

ANNA PLATTA

GENERATION Z CONSUMER SEGMENTS IN SUSTAINABLE EDIBLE INSECT FOODS: AN INTEGRATIVE AND COMPARATIVE LITERATURE REVIEW

S u m m a r y

Introduction: The aim of this paper is to provide a synthetic and critical analysis of the literature on the segmentation of Generation Z consumers in the context of their willingness to consume sustainable food containing edible insects. An integrative literature review was conducted, covering publications from 2015 to 2025 indexed in Scopus, Web of Science, EBSCO and BazEkon. The analysis included quantitative, qualitative and experimental studies addressing the sustainable consumption of insect-based foods and consumer segmentation. The findings were synthesized within a comparative framework, with particular emphasis on psychographic and behavioral approaches.

Results and conclusions: The results indicate that Generation Z demonstrates a high level of declared pro-environmental orientation, which is not fully reflected in actual consumer behavior. The cross-study analysis reveals recurring segmentation patterns, regardless of geographical context or methodological approach. The predominance of self-reported data, the frequent use of non-representative samples and the lack of standardization in the variables analyzed limit the comparability of findings and their generalizability. Moreover, the cross-sectional design of most studies prevents the assessment of segment stability over time. These limitations point to the need for longitudinal and cross-cultural research, as well as for studies integrating declarative measures with actual consumer behavior. The findings suggest that communication strategies should be adapted to consumers' levels of neophobia and risk perception, while greater emphasis should be placed on product forms that reduce the visibility of the insect component. This paper contributes to the literature by integrating dispersed research findings and synthesizing them from a segmentation perspective. It identifies recurring consumer typologies and systematizes the determinants of acceptance of sustainable food containing edible insects, thereby providing a foundation for further theoretical and empirical research.

Keywords: segmentation study, cross-study synthesis, methodological limitations, sustainable development, young consumers

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Introduction

The transformation of food systems toward greater sustainability has become one of the major areas of inquiry in food science, management and marketing. The literature consistently emphasizes that the environmental costs of conventional animal protein production have intensified interest in alternative protein sources that may reduce pressure on natural resources and support more sustainable consumption patterns [6].

One of the most frequently discussed solutions is the use of edible insects as a component of the human diet. Although insects have long been present in traditional food systems in many regions of the world, entomophagy remains a marginal phenomenon in European countries, which has directed scholarly attention toward the determinants of consumer acceptance. Review and empirical studies indicate that acceptance of such products is constrained primarily by food neophobia, disgust, limited product familiarity and the lack of cultural embeddedness of entomophagy in everyday diets [1, 10, 32].

In this context, particular attention has been devoted to consumers belonging to Generation Z. This cohort is characterized by distinctive consumption patterns, relatively high environmental awareness, intensive use of digital technologies and a growing influence on future food demand structures. At the same time, its food choices are far from homogeneous and remain strongly differentiated by knowledge, attitudes, health orientation and perceptions of sustainable food attributes [9, 29]. For this reason, a segmentation approach appears particularly well suited to the analysis of Generation Z's food-related behaviors.

Recent studies also show that even within Generation Z, a declared pro-environmental orientation does not eliminate the importance of conventional food choice determinants. Taste, price and health continue to serve as central evaluation criteria, while the segmentation of this cohort reveals the coexistence of pro-sustainability attitudes with clear behavioral constraints [5]. This suggests that interpreting Generation Z as a uniformly "green" cohort would be an oversimplification that is not fully supported by empirical evidence.

For this reason, the analysis of willingness to consume sustainable food containing edible insects requires a segmentation-based perspective. Such an approach makes it possible to move beyond aggregated assessments of the cohort as a whole and to identify more homogeneous consumer groups that differ in their levels of acceptance, motivations and perceived barriers.

Against this background, the present study adopts the form of an integrative review aimed at providing a systematic synthesis and critical interpretation of research findings on sustainable food consumption and the acceptance of products containing edible insects among Generation Z consumers.

Based on the literature synthesis, the following theoretical theses were formulated:

T1. Willingness to consume sustainable food containing edible insects among Generation Z is shaped by the interaction of cognitive, emotional, personality-related and contextual determinants, rather than by a single dominant factor.

T2. Environmental awareness increases the likelihood of accepting insect-based food only when the psychological cost of the product, particularly disgust and risk perception, remains moderate or low.

T3. The product form acts as a moderator of the relationship between attitudes toward sustainable food and willingness to consume it. Processed products with a non-visible insect component are more likely to be accepted.

T4. Consumer segments identified in entomophagy research are recurrent across studies not because markets are identical, but because similar configurations of determinants lead to similar product evaluation mechanisms.

T5. In Generation Z, the attitude-behavior gap is segment-dependent, being the weakest among eco-oriented innovators and the strongest among skeptical rejecters.

T6. Cultural and market context does not alter the existence of consumer segments as such, but rather modifies their size, distinctiveness and the dominant barriers to acceptance.

Material and methods

Study design

This study employed an integrative review, an approach that enables the systematic synthesis of findings derived from diverse methodological traditions, including quantitative, qualitative and experimental research. This approach was selected because the literature on the acceptance of food containing edible insects and on consumer segmentation is highly heterogeneous, which precludes the use of conventional meta-analytic procedures.

The review was conducted in accordance with a procedure adapted for integrative reviews and comprised of four stages: identification, screening, eligibility assessment and inclusion of publications in the final synthetic analysis.

Literature search and selection strategy

The literature search was carried out in four scientific databases: Scopus, Web of Science, EBSCO and BazEkon. The selection of these databases was justified by their complementarity. Scopus and Web of Science provide access to high-quality international publications, EBSCO broadens the scope to interdisciplinary literature, whereas BazEkon makes it possible to include regional research, particularly studies reflecting the Central and Eastern European context.

The review covered the period from 2015 to 2025. This time frame was chosen due to the dynamic development of research on alternative protein sources and the growing intensity of studies on entomophagy and Generation Z consumer behavior after 2015, as reflected in the increasing number of empirical and review publications in this field.

