective in visual-focused areas, such as packaging design, as it enables the discovery of implicit meanings and patterns in the visual components of a product (Krippendorff, 2018; Bell, 2001). This approach, which allows the systematic analysis of visual material, produces valid and reliable results even without user surveys or expert opinions (Van Leeuwen & Jewitt, 2001).

However, the absence of direct user opinions or expert evaluations in the research has been identified as a limitation in terms of validity. It is recommended that future research support these visual analysis findings with consumer surveys or qualitative evaluations by field experts. Thus, findings can be tested in a more comprehensive and application-oriented manner using a multi-method (triangulation) approach. However, this recommendation does not diminish the structural validity of the current study based on visual content analysis; rather, it is considered a complementary contribution to future research.

4. Cheese Packaging Sector Review

In the initial phase of the research, an analysis of cheese packages on the market was conducted using the content analysis method to identify potential sectoral constraints. To gain a more comprehensive understanding of the various types of cheese, products available on the digital sales platforms of chain markets were also considered. A similar content analysis was conducted on elements that require more detailed information, such as plastic or aluminum film. This analysis was performed in physical stores and the information obtained was processed into a table, resulting in a binary data matrix. In this matrix, each category was represented as a separate column, with observations coded as 1 (indicating the presence of the category) or 0 (indicating the absence of the category) in these columns.

In line with the 2021-2022 Online Market Sector report, the research was limited to A101, Migros and Carrefour SA, which have both physical stores and digital sales opportunities, among the top 5 markets in terms of monthly visitor average. Upon examining the prepackaged products under the “cheese category” on these chain markets' websites, 372 kinds of cheese were identified. It should be noted that products sold by weight or without packaging images on the websites (such as bulk foods) were not included in this research.

Upon examining the cheese types analyzed, it became evident that Kashkaval cheese and processed chees hold the largest share in sales, while among ripened cheeses, aged white cheeses lead the market. Regarding producers, it is worth noting that local companies produced 82% of the cheeses, while 8% of the total products were market-branded (Figure 2).

Figure 1. Distribution of cheese types examined

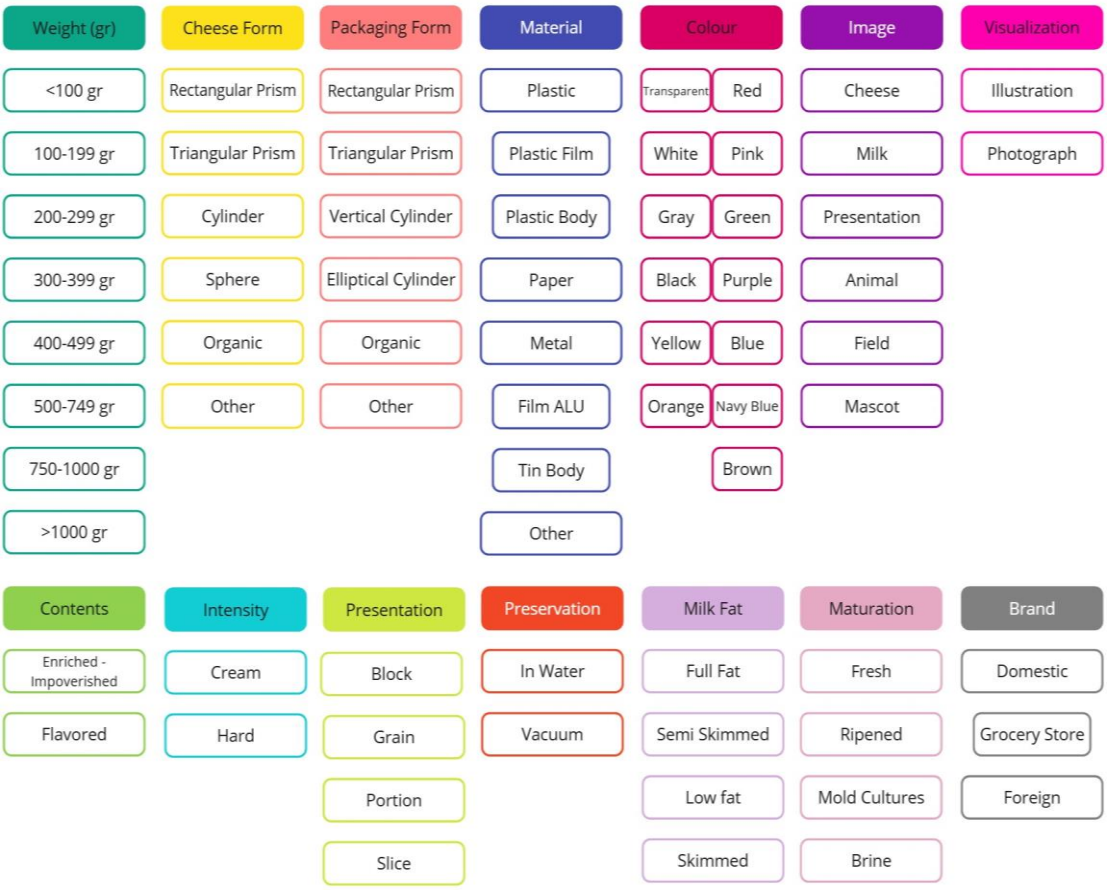

Figure 2. Criteria for Cheese Packaging Content Analysis

In preparation for the study, the Turkish Food Codex and related communiqués were first reviewed. The criteria of milk fat content and ripening status were classified based on these regulations (Türk Gıda Kodeksi Yönetmeliği, 1997). Other study criteria were determined by analyzing cheese packaging using qualitative content analysis and creating thematic codes. Qualitative content analysis is a method used to systematically describe the meaning of qualitative material (Schreier, 2012). Packaging visuals were utilized to identify recurring patterns in the data and establish meaningful criteria for analysis. The production methods of cheese varieties, packaging techniques, design features and producer scale have been categorized, resulting in 68 different sub-criteria. Figure 2 visualizes these criteria by assigning specific colors to each, maintaining consistent color codes throughout the research.

