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Research Article

Identifying And Evaluating Determinants Of Edible Product Packaging For Consumer Buying: An ISM-MICMAC Approach

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ABSTRACT

Consumer behavior toward edible product packaging is pivotal in shaping purchasing decisions and influencing market dynamics and sustainability efforts. This research paper investigates the determinants influencing consumer buying behavior regarding edible packaging. Employing the interpretive structural modeling (ISM) and (MICMAC methodologies, it seeks to identify and evaluate the hierarchical relationships among various factors affecting consumer preferences in this domain. By employing a comprehensive approach, the study aims to provide insights into the complex interplay of factors shaping consumer choices in edible product packaging, thereby offering valuable guidance for marketers and policymakers seeking to enhance product packaging strategies and meet consumer needs effectively. The preliminary findings suggest that determinants such as Packaging Regulation, Packaging Materials, innovative packaging, and Sustainability significantly influence consumer perceptions and purchasing decisions regarding edible product packaging. Moreover, the ISM-MICMAC framework identifies critical factors exerting maximum influence and those with high driving power and dependence, thus facilitating strategic interventions for effective packaging design and marketing strategies. This research's implications extend to academia and industry, offering valuable insights into understanding consumer behavior towards edible product packaging and guiding marketing strategies to enhance consumer satisfaction and sustainability initiatives.

Keywords: Edible Product, Packaging, Consumer Buying, ISM, MICMAC

Introduction

Over the past decades, consumer preferences have evolved, and the demand for high-quality edible products has grown significantly. In tandem with this trend, the significance of product packaging in influencing consumer buying decisions has become increasingly pronounced. The packaging of edible products plays a pivotal role in preserving the quality and safety of the contents and attracting consumers through aesthetic appeal and functional considerations. Consumers are confronted with numerous choices with a surge in the variety of edible products available in the market. This diversity has elevated the importance of packaging as a critical factor influencing consumer purchasing behavior. Packaging serves as a protective barrier and communicates vital information about the product, impacting consumer perceptions and choices.

Various factors, including visual appeal, functionality, information clarity, and environmental sustainability, shape consumer preferences for edible packaging. As noted by Kotler and Armstrong (2018), packaging is a critical element of the marketing mix that directly influences consumer perception and purchasing decisions. Despite the acknowledged importance of edible product packaging, there is a need to systematically identify and evaluate the determinants that significantly influence consumer buying decisions. This research recognizes the gaps in the existing literature, particularly in the context of a structured approach to understanding the interrelationships among these determinants. The paper aims to identify and evaluate the determinants influencing consumer buying behavior regarding edible product packaging. It will utilize the ISM and MICMAC

approach to analyze the interrelationships among these determinants, providing insights into their hierarchical structure and impact on consumer decision-making processes.

Review of Literature

Different studies (e.g., Deo & Hosee, 2017; Kasza et al., 2022; Silayoi & Speece, 2007) investigate the influence of packaging attributes on consumer behavior, such as purchase intentions, sustainability perceptions, and product evaluations. Factors like visual appeal, material, design, and information on packaging play significant roles in shaping consumer perceptions and decisions. Boz et al. (2020) explore consumer considerations for sustainable packaging, highlighting the growing importance of environmental concerns in packaging choices. Ilyas et al. (2021) and FSSAI (2011) address regulations concerning food packaging materials and labeling, emphasizing the importance of safety and compliance in packaging design and production. Research by Warfield (1974) discusses the interpretation of complex structural models relevant to understanding organizational systems, while studies by Mateen Khan et al. (2018) and Mishra and Jain (2012) focus on consumer buying behavior in specific contexts like packaged food items. Various methodologies have been employed to identify and evaluate determinants of packaging preferences. Multi-criteria decision-making techniques, such as the Analytic Hierarchy Process (AHP) and Interpretive Structural Modeling (ISM), have been utilized by researchers like Deliya and Parmar (2012) to analyze the hierarchical relationships among packaging attributes and consumer preferences. Fatima and Siddqui (2022) explored the application of Integrated Structural Modeling (ISM) in understanding complex relationships among variables affecting consumer behavior. They demonstrated how ISM techniques can uncover hierarchical structures and interdependencies among determinants impacting consumer choices. Integrating Interpretive Structural Modeling (ISM) with MICMAC offers a comprehensive framework for understanding the interdependencies among packaging determinants and their impact on consumer buying behavior. Research by Singh and Gupta (2021) demonstrated the effectiveness of the ISM-MICMAC approach in identifying key drivers of green product factors and their relative influence on consumer decision-making.
It is summarized that numerous methods have been presented in the literature to identify packaging determinants linked to consumers buying various products. Few studies are focused on the edible products category. Further, studies on identifying the packaging determinants for edible products are not available in the form of concentrating all determinants together. This gap provides the guidelines for the present study.