Combinations of keywords in both English and Polish were used, including: sustainable food consumption, edible insects, entomophagy, consumer segmentation, Generation Z and young consumers, combined with the boolean operators AND and OR. The search strategy was iteratively refined to improve the relevance of the retrieved records.

Inclusion and exclusion criteria

To ensure transparency and replicability, explicit inclusion and exclusion criteria were applied. The inclusion criteria were as follows: (1) articles published in peer-reviewed journals, (2) publications from 2015 to 2025, (3) empirical studies, including quantitative, qualitative and experimental research, as well as systematic reviews, (4) studies addressing sustainable food consumption, the acceptance of edible insects, or consumer segmentation, (5) studies involving young consumers or allowing this group to be identified separately.

The exclusion criteria comprised: (1) non-peer-reviewed publications, such as reports and popular science materials, (2) articles without full-text access, (3) studies focused exclusively on the technological aspects of insect production without a consumer-related component, (4) duplicate records across databases.

The selection process proceeded in several stages: (1) the identification of records in the databases, (2) the removal of duplicates, (3) preliminary screening based on titles and abstracts, (4) full-text assessment, (5) inclusion in the final synthesis. However, given the nature of the integrative review, the synthesis was not restricted to studies based on a uniform methodology. Ultimately, 34 articles were subjected to detailed examination, of which 12 publications were included in the final analysis, as they offered sufficient methodological and conceptual comparability.

Quality assessment of source studies

The quality of the included studies was assessed qualitatively using the following criteria: (1) the adequacy of the research method in relation to the study aim, (2) sample size and representativeness, (3) transparency in the operationalization of variables, (4) consistency between empirical findings and the conclusions drawn, (5) the presence of methodological limitations acknowledged by the authors. Due to the heterogeneity of the analyzed studies, no formal scoring scale was applied. Instead, a comparative qualitative assessment was used to identify the most common methodological limita-

tions, such as the predominance of self-reported data and the frequent reliance on student samples.

Operationalization of the comparative synthesis

The synthesis of findings was conducted using a cross-study comparative logic, which constitutes a key element of the integrative review approach.

The analysis compared the studies across five dimensions: (1) the basis for segmentation, including psychographic, behavioral, Theory of Planned Behavior (TPB) - based and risk perception - based approaches, (2) the structure of segments, including the number and characteristics of consumer groups, (3) segment-defining determinants, including neophobia, environmental awareness, health awareness, cultural factors, emotional factors, product-related factors and sensory factors, (4) main conclusions, (5) methodological limitations.

The synthesis involved: (1) identifying recurring segment configurations, (2) comparing findings across different geographical and methodological contexts, (3) assessing the consistency of findings across different methodological approaches, (4) integrating the results into generalized consumer typologies.

To enhance the transparency and comparability of the findings, an additional analytical step was introduced in the form of a cross-study synthesis table. This table included a subset of publications selected from all analyzed studies on the basis of clearly defined analytical criteria.

Only the studies meeting all of the following conditions were included in the table: (1) they were empirical in nature, (2) they applied formal consumer segmentation or allowed segments to be distinguished on the basis of clearly defined variables, (3) they addressed the acceptance of food containing edible insects, (4) they provided sufficient information to compare segmentation determinants, segment structure, research conclusions and methodological limitations.

Results and discussion

Sustainable Food Consumption (SFC)

The concept of sustainable food consumption may be defined as a set of consumer practices and food-related decisions aimed at reducing the negative environmental impact of the food system, while maintaining high nutritional value, food safety and the social responsibility of food production and distribution. From a systems perspective, this concept refers to the entire food chain, from raw material production, through processing and distribution, to consumption and food waste management [31].

In empirical research, sustainable food consumption is operationalized through a range of indicators related to consumer choice. These most commonly include the selection of local and seasonal food, the purchase of organic products, the reduction of

meat consumption, the preference for plant-based diets, the limitation of food waste and the willingness to accept new, more sustainable protein sources. In recent years, increasing scholarly attention has been directed toward the behaviors of young consumers belonging to Generation Z. This group is considered particularly important from the perspective of the future structure of the food market, as it is currently entering the stage of independent consumer decision-making and, in the longer term, is expected to play a major role in shaping demand for food products.

In the case of Generation Z, a high level of declared pro-environmental orientation can be observed, although this does not always translate into actual purchasing behavior. This reflects the persistent attitude-behavior gap and remains one of the most frequently examined issues in research on sustainable food consumption.

One of the studies examining sustainable food consumption practices among young consumers was conducted by Kamenidou et al. [9] in Greece. The authors focused on Generation Z students studying away from their family homes. The study explored various manifestations of sustainable food consumption, including the consumption of seasonal and regional products, the reduction of meat intake, the choice of organic products and preference for foods with a lower environmental impact. The results showed that respondents relatively often declared purchasing seasonal and regional products, whereas they were much less likely to engage in behaviors requiring more substantial changes in dietary habits, such as reducing meat consumption or systematically choosing organic food. The segmentation analysis identified two segments of young consumers differing in the extent to which sustainable food consumption practices were implemented. However, the authors noted that the study was limited by a non-representative sample and its exclusive focus on students, which restricts the generalizability of the findings to the broader Generation Z population.

The determinants of sustainable food perception were also examined in the study by Su et al. [29], conducted in the United States among young consumers belonging to Generation Z. The research model included the level of environmental awareness, environmental values, health orientation and the perceived importance of selected food product attributes. The food category under analysis covered a broad range of products considered sustainable, including local food, products with a reduced environmental footprint and alternative protein sources. The findings allowed the authors to identify three consumer segments differing in the degree of ecological sensitivity: highly environmentally engaged consumers, moderately pro-environmental consumers and consumers with low ecological sensitivity. The study demonstrated that the level of environmental awareness significantly influenced the way sustainable food attributes were perceived. At the same time, the analysis was limited by the relatively low ethnic diversity of the sample and the exclusive use of self-reported data. The authors therefore

highlighted the need for further studies using both qualitative methods and more diverse population samples.