Data Processing

This study employed clustering, hierarchical clustering and correspondence analysis methods to analyze criteria in cheese packaging. In the first stage, clustering was used to categorize the requirements into groups, identifying the fundamental factors that influence packaging design. In the next step, hierarchical clustering was applied to define these factors into detailed subgroups further and examine intergroup relationships. Finally, correspondence analysis was conducted to validate the accuracy of these relationships, clarifying which variables align more effectively and visualizing the strength of these associations. This approach enabled the discussion of optimal design elements and efficient combinations in packaging.

Cluster analysis

The content analysis results of cheese packages underwent cluster analysis using the SPSS/Direct Marketing/Cluster module to group the identified criteria. Cluster analysis encompasses methods that facilitate the division of units and variables into subclusters based on their similarities, as well as the visual representation of these groups (Edwards & Cavalli-Sforza, 1965). Initially, the number of clusters was set to 5, but the silhouette measure of cohesion and separation was low. Consequently, the criteria with the highest degree of significance were identified. Subsequently, SPSS automatically determined the number of clusters using a two-step algorithm. In this approach, the average silhouette value was set at 0.3 (medium), resulting in outcomes within an acceptable range. The analysis revealed two main clusters: one comprising 21.2% of the products, with 79 items and the other comprising 78.8% of the products, with 293 items. This demonstrates that the automatic determination of the number of clusters yields more balanced results regarding agreement and disagreement in cluster analysis. In SPSS, the "predictor importance" value indicates the degree of importance of the variables (criteria) used in the analysis in forming clusters, i.e., how effectively each variable contributes to the clustering process. These values help us understand which criteria distinguish the clusters more significantly in the analysis results. In this study, identifying two criteria with the highest degree of importance indicates that these criteria play a pivotal role in cluster formation. Therefore, considering these criteria enhances the accuracy and validity of the analysis results.

Upon analyzing the prioritization of the top 10 criteria from the extensive pool of 68 criteria, delineated in Figure 3 and visualized using a color scale, the foremost positions are claimed by the sub-criteria "cream" and "solid". This pivotal revelation underscores the paramount importance of product density in packaging. Notably, the

analysis reveals that solid cheeses have nearly four times the prevalence in the market compared to cream cheeses.

The third-ranking criterion pertains to the use of aluminum films in cream cheese, while the sixth spot is attributed to the use of plastic films in hard cheese. These supplementary materials, serving as secondary covers alongside the primary packaging, aim to safeguard product content, extend shelf life and ensure leak-proofing.

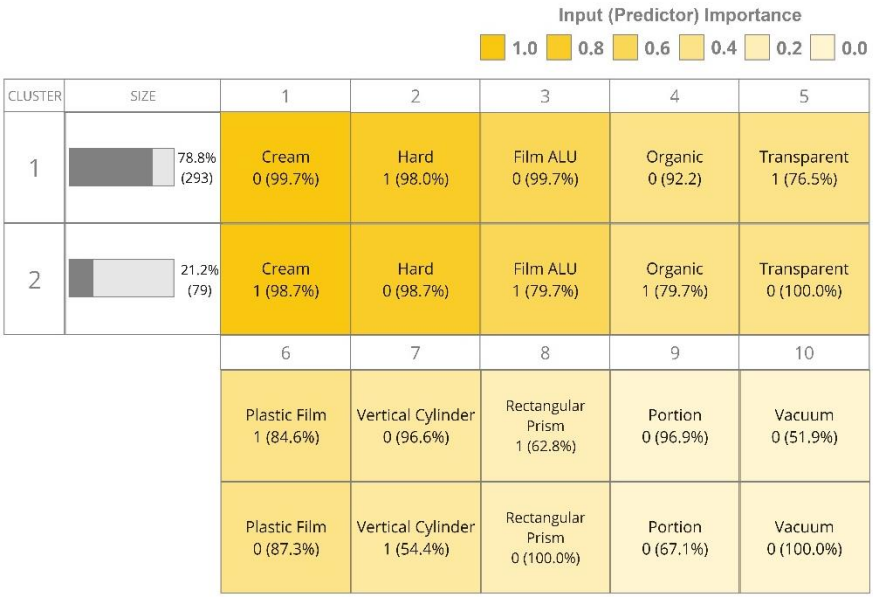

Figure 3. Importance percentages of the top 10 criteria

Within the selected sample, the fourth-ranking criterion pertains to “organic-shaped cheeses”, a feature naturally prioritized in cream cheeses due to their inherently shapeless nature. Similarly, “rectangular-shaped cheeses” claim prominence in solid cheese packaging, holding the eighth position.