Methodology

This research addresses the identified gaps using the Interpretive Structural Modeling-Matriced Impacts Croises Multiplication Appliquee a un Classement (ISM-MICMAC) approach. The objective is to systematically identify, evaluate, and establish the interrelationships among the determinants of edible product packaging that impact consumer buying decisions. This study aims to explore and understand the determinants without presupposing specific relationships; it is exploratory, allowing for a comprehensive examination of various strategies and their effectiveness in influencing consumer buying behavior related to edible product packaging. The primary focus is developing a comprehensive understanding of the factors influencing consumer perceptions and decisions regarding edible product packaging. The research aims to provide a structured model that illuminates the interplay among these determinants by employing the ISM-MICMAC approach. The ISM-MICMAC approach will be used as a systematic methodology to analyze and model the determinants of edible product packaging. This method allows for a nuanced understanding of the relationships among the identified factors, offering valuable insights for improving packaging strategies.

Application of ISM approach

The ISM method was first presented by Warfield (Warfield, 1974) as a way to study the intricate socioeconomic system. The ISM approach creates a structured, hierarchical, interrelationship-based model of several components, which aids in the solution of complicated problems(Swarnakar, Vaidya et al., 2019). An interactive, methodical process called ISM creates a structured model of a complex system(Khurana et al., 2010). It is beneficial to comprehend how various components interact (Swarnakar, Singh et al., 2019). The following are the steps involved in implementing the ISM approach:

Identification of Determinants of edible product packaging for customer

Expert comments and a literature survey have been used to identify the packaging determinants. Twenty experts from the academic community, business community, and stakeholder groups have been chosen to conduct the study. Based on expert observations, a list of identified factors was narrowed to 15 critical determinants. The details of the packaging determinants for edible products are shown in Table 1.

Formation of structural self-interaction matrix (SSIM)

Structural self-interaction matrix formation (SSIM) Using the expertise of experts, the SSIM is designed to determine the contextual relationship between the chosen packaging determinants. With the help of specialists, the contextual relationship between packaging determinants based on their directional association has been

documented. Various specialists have provided a total of fifteen SSIMs. A frequency analysis has been performed to remove the disparities in viewpoints.

Table 1 Critical Determinants of edible product packaging for consumers

Sr. No	Determinants of edible product packaging	Source
1	Packaging Material	(Deo & Hosee, 2017)(Kip Viscusi, 2023)(Dadras, 2015)(*Material of Packaging*, n.d.)(Rosmiati et al., 2023)
2	Sustainability	(Yokokawa et al., 2019)(Quzone, 2018)(Kapse et al., 2023)(Kasza et al., 2022)(Products & Practices, 2020)
3	Cost	(Deo & Hosee, 2017)(Kip Viscusi, 2023)(Ahmad & Ahmad, 2015)(Kapse et al., 2023)
4	Packaging Graphic	(Hall-Phillips & Shah, 2017)(Ahsan Ansari & Siddiqui, 2019)(Dadras, 2015)(M. Deliya & J. Parmar, 2012)(Boz et al., 2020)
5	Quality of Packaging	(Silayoi & Speece, 2007)(Alahl, 2018)(Mishra & Jain, 2012)(Mateen Khan et al., 2018)
6	Storage	(Hall-Phillips & Shah, 2017)(Ahsan Ansari & Siddiqui, 2019)(Steenis et al., 2017)
7	Sensory Appeal	(Silayoi & Speece, 2004)(Quzone, 2018)(Underwood & Klein, 2002)(Ahsan Ansari & Siddiqui, 2019)
8	Innovating Packaging	(M. Deliya & J. Parmar, 2012)(Silayoi & Speece, 2004)(Deo & Hosee, 2017)(Ahmed et al., 1450)(Ahsan Ansari & Siddiqui, 2019)
9	Clarity of Information	(Hall-Phillips & Shah, 2017)(Deo & Hosee, 2017)(Silayoi & Speece, 2007)
10	Eco-friendly packaging	(Ahmad & Ahmad, 2015)(Mishra & Jain, 2012)(Products & Practices, 2020)(Boyce et al., 2008)(Fatima et al., 2022)
11	Branding	(Deo & Hosee, 2017)(Steenis et al., 2017)(M. Deliya & J. Parmar, 2012)(Silayoi & Speece, 2004)(Silayoi & Speece, 2007)(Ahmed et al., 1450)(Ahsan Ansari & Siddiqui, 2019)(Ahmad & Ahmad, 2015)
12	Regulatory Compliance	(Kip Viscusi, 2023)(Products & Practices, 2020)(Ilyas et al., 2021)(FSSAI, 2011)
13	Consumer Preferences	(Siddiqui et al., 2022)(Oliveira et al., 2021)(Kulkarni & Hemant Baliram Assistant Professor, 2023)