An important contribution to the development of research on sustainable food consumption among Generation Z was also made by studies conducted in Central Europe. Jakubowska et al. [8] carried out a study in Poland on a sample of 438 Generation Z respondents, examining the determinants of purchase intentions toward sustainable food. The authors applied an extended Theory of Planned Behavior model that included variables such as attitudes toward sustainable food, consumer knowledge, health awareness and the level of trust in food products. The results indicated that the strongest predictors of purchase intention were attitudes toward sustainable food and consumer knowledge. By contrast, subjective norms, perceived behavioral control and health awareness did not show a significant effect on declared willingness to purchase. The authors pointed out that among young consumers health awareness alone did not necessarily translate into actual or even declared purchasing behavior. A further limitation of the study was its focus on purchase intentions rather than actual consumer behavior.

The concept of sustainable food consumption is also increasingly examined in relation to reducing meat intake and the growing adoption of plant-based diets. Raptou et al. [25] conducted a comparative study involving members of Generation Z in Greece, the United Kingdom and India. The aim of the study was to analyze the determinants of young consumers' willingness to adopt plant-based diets and to reduce the consumption of animal-derived products. The research model included such factors as the perceived health benefits of plant-based diets, attachment to animal protein, concerns about nutrient deficiencies, knowledge of healthy lifestyles and the level of engagement in meal preparation. The findings revealed the existence of two main consumer segments: supporters of plant-based diets and consumers skeptical about reducing animal-based products. The authors emphasized that attitudes toward plant-based diets were relatively similar across the countries studied, suggesting a certain degree of homogenization in food-related attitudes among young consumers. However, the study was limited by the use of snowball sampling and the overrepresentation of students in the sample.

The literature also increasingly addresses young consumers' attitudes toward emerging food technologies and alternative protein sources. In this context, particular attention has been given to foods containing edible insects, which are frequently identified as a potentially sustainable source of protein. Platta et al. [21] examined how the willingness of young consumers, specifically Generation Z students, to pay a higher price for foods containing edible insects relates to socio-demographic characteristics, gender, place of residence, field of study, and self-assessed economic situation, as well as to product attributes and the type of EI-based food. The findings showed that Polish

students' willingness to pay a higher price for foods that contain edible insects in hidden form, for example, finely milled into flours used as ingredients in familiar products, stems from the acceptance of foods with high nutritional and health value that are produced within sustainable food systems. Students at Polish universities express their concern for the environment in the context of food production with a reduced carbon footprint. Research conducted by Mikulec et al. [16] has shown that Polish students' decisions to consume insect-based foods are influenced by three main and independent categories of factors, health and environmental consciousness, sensory (organoleptic) qualities and dietary habits. It has also been confirmed that the greater the students' awareness of health and environmental issues is, the more likely they are to consider trying foods containing edible insects [15, 16, 17, 18, 19, 20]. Furthermore, previous studies have demonstrated that a positive attitude toward edible insects, as well as an intention to purchase insect-based products, is strongly correlated with students' declared willingness to consume them [17]. International research points to a range of additional moderating variables that influence consumers' attitudes toward insects. At the same time, the authors noted that the study sample consisted exclusively of students, which limits the extent to which the findings can be generalized to the wider population of young consumers.

The literature reviewed so far indicates that research on sustainable food consumption among Generation Z covers a broad spectrum of food categories, including local and seasonal food, organic products, plant-based diets, meat alternatives and new protein sources such as foods containing edible insects. At the same time, empirical findings point to substantial heterogeneity in the attitudes of young consumers and to a persistent gap between declared pro-environmental values and actual purchasing behavior. This suggests the need for further research that integrates segmentation approaches with the analysis of actual consumer practices and that more explicitly accounts for cultural differences among young consumers across different regions of the world.

An important complement to research on sustainable food consumption is provided by studies focusing on the acceptance of new protein sources, in particular products containing edible insects. The literature indicates that edible insects are characterized by high feed conversion efficiency, low water requirements and lower greenhouse gas emissions compared with conventional animal production, making them a potentially important component of sustainable food systems [31]. Consumer studies conducted in Europe and North America show, however, that the acceptance of insect-based products is strongly conditioned by psychological and cultural factors. Verbeke [32], in an analysis of consumer attitudes in Belgium, demonstrated that willingness to consume products containing insects was associated with an interest in sustainable food, curiosity toward novel food experiences and a higher level of food neophilia. At the same

time, disgust perception and the lack of prior experience with this type of food acted as major barriers to acceptance. Similar conclusions were reported by Hartmann and Siegrist [6], who examined the determinants of acceptance of new protein sources in Western Europe. They found that attitudes toward insect-based products were strongly related to the level of environmental awareness, health orientation and food neophobia. Their study also indicated that younger consumers displayed a higher level of acceptance of alternative protein sources than older consumers.

An important contribution to the development of research on the perception of insect-based products was also made by Tan et al. [30]. Their study examined consumer responses to different modes of presenting foods containing insects. The findings showed that acceptance was significantly higher for processed products in which insects were incorporated as an invisible ingredient than for products containing whole insects. These results point to the central importance of product form and of the way such products are framed in marketing communication. Similar conclusions were reported by Laureati et al. [11], who investigated the perception of insect-based foods among young consumers in Italy. They demonstrated that processed products, such as snacks or bakery items containing insect flour, were evaluated much more positively than products containing whole insects. The study also indicated that prior exposure to information about environmental benefits may increase the acceptance of such foods.

The literature increasingly emphasizes the role of pro-environmental attitudes and ethical values in shaping willingness to consume insect-based products. Mancini et al. [13], drawing on findings from studies conducted in different European countries, concluded that consumers with higher levels of environmental awareness were more likely to declare willingness to try foods containing insects. At the same time, they stressed that sensory factors, such as taste, smell and visual appearance, continue to play a decisive role in consumer decision-making. Similarly, Sogari et al. [27] and Menozzi et al. [14] found that younger consumers more often than older age groups declared an interest in products containing insects, although their actual willingness to consume them remained limited. The authors identified cultural factors, a lack of prior consumer experience and limited market availability as the main barriers to acceptance.