Transparency, positioned fifth among the criteria, is notably present in 76.5% of solid cheese packaging but is absent in cream cheese packaging. Additionally, it is noteworthy that cylindrical containers encompass nearly half (54.4%) of cream cheese packaging while being scarcely employed (96.6% unused) for solid cheese packaging. Furthermore, the criteria of “portioning” and “selling with vacuum packaging”, which secured the ninth and tenth positions, respectively, emerge as infrequent occurrences in both the cream and solid cheese packaging categories.

Moreover, while organic-shaped solid cheeses constitute less than 10%, vacuum packaging is favored at approximately 48.9%. Additionally, organic-shaped packaging is encountered at a rate of 39.6%. These statistics indicate the preference for vacuum sealing, often utilizing polyethylene films, for packaging cheeses with distinct shapes. Vacuum sealing, typically associated with the practical packaging of fresh cheeses, is also chosen as secondary packaging for aged cheeses, thereby prolonging their shelf life. Factors such as cost advantages, including unit pricing, lightness and minimal design constraints for shape, except for label design, significantly influence these preferences.

The preservation methods for solid, dense fresh cheeses predominantly adopt fixed shapes, especially rectangular packaging. For cream cheeses, plastic material usage for

the body reaches 79.7%, representing a fixed container, while this rate drops to nearly 49.5% for solid cheeses, approximately half of the packaging instances.

Weight does not exert a dominant influence on packaging. Notably, cheeses weighing less than 100 grams and those weighing over 750 grams share similar packaging features, with both categories leaning towards vacuum sealing and the use of plastic films.

Metal materials are frequently chosen, especially in premium and specialty series, such as "gourmet". Triangular cheeses are typically packaged as individual portions wrapped in aluminum film and encased in a vertical cylindrical paper packaging. This unique cheese and packaging form establish a distinct category on retail shelves.

Hierarchical clustering

The hierarchical clustering method aims to construct clusters sequentially based on the similarities between individual units. It organizes the levels of relationships among elements, incorporating them into clusters based on either distance or similarity measures (Köhn & Hubert, 2015). To delve deeper into the findings and explore the data with subgroups, an analysis was conducted using the AMADO Online/Homogeneous Numerical Data/Hierarchical Clustering module (AMADO Online, 2023). Figure 4 displays the dendrogram resulting from the analysis. In the dendrogram, the connecting lines illustrate the importance of relationships, hierarchically depicting how criteria are related. Each leaf in the dendrogram represents a data point, while nodes represent combinations or groups of data points. The root at the top signifies the aggregation of all data points. Lower connection heights indicate closer relationships, whereas higher heights denote more distant relationships (Güneş, 2021). The close criteria resulting from the analysis form clusters with similar characteristics. As the dendrogram branches merge towards the root, relationships become more distant, weaker and heterogeneous. Therefore, the initial branches form more cohesive subsets that are more meaningful. Additionally, the height of the merging lines between the two criteria provides insights into the similarity of subsets. The subsets within the dendrogram are analyzed based on the packaging samples available in the market, prioritizing sub-relationships towards the common root. Each subgroup in the dendrogram is supported by samples selected from the packaging images studied and represented visually. This enables abstract data sets to be linked to concrete packaging examples, providing a more comprehensible and nuanced analysis of how design elements manifest themselves in practice. This visually supported approach has facilitated the interpretation of analysis results and made the category differences in packaging design more clearly visible.

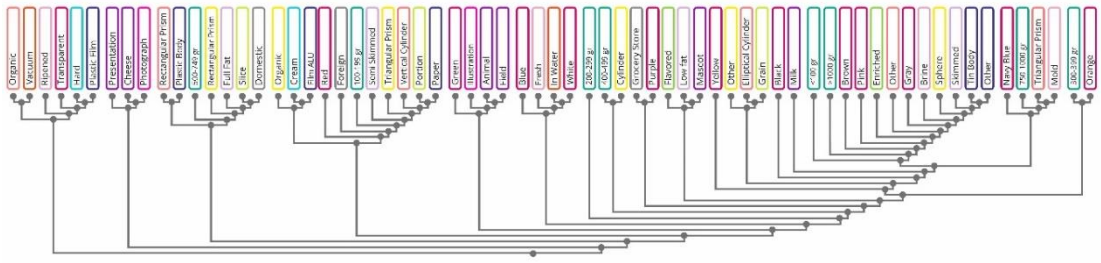

Figure 4. Dendrogram of criteria by using AMADO

Upon analyzing the hierarchical clustering analysis on the horizontal axis, it was observed that clusters are associated with specific characteristics of cheese types. These

clusters are structured based on similarities in production methods, maturity levels, shapes and packaging characteristics.

The prominent subset of the dendrogram, which encompasses the highest number of criteria, begins with various material properties (Figure 5). The “other materials” category includes traditional cheeses that utilize materials such as cloth in their packaging. Another category within this subset comprises pickled cheeses packaged in tin, often labeled as gourmet or unique series cheeses, distinguished by their metal body material.

Figure 5. Subset-1

Further along this branch, other criteria branch out individually and are less frequent numerically. These include fat-free content, a spherical shape, brine maturation, a grey color and alternative packaging forms, such as cans and tubes. Criteria related to enrichment with vitamins or lactose purification, packaging colors such as pink and brown and weights below 100 grams or exceeding 1000 grams are also included in this category. Consistent with the SPSS findings, cheeses with the lowest and highest weights are grouped within the same cluster. Other characteristics follow suit and represent the least common traits among the analyzed packages.