The following four conditions with symbols have created the contextual relationship for each determinant. Every symbol has a distinct meaning.

- V → row variable influences corresponding column variable.
- A → row variable is influenced by the corresponding column variable.
- X → row and corresponding column variable influence each other.
- O → row and corresponding column variable have no relationship.

Table 2: Structural self-interaction matrix.

	Consumer Preference	Packaging Graphic	Clarity of Information	Branding	Packaging Materials	Leb Certification	Storage Capacity	Innovating Packaging	Quality of Packaging	Eco friendly	Sensory Appeal	Cost	Sustainability
Consumer Preferences		A	A	A	A	A	A	A	A	A	A	A	A
Packaging Graphic			X	V	A	A	A	A	v	A	V	v	O
Clarity of Information				O	A	A	A	O	V	X	V	O	O
Branding					A	A	O	A	A	A	O	V	O
Packaging Materials						A	O	A	V	O	V	V	V
Regulatory Compliance							O	V	V	O	O	V	V
Storage Capacity								A	O	O	X	V	O
Innovating Packaging									V	O	V	V	X
Quality of Packaging										O	A	V	A
Eco friendly											V	O	O
Sensory Appeal												O	O
Cost													A
Sustainability													

The following would be a better understanding of the development of SSIM; one example is provided herewith:

- Determinant "consumer behavior" is attained by "sustainably" in packaging, so the interrelation between these determinants is symbolized as "A."
- Determinant "packaging graphics" assist in attaining "sensory appeal" among consumers, so the interrelation between these determinants is symbolized as "V."
- Determinant innovation in packaging and sustainability assist each other, so the interrelation between this determinant is symbolized as "X."
- The determinants "packaging graphic" and "sustainability" have no relationship, so the determinant no relationship symbolized as "O."

The SSIM is developed and presented in Table 2 based on the above concept.

Formation of initial reachability matrix (IRM)

The IRM is a binary matrix that is produced by applying the following conversion procedures to transform SSIM into IRM:

- In the IRM, convert with entries (i, j) = 1 and (j, i) = 0 if the symbol "V" was represented by the ('i', 'j') entry in the SSIM.
- In the IRM, convert with entries (i, j) = 0 and (j, i) = 1 if the symbol "A" was represented by the ('i', 'j') entry in the SSIM.
- If the symbol "X" was represented by the ('i', 'j') entry in the SSIM, then the IRM converted with the entries (i, j) = 1 and (j, i) = 1.
- In the IRM, convert with entries (i, j) = 0 and (j, i) = 0 if the symbol "O" was represented by the ('i', 'j') entry in the SSIM.

Based on these conditions, the IRM was created and is shown in Table 3.

The derived IRM's transitivity must first be examined. The following presumptions are used to check for transitivity across package determinants: if "A" is connected to "B," and "B" is related to "C," then "A" is related to "C." In this scenario, "0" is substituted with the integer value "1*," which exhibits transitivity (Sushil, 2012). Once the transitivity has been verified, the final reachability matrix (FRM) is produced. Table 4 presents the obtained FRM.