An important perspective on the development of research into insect-based food consumption is also provided by House [7]. He argued that the acceptance of insects as food in Western countries depends not only on consumer perceptions themselves, but also on the way these products are introduced to the market, including marketing communication strategies, consumer education and the extent to which new products are integrated into existing culinary patterns. Research by Lombardi et al. [12] further confirmed that younger consumers are more inclined to experiment with novel protein sources, including insect-based products, particularly when these products are presented as part of an innovative and sustainable diet.

An analysis of studies conducted across different geographical contexts points to the recurrence of segmentation patterns. In the study by Kamenidou et al. [9] conducted in Greece, segments were identified that differed in the extent to which sustainable food consumption practices were implemented, with behaviors requiring greater changes in habits, such as meat reduction, being less frequently adopted. In turn, Su et al. [29] in the United States showed that environmental awareness differentiates the perception of sustainable food attributes and the willingness to consume such products. Similar relationships can also be observed in Central Europe. Jakubowska et al. [8] demonstrated that attitudes and consumer knowledge are stronger predictors of purchase intention than social norms or perceived behavioral control. These findings highlight the limited explanatory power of classical behavioral models in accounting for Generation Z behavior. In the context of plant-based diets, Raptou et al. [25] identified two main segments, supporters and skeptics, with relatively small differences between countries, which suggests a partial homogenization of food-related attitudes among young consumers.

Including edible insects within this line of inquiry broadens the scope of the sustainable food consumption concept. The available evidence indicates that their acceptance depends on psychological factors, such as neophobia and disgust, cognitive factors, such as environmental awareness, and sensory factors, particularly product form. Of particular importance is the degree of product processing. Higher acceptance is consistently observed for formats in which insects are not visible [4, 11, 30].

Taken together, the studies conducted to date consistently show that the acceptance of insect-based food is determined by three broad groups of factors: (1) cognitive, including environmental and health awareness, (2) emotional, including disgust and anxiety, and (3) personality-related, including food neophobia and openness to innovation [6, 13, 14, 32].

In summary, the literature indicates that the concept of sustainable food consumption in research on Generation Z encompasses both traditional aspects of food choice, such as the purchase of local, organic or plant-based food, and the acceptance of new protein sources, including products containing edible insects. At the same time, empirical findings show that despite the growing environmental awareness of young consumers, the acceptance of such products remains differentiated and depends on a wide range of psychological, cultural and market-related factors. This points to the need for further research integrating the analysis of consumer attitudes, sensory determinants and marketing communication strategies in the context of developing sustainable food systems.

Consumer Segmentation in Edible Insect Research (CSEIR)

Consumer segmentation is one of the principal analytical tools used in research on the acceptance of foods containing edible insects. The literature is dominated by two complementary approaches: psychographic and behavioral segmentation. Psychographic segmentation focuses on consumers' internal characteristics, such as values, lifestyle, attitudes, beliefs and the level of food neophobia [2, 3, 14, 19, 22, 28, 29, 32, 33]. Behavioral segmentation, in turn, refers to observable actions, such as willingness to pay, purchase intention or actual food choices [3, 14, 22, 23, 28, 30, 32, 34]. In studies on sustainable food consumption and the acceptance of edible insects, these two approaches are usually combined. In empirical practice, however, the psychographic dimension clearly prevails, largely due to the limited availability of behavioral data and the market for these products, which is still at an early stage of development.

From an analytical perspective, segmentation is particularly well justified in this field because aggregated descriptions of consumer attitudes tend to oversimplify the phenomenon. This is especially relevant in the case of Generation Z, which is often portrayed in the literature as a relatively pro-environmental cohort, but in reality is internally differentiated in terms of its willingness to accept new protein sources. As a result, segmentation studies in this area focus not only on identifying the levels of acceptance, but also on recognizing distinct configurations of motivations, barriers and product evaluation patterns.

A review of international studies indicates a relatively high degree of consistency in segmentation structures despite methodological differences. In the study by Verbeke [32], conducted in Belgium, the segments of potential adopters, cautious consumers and resistant consumers were identified, with food neophobia, pro-environmental orientation and willingness to replace meat with an alternative protein source emerging as the key differentiating factors. This finding extends beyond a single national context, as it suggests that the acceptance of insects is not a simple function of declared support for sustainable food, but rather the result of the coexistence of openness to innovation, reduced disgust and readiness to modify dietary habits. At the same time, the study is limited by its reliance on self-reported behavioral measures and by its focus on a single national market.

A comparable pattern was reported by Hartmann and Siegrist [6], who analyzed consumers in Switzerland and Germany. The authors identified eco-oriented, pragmatic and skeptical segments, showing that these groups differed not only in their level of acceptance of novel protein sources, but also in the way they perceived risk and health-related benefits. Compared with the Belgian study, this analysis placed stronger emphasis on the role of risk perception, suggesting that segmentation in entomophagy research has not only an evaluative dimension, but also a cognitive one. At the same

time, the lack of data on actual purchasing behavior limits the possibility of assessing whether declared acceptance translates into real market adoption.

Studies focusing directly on Generation Z consistently point to the key role of environmental awareness, although its explanatory power is not absolute. Su et al. [29], analyzing young consumers in the United States, distinguished the segments of sustainable activists, sustainable believers and sustainable moderates. The highest willingness to accept alternative protein sources was observed among respondents with the highest level of environmental awareness, which confirms the importance of this dimension in the segmentation of young consumers. At the same time, the limited representativeness of the sample reduces the extent to which these findings can be generalized to the wider Generation Z population. In turn, Menozzi et al. [14], drawing on the Theory of Planned Behavior in the Italian context, demonstrated that segments differing in their level of consumption intention were shaped by attitudes, social norms and perceived behavioral control. Taken together, these two studies show that although environmental and normative variables may serve as meaningful segmentation dimensions, their importance depends on the theoretical framework adopted and on the way the acceptance construct is operationalized.