In the second part of the hierarchical classification, cheeses matured with mold cultures and those in triangular prism packaging are included, along with the navy blue color criterion and the upper cluster (Figure 6). These cheeses, matured with mold cultures and featuring blue and green mold veins, are sold in cylindrical blocks. Their packaging is designed to align with these characteristics, presented in triangular slices. Furthermore, since these cheeses are classified as “blue moldy cheese”, the packaging color is expected to fall within the navy-blue cluster.

Figure 6. Subset-2

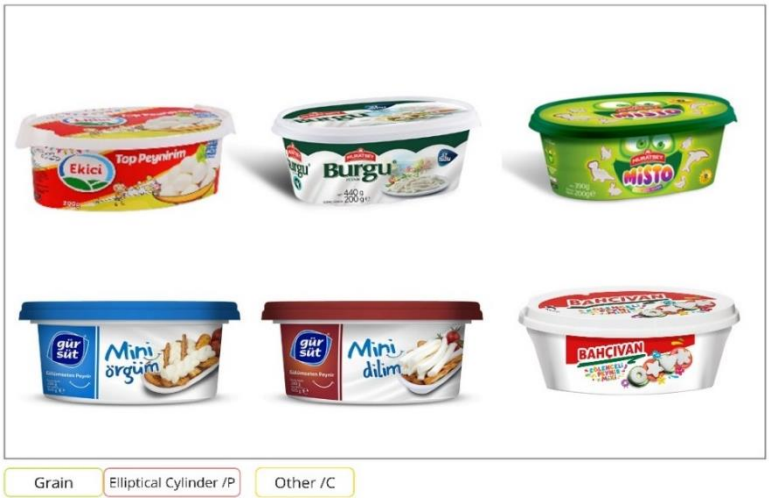

Figure 7. Subset-3

Another grouping is the association of granular cheese products with elliptical cylinder packaging (Figure 7). These cheeses are frequently preserved in water and fall under the "Other" cheese form category, encompassing both playfully designed geometric shapes and traditional forms, such as braided and ball-shaped cheeses.

The next sub-cluster comprises low-fat cheeses, paired with products featuring mascots or characters on their packaging. Flavored cheeses are included in the next top cluster (Figure 8). The La Vache Qui Rit brand and its red cow mascot dominate the packaging designs, influencing the breakdown. Semi-fat and low-fat fresh cheeses, including low-fat soft 'petits suisses' type cheeses, are available in various forms, portions and flavors, frequently incorporating mascots and illustrations tailored to specific target audiences.

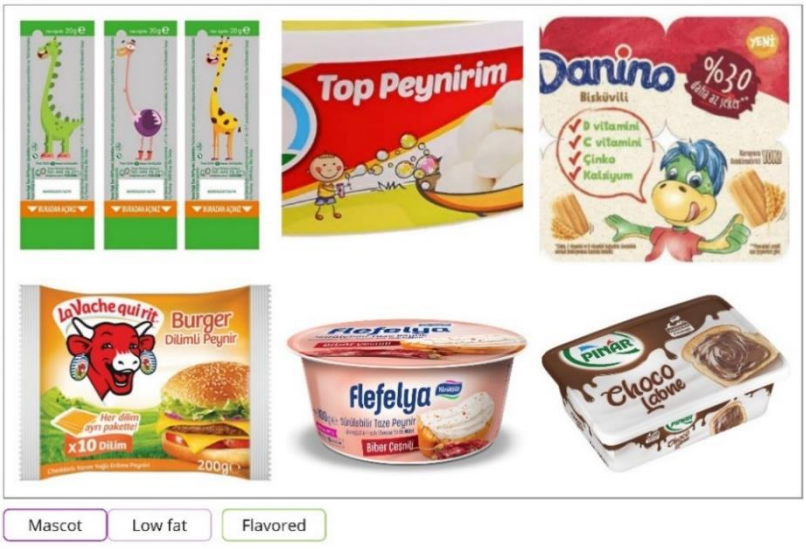

Figure 8. Subset-4

Figure 9. Subset-5

The subsequent clustering reveals a correlation between supermarket products and the use of purple hues in packaging. Upon analyzing the listed cheeses, it becomes evident that the Migros market brand cheese products predominantly use purple hues and shades to establish a cohesive product family (Figure 9). This sub-cluster emerges as a sectoral feature, demonstrating the influence of manufacturer brand identities on packaging colors. Similarly, a watercolor illustration of a green field in a purple watercolor style is employed as the background.

The clustering aligning with cylindrical cheese forms within the weight range of 400-499 grams indicates an association with cylindrical-shaped cheeses, such as Kashkaval cheese and processed cheese, when examining various cheese types, as depicted in Figure 10. This weight category notably customizes the preferred cylindrical product form. Despite potential variations in brand graphic elements, the product's form, weight and packaging structure maintain consistent characteristics.

Figure 10. Subset-6

Figure 11. Subset-7

In another cluster, where different colors are closely associated, white is paired with cheeses preserved in water and sold. This cluster, generally comprising the preservation-type cottage and fresh cheese groups, supports the fresh cheese supercluster and the use of blue color (Figure 11). The white and blue selection for this group, which has a creamier structure and a more neutral flavor in water, reinforces the connotations of lightness and freshness.

In another category of visualization, it is observed that green field visuals and animal figures are matched (Figure 12). It was observed that background illustrations, such as large green areas, farm landscapes and flowery greens symbolizing naturalness, were used in many packages with green tones.