Table 3: Initial reachability matrix (IRM).

	Consumer Preferences	Packaging Graphic	Clarity of Information	Branding	Packaging Materials	Leb Certificat	Storage Capacity	Innovating	Quality of Packagin	Eco friendly	Sensory Appeal	Cost	Sustainability
Consumer Preferences	1	0	0	0	0	0	0	0	0	0	0	0	0
Packaging Graphic	1	1	1	1	0	0	0	0	1	0	1	1	0
Clarity of Information	1	1	1	0	0	0	0	0	1	1	1	0	0
Branding	1	0	0	1	0	0	0	0	0	0	0	1	0
Packaging Materials	1	1	1	1	1	0	0	0	1	0	1	1	1
Regulatory Compliance	1	1	1	1	1	1	0	1	1	0	0	1	1
Storage Capacity	1	1	1	0	0	0	1	0	0	0	1	1	0
Innovating Packaging	1	1	0	1	1	0	1	1	1	0	1	1	1
Quality of Packaging	1	0	0	1	0	0	0	0	1	0	0	1	0
Eco friendly	1	1	1	1	0	0	0	0	0	1	1	0	0
Sensory Appeal	1	0	0	0	0	0	1	0	1	0	1	0	0
Cost	1	0	0	0	0	0	0	0	0	0	0	1	0
Sustainability	1	0	0	0	0	0	0	1	1	0	0	1	1

Level partitions (LP)

The obtained FRM is used to partition the level. The level partition table was divided into multiple rows: the level position was in the last row, including the selected packaging determinants (in this case, 13 packaging determinants), reachability set, antecedent set, and intersection. The set of packaging determinants' value or number present in a certain packaging determinants row made up the reachability set, while the set of packaging determinants in a specific determinant's column made up the antecedent set. The determinants shared by the antecedent set and reachability are shown in the intersection column. They are level if the factors determining reachability and intersection are the same. The determinants are specified as the level is

eliminated from the table and moves on to the final level. The level partition was carried out for this investigation, and the results are shown in Table 5.

Table 4: Final reachability matrix

Variables	Consumer Preferences	Packaging Graphic	Clarity of Information	Branding	Packaging	Packaging	Storage Capacity	Innovating Packaging	Quality of Packaging	Eco friendly	Sensory Appeal	Cost of Packaging	Sustainability
Consumer Preferences	1	0	0	0	0	0	0	0	0	0	0	0	0
Packaging Graphic	1	1	1	1	0	0	1*	0	1	1*	1	1	0
Clarity of Information	1	1	1	1*	0	0	1*	0	1	1	1	1*	0
Branding	1	0	0	1	0	0	0	0	0	0	0	1	0
Packaging Materials	1	1	1	1	1	0	1*	1*	1	1*	1	1	1
Regulatory Compliance	1	1	1	1	1	1	1*	1	1	1*	1*	1	1
Storage Capacity	1	1	1	1*	0	0	1	0	1*	1*	1	1	0
Innovating Packaging	1	1	1*	1	1	0	1	1	1	1*	1	1	1
Quality of Packaging	1	0	0	1	0	0	0	0	1	0	0	1	0
Eco friendly	1	1	1	1	0	0	1*	0	1*	1	1	1*	0
Sensory Appeal	1	1*	1*	1*	0	0	1	0	1	1*	1	1*	0
Cost of Packaging	1	0	0	0	0	0	0	0	0	0	0	1	0
Sustainability	1	1*	1*	1*	1*	0	1*	1	1	1*	1*	1	1

Table 5 Level partition (Iteration 1 to 13 combined)