A similar line of interpretation emerges in studies conducted outside Europe. Sogari et al. [28], analyzing consumers in Australia, identified the segments of enthusiasts, neutral consumers and rejecters. Their segmentation was based on knowledge, attitudes and openness to innovation, and the findings suggest that education and informational exposure may increase the acceptance of insect-based food. This conclusion should, however, be interpreted with caution, as the small and non-representative sample limits the strength of generalization. The study is therefore important primarily as the confirmation of the direction of the observed relationships, rather than as the conclusive evidence of their stability. A similar pattern was observed in studies involving Generation Z consumers in Poland. Platta et al. and Mikulec et al. [15, 16, 17, 18, 19, 20] demonstrated that segments characterized by higher levels of health and environmental awareness showed greater willingness to consume insect-based food. This finding is consistent with results reported in American and Western European studies, although the limitation associated with the use of a student sample must again be acknowledged. This issue is far from marginal. In entomophagy research, the overrepresentation of students creates a risk of overestimating declared openness and underestimating the market barriers present in the general population.

A different, yet complementary, dimension of segmentation was presented by Lombardi et al. [12], who focused on willingness to pay and emotional responses to the product. Their findings showed that consumer segments differ not only in terms of the level of acceptance, but also in their responsiveness to marketing and informational communication. From the perspective of a cross-study synthesis, this means that seg-

mentation in research on insect-based food should not be reduced solely to attitudes toward the product itself, but should also take into account the way benefits are presented, the nature of information provided and strategies aimed at reducing negative emotional reactions.

This interpretation is further reinforced by cross-cultural research. Comparing studies conducted in the Netherlands and Thailand, Tan et al. [30] showed that cultural experience with entomophagy significantly affects both segment structure and the strength of psychological barriers. In countries where insect consumption is embedded in culinary tradition, the level of acceptance is higher, whereas the role of disgust and neophobia is lower. This conclusion is methodologically important, as it suggests that segmentation should not be treated as a culturally universal tool without appropriate contextual adaptation. At the same time, the study remains limited by the small number of countries compared, which does not allow for full generalization of the findings on a global scale.

Price, willingness to pay and economic barriers should be regarded as key determinants of Generation Z consumers' willingness to consume sustainable food containing edible insects. Among Generation Z consumers, environmental awareness is not sufficient for product acceptance if price, availability, taste, safety and convenience do not create a compelling market value. In Germany, the price barrier is evident even among early adopters, whereas in Poland, acceptance depends on the combined fulfilment of functional, environmental and economic expectations [12, 17, 18, 19, 20, 21, 22, 23].

In light of the synthesis conducted, it may be concluded that the segmentation approach in research on consumers of sustainable food containing edible insects has substantial analytical value, although its full potential has not yet been realized. On the one hand, the literature consistently indicates the importance of psychographic variables, especially environmental awareness, food neophobia, health orientation and openness to innovation. On the other hand, most studies rely on self-reported data and non-representative samples, which limits generalizability and increases the risk of overestimating consumption intentions. In this sense, the cross-study analysis leads to a two-fold conclusion. First, a relatively high degree of consistency has been achieved in identifying the main segmentation determinants and the most typical consumer profiles. Second, this consistency should not be equated with the full methodological maturity of the field. The lack of standardization in the operationalization of key variables, the limited comparability of measurement tools and the dominance of cross-sectional studies all weaken the possibility of building cumulative knowledge. For this reason, consumer segmentation in the context of entomophagy remains a promising, but still methodologically fragmented, area of research.

Table 1. Cross-study synthesis of young consumers segmentation in edible insects food research

Author (year)	Country	Sample size (n)	Method	Segments (number and names)	Key determinants of segmentation	Key findings	Limitations of the study	Contribution to the synthesis
Verbeke (2015) [32]	Belgium	368	Binary logistic regression modeling	3 segments: innovators, cautious, rejectors	Food neophobia, interest in sustainability, convenience and a willingness to replace meat	Acceptance stems from a mindset of openness and a reduction in disgust	Single country	Benchmark for subsequent 3-segment typologies
Tan et al. (2015) [30]	Netherlands vs Thailand	79 vs 81	Focus group interviews	2 profiles: high vs. low acceptance depending on context	Cultural experience, visibility of insects	Culture breaks down psychological barriers and reshapes market segments	Small sample	It confirms that segmentation depends on the culture and the nature of the product
Menozzi et al. (2017) [14]	Italy	231	Theory of Planned Behavior (TPB)	2 segments: high vs. low intent segments	Attitudes, social norms, behavioral control	The significance of the determinants depends on the theoretical framework (TPB)	No behavior data	This reinforces the view that segmentation is dependent on the theoretical framework
Sogari et al. (2019) [28]	Australia	555	Qualitative studies	2 segments: health and environment conscious vs. climate change denier	Taste experiences, psychological, health, environmental and marketing factors	Education increases acceptance, but the effect is limited by methodological constraints	No behavior data	This confirms the importance of knowledge as a segmenting variable

Su et al. (2019) [29]	USA	812	Cluster analysis	3 segments: sustainable activists, sustainable believers, sustainable moderates	Degree of ecological awareness, the importance of the perception of sustainable food attributes, food choices associated with healthy eating habits, sociodemographics	Environmental protection and health-related product features strongly differentiate the segments	Sample with no ethnic diversity	Key contribution to segmentation within Generation Z
Brunner and Nuttavuthisit (2020) [3]	Switzerland vs Thailand	542 vs 500	Hierarchical cluster analysis	4 segments: early adopters, early majority, late majority and laggards	Food neophobia, product type, experience, culture	The structure of segments is not culturally universal; consumers in countries with an entomophagy tradition behave quite differently from those without one	Non-representative sample	This reinforces the argument that segmentation is not universal
Verneau et al. (2020) [33]	Italy and Denmark	150 vs 150	Hierarchical cluster analysis	5 segments: rational, adventurous, careless, conservative, uninvolved	Food Related Lifestyle Scale (FRLS)	Food-focused lifestyle strengthens or weakens consumption intentions	Non-representative sample	It introduces segmentation based on food-focused lifestyle rather than only attitudes
Bisconsin-Júnior et al. (2022) [2]	Brazil	780	Hierarchical cluster analysis	3 segments: low risk and a positive attitude, medium risk and a neutral attitude, high risk and a negative attitude	Risk perception, disgust, sociodemographic characteristics	Risk perception structures segments more than values	Non-representative sample	It reinforces the role of emotional and cognitive determinants