Figure 12. Subset-8

Figure 13. Subset-9

In the next group, cream cheese and aluminum film material are followed by organic and single-serving portions, paper materials, cylindrical packaging and triangular prism cheese forms, all of which indicate the triangular cheese category, as supported by SPSS data (Figure 13). The use of red is attributed to companies' brand colors.

Two distinct subclusters are discernible within the clustering observed in the third breakpoint, as depicted in Figure 14. The first subcluster indicates a correlation, suggesting that rectangular-shaped packaging primarily utilizes plastic as the body material. The second subcluster signifies the domestic production of sliced cheeses, characterized by their full-fat content, rectangular shape and weights.

Figure 14. Subset-10

Figure 15. Subset-11

The branching continues with content visuals (Figure 15). Upon analyzing the samples, it was observed that, in addition to cheese molds and slices, images of cheese usage areas, such as cheese on bread, salad, soup, pizza, hamburger, tomatoes, greens and fruits, were commonly included on the presentation board. Conversely, cream cheese packaging typically depicts the cheese spread on bread and bagels, accompanied by photographs featuring tomatoes, greens or jam. In the triangular cheese category, it was noted that the triangular form and bagel visual were used.

Another closely related feature is the subset involving solid cheeses and plastic films. This subset encompasses protective coating films for cheeses with fresh and moist ingredients, as well as protective inner packaging, typically employing vacuum films for aged ingredients. Additional criteria associated with this cluster include transparency, as it allows the highlighting of characteristics such as color, texture and pores specific to ripened cheeses. In another closely related sub-cluster in Figure 16, it was observed that hard cheeses with organic packaging were predominantly produced using vacuum-formed plastic films in the sampled cases.

Figure 16. Subset-12

Multiple correspondence analysis (MCA)

The primary objective of correspondence analysis is to visually depict the relationship between rows and columns within cross-tables, ultimately reducing dimensions to improve interpretability. When the table comprises two variables, it is termed simple correspondence analysis, while with three or more variables, it is referred to as multiple correspondence analysis (Roux & Rouanet, 2010). Multiple Correspondence Analysis (MCA) extends correspondence analysis to handle more than

two categorical variables (Halford, n.d.). MCA reduces the categorical variables in the original dataset to a small number of dimensions known as components.

In the study's final stage, criteria closely related to MCA analyses will be evaluated and their relationships with different features of cheese packaging will be explored using 3D visualization. The dimension reduction algorithm was implemented using the Python 3 library "Prince", designed for factor analysis. The MCA analysis was conducted to visualize the results in a 3D graph (Figure 17), enhancing the understanding of the relationships between the criteria. Based on information from clustering analysis, the study focused on material type, cheese and packaging shape, transparency and categories such as density, milk fat and ripeness in cheese characteristics. These were selected based on their predictor importance value exceeding 0.2 in packaging design. The graph illustrates the distribution of these criteria across three main components (Component 1, Component 2, Component 3) on the X, Y and Z axes, indicating their relationships and the proximity or divergence of specific groups. Component 1 explains the highest variance in the dataset and reflects the most vital relationships. Component 2 accounts for additional variance and reveals the second most significant relationships. Component 3 explains residual variance not captured by Components 1 and 2, highlighting less significant relationships. Each data point represents a criterion related to a specific type of cheese packaging. The color scale indicates values ranging from low (purple, 0.0) to high (yellow, 1.0), visually representing the intensity of the criteria across the components.

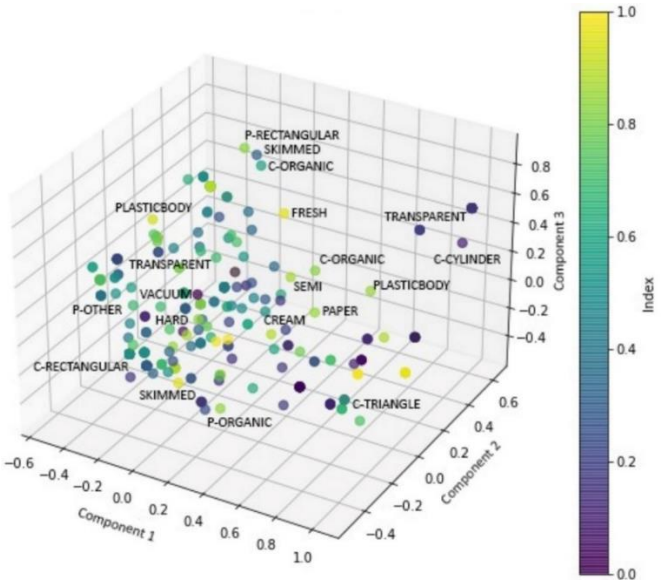

Figure 17. Multiple Correspondence Analysis by Python 3

Plastic materials play a central role in packaging graphics and are versatile enough to accommodate a wide range of cheese shapes. The use of transparent materials also appears widespread. Paper, aluminum and tin as packaging materials are associated with specific cheese shapes and are concentrated in more distinct areas of the spectrum. Organic packaging forms more frequently utilize plastic materials.

Fresh cheeses are clustered more closely, while mature cheeses are positioned more centrally. Fatty and semi-fatty cheeses tend to cluster with fresh and mature cheeses, whereas low-fat and fat-free cheeses are separated from these groups.

The MCA method reduced categorical data into three main components and utilized these components to illustrate how cheese packaging is clustered and which characteristics are interconnected. This analysis will provide insights for optimizing packaging design within the cheese sector and identify opportunities for innovative approaches.