Elements(Mi)	Reachability Set R(Mi)	Antecedent Set A(Ni)	Intersection Set R(Mi)∩A(Ni)	Level
Consumer Preferences	1,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	1,	1
Packaging Graphic	2, 3, 7, 10, 11,	2, 3, 5, 6, 7, 8, 10, 11, 13,	2, 3, 7, 10, 11,	5
Clarity of Information	2, 3, 7, 10, 11,	2, 3, 5, 6, 7, 8, 10, 11, 13,	2, 3, 7, 10, 11,	5
Branding	4,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13,	4,	3
Packaging Materials	5, 8, 13,	5, 6, 8, 13,	5, 8, 13,	6
Packaging Regulation	6,	6,	6,	7
Storage Capacity	2, 3, 7, 10, 11,	2, 3, 5, 6, 7, 8, 10, 11, 13,	2, 3, 7, 10, 11,	5
Innovating Packaging	5, 8, 13,	5, 6, 8, 13,	5, 8, 13,	6
Quality of Packaging	9,	2, 3, 5, 6, 7, 8, 9, 10, 11, 13,	9,	4
Eco friendly	2, 3, 7, 10, 11,	2, 3, 5, 6, 7, 8, 10, 11, 13,	2, 3, 7, 10, 11,	5
Sensory Appeal	2, 3, 7, 10, 11,	2, 3, 5, 6, 7, 8, 10, 11, 13,	2, 3, 7, 10, 11,	5
Cost of Packaging	12,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,	12,	2
Sustainability	5, 8, 13,	5, 6, 8, 13,	5, 8, 13,	6

Formation of ISM-based model

The relationship between packaging determinants is obtained by the FRM result (see Table 4), and the digraph is formed based on the level partition result (see Table 5). When the packing determinants 'i' and 'j' have a value of '1' in the FRM table, the relationship arrow indicates the direction from 'i' to 'j.' The digraph's transitivity has been eliminated to create the structured model. The structured hierarchical model only displays direct interrelation links in the ISM method, whereas the digraph has direct and transitive relationships (Swarnakar, Tiwari et al., 2020)(Swarnakar, Jain et al., 2020). This is the distinction between the two models. Figs. 2 and 3 display the digraph and the consumer purchasing model created for packaging determinants.

Application of MICMAC analysis

The matrix multiplication principle serves as the foundation for the MICMAC analysis. Based on their nature, packaging determinants are grouped using the MICMAC analysis. Clustering depends on each packaging determinant's driving and dependent powers. When the dependent power is determined by adding the values displayed in the column, the driving power can be computed by adding the values of the row presented in the FRM. Table 6 shows the determined driving and dependency power. Figure 4 displays the MICMAC analysis findings.

MICMAC Ranking of Packaging Determinants

Based on the ratio of driving to dependent power, the rank of packaging determinants is determined. The determined value of the high driving and dependence power ratio, among other factors, has been used to award ranks. (For example, the customer preference determinant yielded rank one because its ratio value is 13.00. Using the rule mentioned above (Swarnakar, Jain, et al., 2020)(Swarnakar, Tiwari, et al., 2020), the rank of each packaging determinant was determined and is shown in Table 6.

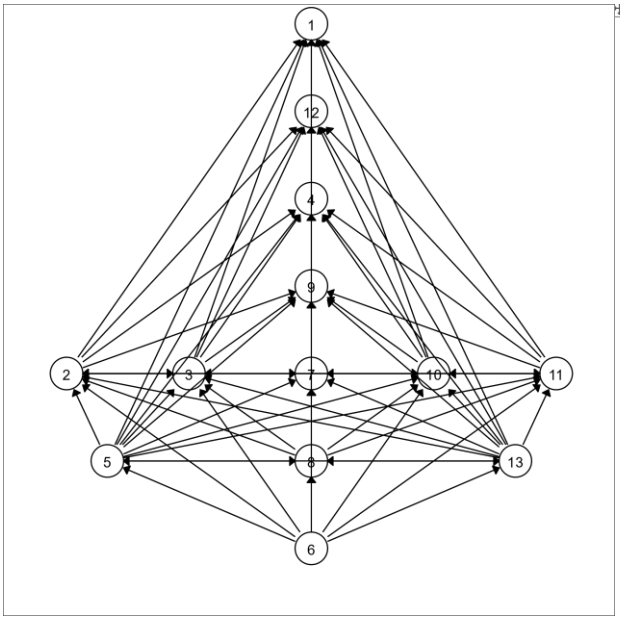

Figure 1 Structured digraph.