Platta et al. (2024a) [19]	Poland	749	Cluster analysis	3 segments: high purchase intent, moderate purchase intent, low purchase intent	Concern for the environment, attitudes and motivations regarding the purchase of edible insects	The willingness to buy food containing insects is driven by concern for the environment	Students only	An important contribution to the direct analysis of Generation Z in Poland
Puteri et al. (2024) [23]	Germany	922	Cluster analysis	4 segments: reluctant buyers, all-claims enthusiasts, budget-conscious “naturals”, value-oriented sceptics	Product type, product attributes, price, sensory	Segments require precise targeting	Adopters only	Enhances the usefulness of segmentation for market targeting
Platta et al. (2025b) [22]	Poland	749	Hierarchical cluster analysis	4 segments: conscious enthusiasts, quality-oriented pragmatists, sceptics and disengaged	Food neophobia, concern for food safety, concern for environmental sustainability and product attributes (taste, aroma, health and nutrition claims)	Acceptance requires meeting many expectations simultaneously	Students only	It reinforces the practical aspects of segmentation: product attributes, sustainability and food safety
Ranga et al. (2025) [24]	Greece vs Ireland	283 vs 206	Qualitative studies	2 segments: higher vs. lower readiness	Taste, price, Food neophobia, safety, insect visibility	Cross-cultural differences modify the size of segments	Non-representative sample	It confirms that the segments are typologically stable but contextually variable

From the perspective of future research, three directions appear particularly important. First, longitudinal studies are needed to assess the stability of segments over time. Second, psychographic segmentation should be more strongly linked to actual purchasing behavior. Third, the development of cross-cultural research should rely on more comparable measurement instruments. Only under these conditions will it be possible to move from useful, but still partly exploratory, typologies toward more robust models of consumer segmentation in the field of edible insect-based food.

To systematize the findings of the empirical studies and enable their direct comparison, a cross-study synthesis table was developed (Table 1). This table includes selected studies meeting the criteria of analytical comparability and presents them according to a uniform framework covering the basis of segmentation, segment structure, key determinants, main findings and contribution to the synthesis. The table serves as a tool for integrating research findings, rather than merely listing them, and makes it possible to identify recurring segmentation patterns at the international level.

The cross-study synthesis presented in Table 1 indicates a high degree of consistency across findings despite considerable methodological and geographical variation. Regardless of the segmentation approach applied, the literature consistently identifies three overarching consumer profiles: eco-oriented innovators, pragmatic accepters and skeptical rejecters. Differences between these segments are shaped primarily by the level of food neophobia, risk perception and the importance attributed to environmental and health-related benefits. At the comparative level, the literature reveals a notable convergence of results. Across European and Australian studies, the same three broad profiles are repeatedly identified: eco-oriented innovators, pragmatic accepters and skeptical rejecters [6, 28, 32]. The distinctions between these segments arise mainly from differences in neophobia, risk perception, the importance attached to environmental and health benefits and the willingness to experiment with novel foods. This convergence is analytically significant because it suggests that, despite differences in segmentation methods, ranging from classical cluster analysis and TPB-based models to studies focused on willingness to pay, researchers continue to identify consumer types characterized by recurrent configurations of traits.

At the same time, the comparative analysis shows that segment structure is not universal, but rather moderated by cultural context, consumer experience and product form. In particular, the visibility of insects and perceptions of product quality, especially safety and taste, play a role that is at least as important as value-based determinants. This means that segmentation in entomophagy research should be interpreted as the outcome of interactions among psychographic, cognitive and contextual factors, rather than as a stable typology independent of market conditions.

To date, the literature on sustainable food consumption and the literature on entomophagy have developed largely in parallel. The former has focused on pro-

environmental purchasing practices, meat reduction and plant-based diets, whereas the latter has concentrated on the acceptance of insects as a novel protein source. As a result, the relationship between these two research fields has remained only partially specified. This manuscript contributes by integrating them and by showing that willingness to consume foods containing edible insects is not a separate sustainability issue, but rather a specific case of sustainable food innovation in which environmental, health-related, emotional, cultural, product-related and sensory factors intersect.

The second contribution of the manuscript is its systematizing role. The synthesis of the SFC and CSEIR sections shows that dispersed findings can be organized within a common explanatory architecture. Regardless of whether the studies were grounded in the Theory of Planned Behavior, psychographic segmentation, risk analysis or product attribute research, the same groups of determinants recur: cognitive, emotional, personality-related and contextual ones. This suggests that the literature has reached a greater level of conceptual consistency than might be expected from its methodological pluralism. The contribution of the present study therefore lies not only in bringing together existing findings, but also in revealing the common mechanism that generates differentiated profiles of acceptance.

The third contribution concerns the reinterpretation of the attitude-behavior gap. In the current state of research, this gap is usually described in general terms as a discrepancy between declared environmental awareness and actual purchasing practices. However, the synthesis conducted here suggests that this gap is not uniform across the entire Generation Z cohort, but is rather segment-dependent. Among eco-oriented innovators, declared values are more likely to be reflected in willingness to try new protein sources. Among pragmatic accepters, pro-environmental values are filtered through considerations of taste, price, safety and convenience. Among skeptical rejecters, declarations have little real influence on behavior, as emotional and cultural barriers outweigh environmental motives. In this way, the manuscript shifts the interpretation of the attitude-behavior gap from the level of a general observation to that of a segmentation-based mechanism.

The fourth contribution lies in clarifying the status of segmentation as a theoretical tool, rather than merely an analytical technique. In a large part of the previous literature, segmentation functioned primarily as a classification procedure used to describe the market. The joint reading of the SFC and CSEIR sections suggests, however, that segments are not arbitrary statistical groupings, but rather represent relatively stable configurations of decision-making mechanisms. In this sense, segmentation may be elevated to the level of a middle-range explanatory model, showing how cognitive, emotional and contextual determinants jointly shape differentiated profiles of the acceptance of sustainable food containing edible insects. This shift is theoretically important because it makes it possible to develop a formal model integrating two research

fields that have so far remained only partly connected, namely sustainable food consumption research and research on the acceptance of entomophagy.