5. Discussion

A comprehensive investigation of 372 distinct cheese packaging variants available across three supermarket chains, assessed against 14 principal criteria and 67 sub-criteria, yielded compelling insights on the impact of packaging design within the cheese industry:

Density's Dominance: Cheese packaging is significantly influenced by the density of the cheese, whether it is solid or creamy in form.

Distinctive Clustering: Criteria affecting packaging form, material and color form distinct clusters, aligned with different cheese varieties, ensuring consistent packaging features in both physical stores and e-commerce platforms.

Our observation that color, form and visuals are primary drivers in cheese packaging aligns closely with earlier work in the field. Bone and France (2001) and Örücü and Tavşancı (2001) emphasize packaging form, color and graphics as essential graphic elements influencing purchase decisions, precisely the criteria that clustered so distinctly in our study across cheese types. Similarly, Wang et al. (2023) highlight how color not only stands out during purchase but also modulates other graphic elements, which resonates with our finding that material transparency or opacity is deployed strategically (e.g. transparent films for solid cheeses to build trust and opaque for cream cheeses to mask processing).

Form Preferences: Over 54.4% of cream cheese packaging favors cylindrical forms, whereas solid cheese packaging demonstrates less than 4% utilization of this form.

Our quantification of form preferences (e.g., 54.4% cylindrical cream-cheese packages) aligns with Eldesouky and Mesias's (2014) finding that form and color are the primary factors influencing consumer choices in cheese packaging, with price and brand following as secondary factors. Both studies confirm that consumers tend to gravitate toward familiar shapes (such as blocks and tubs) and corporate color schemes, which reinforces brand identity and purchase confidence.

On the other hand, while Lindh et al. (2016) emphasize the importance of transport-friendly design and ease of handling for consumer choice, our results showed that weight was not a significant factor in material selection. Instead, secondary functions (re-closure, film thickness) and visual transparency appear to drive design decisions more strongly in the Turkish market, suggesting cultural or logistical differences in what "ease of transport" means for consumers here.

Regulatory Compliance: According to Article 19, Paragraph B of the Turkish Food Codex (1997), cheese packaging ensures accessibility to the cheese only after it is opened or altered, often featuring opening functions or thin film coatings. Secondary cover functions in plastic packaging, mainly plastic films for solid cheeses and aluminum for cream cheeses, are prevalent.

Tailored Designs for Ripened Cheeses: Two-part packaging designs are specifically tailored for ripened cheese, designed to enhance sales, presentation, service

and storage. These designs incorporate both transparent and opaque plastic materials to support the maturation process.

Material Preferences: Opaque materials are prevalent in cream cheese packaging, whereas solid cheese packaging tends to feature transparent material (76.5%) to counteract rapid oxidation in fresh cheeses and build consumer trust by enabling product visibility.

Cheese Preservation Technique: In solid cheeses like halloumi and cottage cheese, vacuum and plastic films serve as both a single material and internal storage layers for ripened cheeses, known as Cryovac. This technique aims to prevent water loss, inhibit bacterial growth, extend shelf life and enhance flavor while supporting maturation.

Bou-Mitri et al. (2020) report that vacuum packaging with transparent films is overwhelmingly preferred by consumers who prioritize preservation. Yet, our study found that opaque films remain dominant in cream-cheese packaging (over 76% transparent only among solid cheeses). This divergence is due to the different requirements of cheese types. The opaque material, preferred to preserve freshness, also prevents a cloudy image, such as brine, from negatively affecting sales and supports harmony with brand aesthetics.

The Use of Color: The application of color in packaging varies significantly across cheese types and brands. Fresh cheese packaging typically employs white, green and blue hues, while cheeses matured with mold predominantly use blue, navy and dark green tones. Enriched products often feature vibrant colors, whereas low-fat or lactose-free options tend to favor pastel shades.

Figure 18. Examples from brands focusing on color

Brand Strategies: Regarding brands, specific approaches used by four different brands are illustrated in Figure 18. As depicted in the first three examples, brands have adopted diverse methods, including the use of a dominant corporate color, combining corporate color with brand imagery, adapting color schemes to different packaging formats, using text in various colors based on cheese type and employing specific illustrations and color combinations according to cheese variety. In instances where product distinctions are minimal, consumers tend to favor brand names as indicators of quality (Vranešević & Stančec, 2003). These examples highlight that companies in this sector employ diverse strategies in developing brand languages.

In studies of cheese packaging, it has been observed that brand plays a significant role in consumer preferences. Colors define brands and sub-varieties within the cheese sector (Ares *et al*., 2010; Eldesouky & Mesias, 2014). There is no standardized color coding for flavored cheeses. Figure 19 compares the packaging of various companies for fresh cheese and quark. In plain cheese packaging, blue and shades of blue are commonly used alongside white. However, red has been used for chili and strawberry flavors, while green has been employed for herbs and pineapple. Differentiation has been achieved through the visual representation of the flavors.

Figure 19. Color focused examples of flavored products

Visual Element: Analysis of visual elements on packaging reveals a high prevalence of cheese visuals across all categories (58.2% for cream cheese and 57.7% for solid cheese). However, the presentation image is more frequently employed, with usage rates of 33.8% for solid cheese packages and 58.2% for cream cheese packages.

The intended use of visuals on packaging generally aligns well with their intended environments and presentations. The visuals are appetizing and realistic, featuring appealing photographs. Across various cheese types, these visuals incorporate bread and bagels, tomatoes and greens, as well as nuts and fruits. This finding is consistent with the provision of sensory experiences to consumers, as previously discussed in studies (Schifferstein *et al*., 2013). Cheeses are depicted with distinct flavors, indicating their compatibility with specific tastes and suitable dishes (Figure 20). Such visual representations also facilitate consumer decisions when selecting cheeses based on their intended uses.