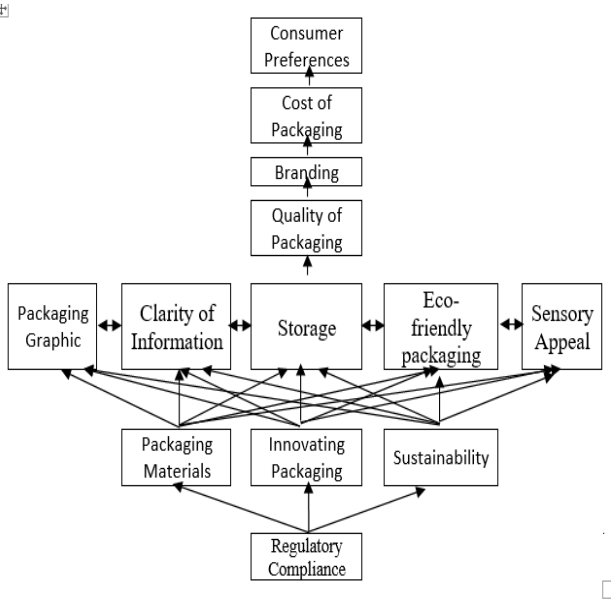

Figure 2 Developed a structured model.

Table 6: The dependence power and driving power of each packaging determinant

	Driving Power	Dependence Power	Ratio	Rank
Packaging Regulation	13	1	13.0000	1
Packaging Materials	12	4	3.0000	2
Innovating Packaging	12	4	3.0000	2
Sustainability	12	4	3.0000	2
Packaging Graphic	9	9	1.0000	3
Clarity of Information	9	9	1.0000	3
Storage Capacity	9	9	1.0000	3
Eco friendly	9	9	1.0000	3
Sensory Appeal	9	9	1.0000	3
Quality of Packaging	4	10	0.4000	4
Branding	3	11	0.2727	5
Cost of Packaging	2	12	0.1667	6
Consumer Preferences	1	13	0.0769	7

MICMAC ranking of packaging determinants-

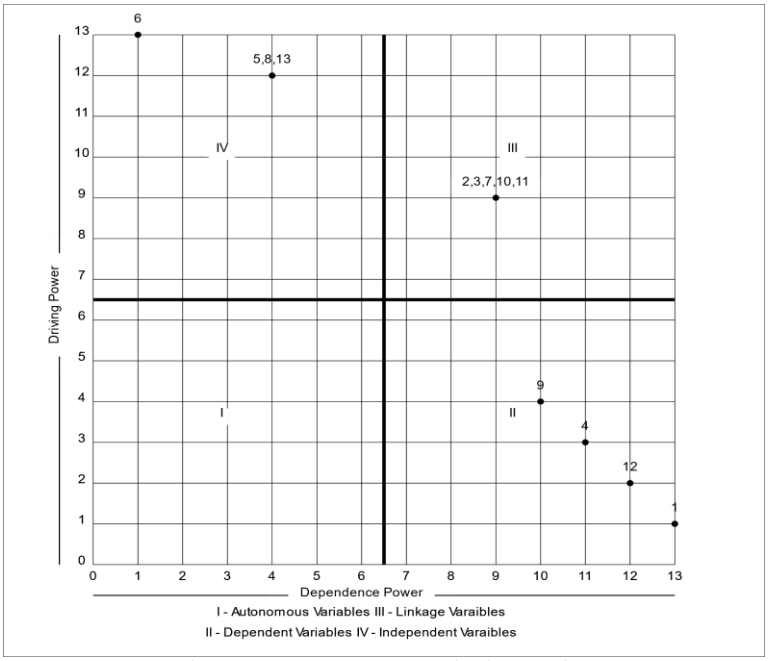

Figure 4 MICMAC analysis results.

Result and discussion

The study aims to determine the factors that affect edible food packaging. For this goal, an integrated methodology has been applied. The following subsections have been discussed in the results.

Finding of ISM approach

Using the ISM technique, a structured model for packaging determinants was created. Seven layers are shown in the generated model. The constructed model's (Fig. 3) bottom position (base) is secured by the packaging design packaging laws, and this startup determinant either directly or indirectly drives every determinant. This determinant is the most critical factor which affects the determinants of edible product packaging for consumers. Apart from these vital factors, the three packaging determinants, packaging material, innovation and sustainability, have been obtained in the second last level. The base level determinant drives or accomplishes these three packaging determinants. Five packaging determinants driven by their bottom level of packaging determinants are shown in the third level of the model. Their bottom-level packaging determinants, or the third, fourth, and fifth levels, yield the second. The top-level packaging determinant is shown in the model, and the other bottom-level packaging determinants are what drive or attain this packaging determinant. The study concludes that since packaging determinants influence customer preference, marketers should concentrate primarily on base-level packaging determinates. All other packaging determinants will improve if this base-level packaging determinant regulation is prioritized.