Finally, the review contributes by demonstrating that product form and cultural context are not merely additional variables, but structural conditions. The SFC section shows that insect visibility, the degree of product processing and market and cultural familiarity with the category modify the strength of psychographic determinants. The CSEIR section, in turn, indicates that without taking these conditions into account, segmentation has only limited comparative value. Accordingly, the theoretical contribution of this study lies in incorporating product-related and cultural factors into the core of the explanatory model, rather than leaving them at the level of background variables.

Formal theoretical model

Based on the synthesis conducted, a formal theoretical model can be proposed to explain Generation Z consumers' willingness to consume sustainable food containing edible insects (Figure 1). The model is integrative in nature and comprises four levels: primary determinants, evaluative mechanisms, consumer segments and behavioral outcomes.

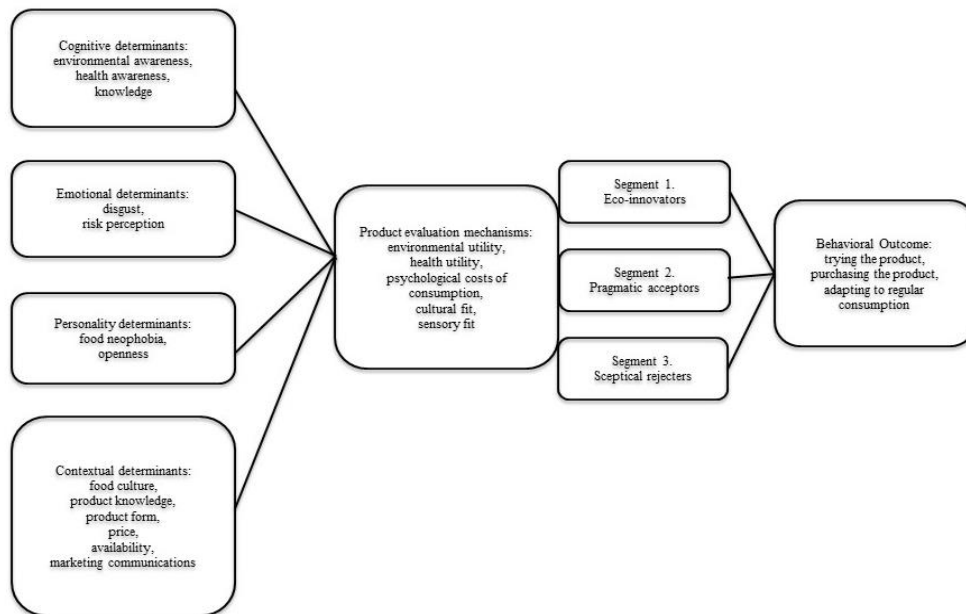


Figure 1. Theoretical model explaining Generation Z consumers' willingness to consume sustainable food containing edible insects

The first level consists of primary determinants, which the literature identifies as relatively stable sources of variation between consumers. Cognitive determinants include environmental awareness, health awareness and the knowledge of sustainable food. Emotional determinants include disgust, anxiety and risk perception. Personality-related determinants include food neophobia, food neophilia and openness to innovation. Contextual determinants include food culture, product familiarity, product form, insect visibility, price, availability and marketing communication.

These primary determinants do not affect behavior directly, but are instead filtered through product evaluation mechanisms (Level II). At this stage, consumers make a parallel assessment of: (1) the product's environmental utility, (2) its health-related and functional utility, (3) the psychological cost of consumption and (4) its cultural and sensory fit [theoretical thesis T1 – T3]. It is precisely at this level that the tension emerges between declared support for sustainability and resistance to the product itself. The model therefore assumes that environmental awareness alone does not generate acceptance if the product receives a low evaluation in terms of safety, taste or cultural fit. This assumption is directly consistent with the findings presented in the SFC and CSEIR sections.

In the proposed theoretical model, the central role is assigned to psychological evaluation mechanisms, which mediate between consumers' individual characteristics and their willingness to consume sustainable food containing edible insects. This assumption is supported by the literature on novel food acceptance, according to which consumer decisions regarding products perceived as new or unusual result from the simultaneous interaction of cognitive, emotional and personality processes [6, 32]. Research indicates that environmental awareness, the knowledge of sustainable food and perceived health benefits influence the assessment of the utility of insect-based products; however, their impact is not direct. Consumers first assess the potential benefits and psychological costs associated with consuming such food [8, 29]. At the same time, the literature consistently indicates that the acceptance of insect-based products is limited by emotional reactions, primarily disgust, uncertainty and perceived risk [2, 13, 30]. Personality traits also play a significant role, particularly food neophobia and openness to new food experiences. Consumers with higher openness are more likely to perceive insect-based products as an attractive protein alternative, whilst those with high neophobia tend to focus more on the potential risks and negative aspects of the product [6, 19, 32]. Furthermore, treating psychological assessment mechanisms as a mediating variable is consistent with the findings of segmentation studies. Analyses conducted in various countries indicate that consumers differ not only in terms of their level of environmental awareness or knowledge, but above all, in the way they interpret and evaluate new sources of protein [3, 23, 24]. This implies that the psychologi-

cal evaluation process serves as a mechanism explaining the transition from individual predictors to specific consumer segments and to declared consumption readiness.

The literature on the acceptance of novel foods indicates that willingness to consume foods containing edible insects does not stem directly from knowledge, environmental awareness or personality traits. These factors first influence the psychological evaluation of the product, which encompasses the perception of benefits, risks and emotional costs. It is this evaluation process that constitutes the key mechanism leading to the emergence of specific consumer segments and differences in the level of acceptance of foods containing insects [6, 29, 32].