While Velasco et al. (2014) demonstrate that typeface (round vs. angular fonts) can alter perceived sweetness or sourness of products, our content analysis did not reveal any systematic clustering of typography by flavor across the 372 samples. This suggests that, in practice, Turkish cheese brands may prioritize pictorial and color cues over typographic nuance for taste communication.

Figure 20. Usage examples of visual elements

Child-oriented Marketing: Children are more likely to select products and packaging adorned with familiar characters, cartoons, celebrities and animals. Parents are often influenced by their children's purchasing decisions (Hill & Tilley, 2002). As depicted in Figure 21, incorporating cartoon or game characters into packaging visuals has made daily products more attractive. Childlike illustrations, playful typography and vibrant colors distinguish this packaging approach. Moreover, positioning cheese, a healthy product category, within children's preference areas is another factor that captures parents' attention. Another strategy employed by certain companies in this sector is the use of brand-specific mascots. Utilizing mascots is a distinctive feature of branded products that enhances brand awareness and recognition (Miller, 2019). Incorporating mascots into general logos or memorable product lines helps attract children's attention and fosters understanding of the associated cartoon characters. Over time, this cultivates a particular perception of the brand and fosters brand loyalty. This approach has proven effective in both graphic design and the development of innovative cheese varieties. New types of cheese have been created with specific designs tailored to children, often shaped and produced in granular form by various companies. Marketing aimed at children is an effective strategy for diversifying packaging and creating new product categories.

Figure 21. Examples of packaging and products designed for children

Designer Guidelines: Based on the specified criteria, a simplified guideline has been developed for designing cheese packaging (Figure 22).