Findings of the MICMAC analysis

The MICMAC analysis clustered the barriers into the following four different clusters.

- **Autonomous cluster-** As an independent cluster, the first cluster is defined. Packaging determinants with weak driving and weak reliance powers, as well as those that have no effect on or influence on other packaging determinants, were considered by this category cluster. Furthermore, the system is not tied to this category determinant. Since no packaging determinant is considered in this study, only a few significant packaging determinants—all of which are the most critical—are considered.
- **Dependent cluster-** Due to their high reliance power, these packaging determinants give decision-makers an adverse outcome. This second category cluster examined packaging determinants with poor driving but great dependence power. Four packaging criteria were considered in this study, including customer preferences, branding, packaging cost, and package quality.
- **Linkage Cluster-** This third category cluster considered the obstacles with substantial reliance and driving forces and the unstable character of these category packaging determinants. Modest adjustments to one packing factor may cause changes to all other aspects. These category packaging determinants should be of concern to the decision-makers. Five packaging characteristics, including packaging graphics, product packaging clarity, product package storage capacity, and packaging's eco-friendliness and sensory appeal, were considered for this study.

- **Independent cluster-** The packaging variables with solid driving power and weak reliance were deemed the most significant packaging determinants in this fourth cluster type. Given that they impact a limited number of other dependent packaging factors, these packaging determinants require immediate attention. Four packaging determinants, packaging regulations, packaging material, innovative packaging, and sustainability, were examined in this study. These packing determinants are positioned at the base or bottom level of the model and function as drive factors. Packaging regulation is crucial in this paradigm, serving as the foundation for all other packaging factors with the most significant driving force.

The finding of MICMAC rank

The MICMAC rank has been determined based on the driving and dependent power calculations in the FRM matrix. The edible packaging determinants' computed MICMAC rank indicates the priority of the packaging determinant's impact on the customer. If the estimated packing determinant rank exactly matches the acquired model determinants, the model is also considered validated. In this instance, the one determinant packing rule also found in the model yielded the first (higher) rank. The second rank was obtained using packaging materials, innovative packaging, and sustainability. The 3rd rank was accepted by the five packaging determinants named Packaging Graphic, Clarity of Information, Storage Capacity, Eco-friendly, and Sensory Appeal as the same as the model. The packaging determinant quality obtained the 4th rank, and branding got the 5th, as shown in the model. Packaging determinants Cost of Packaging and Consumer Preferences received 6th and 7th rank, respectively, the same as the model. As a result, the outcome validates the developed model construction.

Managerial Implications

A systematic methodology for identifying essential packing characteristics has been created in this work. Any company manufacturing edibles can use the model to uncover important packaging factors influencing consumer preferences. The developed model will assist decision-makers in anticipating critical packaging factors that will enhance consumer acceptance of the product and assist current packaging producers in improving product packaging.

Conclusion

In conclusion, this study has thoroughly investigated the packaging of edible products concerning Indian consumer purchasing behavior. Key packaging determinants have been identified and analyzed through a comprehensive review of existing literature. Utilizing the ISM methodology, a structured hierarchical model of these determinants has been developed, and MICMAC analysis has further classified them. The study underscores the pivotal role of packaging regulations as a starting point factor, influencing other determinants and ultimately enhancing product packaging. Theoretical lessons from this research shed light on the complexities of consumer decision-making processes in edible product packaging. By offering a predictive model of significant packaging factors influencing Indian consumers, this study provides valuable insights for decision-makers and manufacturers seeking to optimize their packaging strategies to align with consumer preferences and behaviors.

Credit authorship contribution statement

Prof Arvind Kumar Shukla: Conceptualization, Data curation, Investigation,
Dr. Manmohan Bansal: -Methodology, Validation, Visualization, Writing – original draft,
Ms. Medha Saraswat: Writing – review & editing.

Declaration of Competing Interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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