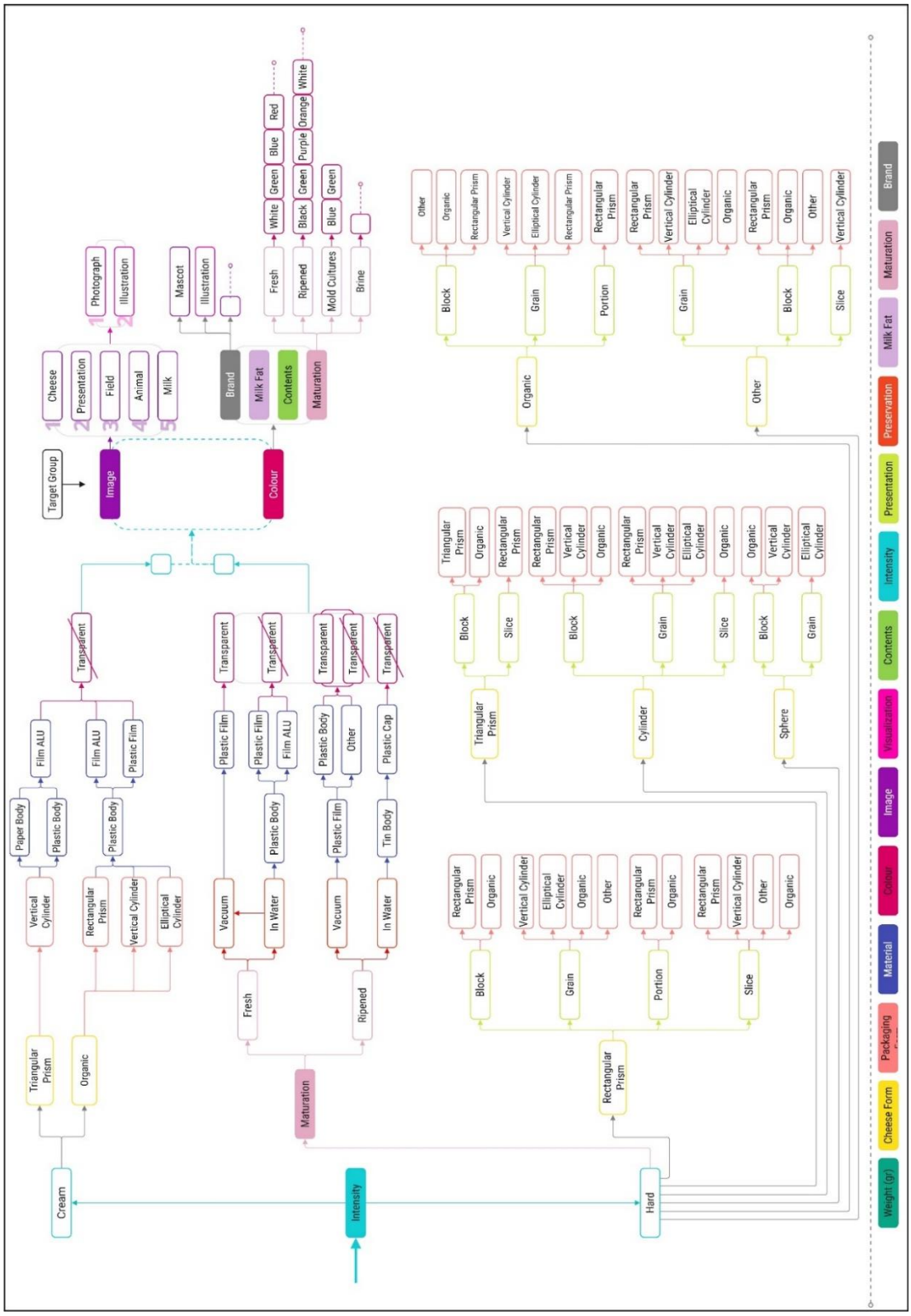

Figure 22. Designer's guide to cheese packaging

The initial design criteria depend on factors such as the type of cheese, production conditions and the required durability. Since material types are used according to the methods specified in the Turkish Food Codex Regulation on Materials and Articles in Contact with Food (2018), packaging designs among cheese types with the same properties tend to cluster and vary through form studies. Similarly, features like packaging openability and label details are extensively explained in the codex. After the implementation of these regulations, the relationship between cheese and packaging form, as well as visual and color choices, depends on designers' discretion and sector-specific factors, such as brand, target audience and product content.

This guideline aims to reveal industry attitudes and serve as a resource for designers seeking to identify primary paths in packaging design, while also providing insights into the creative spaces where they can differentiate their work.

6. Conclusion

This study scrutinized cheese packaging attributes utilizing diverse analytical methodologies to delineate prevailing industry norms. Initially, an examination of 372 pre-packaged cheese products from A101, Migros and Carrefour SA, operating across both physical and digital retail platforms, was conducted on their respective websites. Fourteen principal criteria, encompassing weight, product form, packaging structure, material, color, visual elements, visualization techniques, content specifics, density, presentation styles, preservation methods, milk fat content, ripening and producer details, alongside a total of 67 distinct sub-criteria, were established.

The acquired dataset underwent an initial grouping via cluster analysis. Outcomes revealed two primary clusters in cheese varieties, delineated by the density criterion, categorized as creamy and solid.

In the subsequent phase, a hierarchical clustering method was used to construct subgroups based on shared features within cheese packaging systematically. The resultant clusters and selected sample packaging revealed a correlation where products sharing analogous cheese density, type and forms exhibited similar packaging characteristics regarding form, material and weight within the industry.

Finally, data from prior stages, encompassing product and packaging forms, materials, density, presentation and storage methods, milk fat content and maturation status, underwent multiple correspondence analyses to visually depict interrelations among limiting factors and applied methods in cheese packaging designs.

Emphasizing consumer safety requirements in cheese packaging, as in all food products, according to the criteria set by the Turkish Food Codex, has emerged as a fundamental factor influencing packaging design. The study highlighted cheese density as the primary factor in cheese packaging, revealing that the type of cheese significantly determines features such as packaging form, material and color.

For packaging designers, key factors influencing cheese packaging design include regulations, production methods, cheese density, type of cheese required, target consumer demographics, consumption trends and brand identity. Incorporating these identified factors into initial design considerations, aligned with aspects such as usability, evolving lifestyle trends and consumer expectations, emerged as effective packaging design strategies to distinguish and accentuate products within the market.

When these findings are evaluated within a theoretical framework, they align with well-established models of consumer behavior and design. For instance, Keller's

Customer-Based Brand Equity (CBBE) model emphasizes that brand equity is built on consumer perceptions of brand identity, imagery, judgments and feelings, ultimately leading to loyalty and resonance (Keller, 2001). In this study, visual consistency, packaging form and material selection were found to shape consumer impressions and reinforce brand associations. Similarly, Norman's Emotional Design theory (2004) illustrates how visceral appeal (e.g., color, appetizing visuals), behavioral usability (e.g., opening mechanisms, reclosability) and reflective interpretation (e.g., premium material use, transparency and trust) work together to produce a memorable and emotionally resonant user experience. Additionally, the Stimulus-Organism-Response (S-O-R) model (Mehrabian & Russell, 1974) clarifies how external stimuli - such as packaging visuals, materials and structural form - affect internal consumer states and result in behavioral outcomes, including purchase intention and brand preference. These frameworks validate that packaging is not merely a container, but a critical communication and positioning tool capable of influencing cognitive and emotional processes that shape consumer decision-making. Limitations of the Study and Future Research.

7. Limitations and Future Research

While this study provides a comprehensive analysis of the visual and structural characteristics of cheese packaging, it should be considered within the following limitations:

• Sample Limitation: The study only covers products available on the online platforms of three major supermarket chains operating in Turkey (A101, Migros and Carrefour SA). While the findings cannot be directly generalised to different geographical regions or alternative sales channels, they are open to interpretation and comparative analysis in these areas.

• User Data Shortage: The research was conducted solely through visual content analysis and statistical methods. Qualitative/data-based inputs such as consumer perception, user experience or expert opinions were not included.

• Cross-sectional Design: The study data were collected over a specific time period, which does not allow for the tracking of temporal changes in packaging design and marketing strategies.

• Interpretation Subjectivity: Although systematic, visual coding and analysis processes are based on researcher interpretation and may yield different coding results in different studies (Schreier, 2012; Rose, 2016).

Recommendations for Future Research:

• Use of Mixed Methods: It is recommended that visual analysis findings be supported by consumer surveys, focus group studies and expert evaluations.

• Comparative and Longitudinal Studies: Examining packaging design trends across different cultural contexts or time series will provide a deeper understanding.

• Sustainability and Technology-Focused Research: Studies examining user perceptions of biodegradable materials, innovative packaging technologies and their environmental impacts can be conducted.

In this way, future research can both increase theoretical contributions and enable the development of more inclusive design strategies for practitioners.

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