The third level of the model is formed by consumer segments, understood not merely as statistical classes, but as the configurations of decision-making mechanisms [theoretical theses T4 and T5]. Based on the synthesis, three overarching segments can be distinguished:

- (1) Eco-oriented innovators. This segment is characterized by high environmental awareness, relatively low neophobia, high openness to innovation and lower importance attached to sensory barriers.
- (2) Pragmatic accepters. This segment is characterized by a moderate environmental orientation, a significant role of price, taste, safety and convenience, and a conditional form of acceptance that depends on product characteristics, especially product form.
- (3) Skeptical rejecters. This segment is characterized by high neophobia and/or high risk perception, strong disgust, a low level of cultural fit with the product and weak translation of declared environmental values into behavior.

The fourth level concerns behavioral outcomes, understood as the willingness to try the product, purchase it and incorporate it into repeated consumption. The model assumes that the transition from declarative acceptance to actual behavior is segment-dependent [theoretical thesis T6]. In other words, intention does not have the same predictive value in every segment. Among eco-oriented innovators, it may serve as a relatively strong predictor of trial and purchase. In skeptical rejecters, by contrast, intention remains a weak predictor of actual behavior.

One of the significant limitations of the literature reviewed is the clear predominance of studies conducted in Europe, primarily in Belgium, Germany, Italy, Poland, the Netherlands, Denmark, Greece and Switzerland [12, 14, 16, 17, 19, 24, 30, 32]. This means that most of the available knowledge on the segmentation of consumers of insect-based foods has been generated within a cultural context where entomophagy is not part of traditional dietary practices.

The predominance of European research may influence the segmental structures identified. In countries with a history of low exposure to entomophagy, the acceptance of insect-based foods is strongly determined by psychological factors such as food neophobia, disgust, risk perception and a lack of prior consumption experience [6, 13,

32]. Consequently, most of the segments identified in European studies are differentiated primarily by the degree of openness to food innovation and the level of perceived risk.

The situation is different in societies with a high level of cultural exposure to insect consumption. Comparative research conducted by Tan et al. [30] in the Netherlands and Thailand showed that prior cultural experience significantly reduces the impact of psychological barriers. In the contexts where insect consumption is socially accepted and culturally ingrained, consumer segmentation may be determined to a greater extent by product characteristics, sensory preferences, price or the convenience of use than by the acceptance of the idea of entomophagy itself. Similar conclusions emerge from the research by Brunner and Nuttavuthisita [3], who demonstrated that the structure of consumer segments differs between Switzerland and Thailand despite the use of the same segmentation procedure.

This means that the segments repeatedly identified in the literature, such as ‘pro-environmental innovators’, ‘pragmatic acceptors’ and ‘sceptical rejecters’, may primarily reflect the specific characteristics of Western markets with low exposure to entomophagy. Generalizing these segmentation structures to Asian, African or Latin American populations should therefore be done with caution. In these regions, the determinants of segmentation may take on a different configuration, and the relative importance of neophobia, disgust or social norms may be significantly lower than in Europe.

Consequently, the findings of this review should be interpreted primarily as a synthesis of knowledge concerning markets with low or moderate exposure to entomophagy. One of the most important areas for further research should be to increase the number of cross-cultural analyses covering countries representing different levels of historical and social acceptance of insect consumption. Such an approach will allow us to verify whether the segment typologies currently observed are universal in nature or specific to Western food systems.

In the literature review conducted, attention should be drawn to the predominance of studies based on student samples. This phenomenon is particularly evident in research on Generation Z and the acceptance of foods containing edible insects, where students constitute the most frequently studied group of respondents [9, 16, 17, 19, 28]. The predominance of student samples affects the extent to which the results can be generalized. On average, students have a higher level of education, greater exposure to new ideas related to sustainable development, greater environmental awareness and are more open to food innovations than the general population of young consumers [9, 19]. Consequently, the level of reported acceptance of insect-based foods observed in many studies may be overestimated relative to the Generation Z population as a whole. At the same time, it should be noted that this limitation applies to a significant propor-

tion of the current literature on entomophagy, and not solely to the studies included in this review. The publications analyzed consistently point to the need to extend future research to more diverse populations of young consumers, including those in employment, residents of rural and urban areas, respondents with varying income levels and those not in higher education [10, 13, 32].

Consequently, the findings of this review should be interpreted primarily as a synthesis of knowledge concerning young, relatively well-educated consumers, who constitute an important but not fully representative segment of Generation Z. This limits the possibility of fully generalizing the identified segments to the entire population of young consumers and points to the need for further research using samples that are more representative in socio-demographic terms.

Conclusions

1. The present study constitutes a segmentation-based synthesis focused on identifying recurring consumer segment structures reported in entomophagy research. The cross-study analysis indicates that, despite differences in segmentation methods, including cluster analysis, latent class models and approaches grounded in the Theory of Planned Behavior, the literature consistently identifies similar consumer typologies that differ in the levels of acceptance, motivations and consumption barriers, namely eco-oriented innovators, pragmatic accepters and skeptical rejecters. The contribution of the study therefore lies in systematizing these typologies and integrating them within a comparative global perspective.
2. The review also serves as a conceptual framework for further empirical analyses. Based on the synthesis conducted, the key groups of determinants shaping consumer behavior were identified, namely cognitive factors such as environmental awareness and knowledge, emotional factors such as disgust, anxiety and risk perception, personality-related factors such as neophobia and openness to innovation, and contextual factors such as food culture, product knowledge, product form, price, availability and marketing communications. Integrating these variables within a single analytical perspective provides a foundation for the development of research models based on the SEM approach and for the further operationalization of variables in quantitative studies.
3. The synthesis and critical analysis of the literature point to several important research gaps. Despite the widespread use of segmentation, these approaches are characterized by substantial methodological limitations. Most studies rely on self-reported data and non-representative samples, which restricts the generalizability of the findings. In addition, the lack of standardization in variables and segmentation methods makes it difficult to compare results across studies. The limited number of longitudinal studies also prevents the assessment of changes in consumer at-

- titudes over time. It was further identified that cross-cultural analyses remain underdeveloped, particularly those involving countries with different food traditions.
4. The review demonstrates the need to integrate self-reported data with actual consumer behavior. Future research should also focus on combining psychographic approaches with the analysis of real market choices and on taking into account the role of marketing communication strategies in shaping the acceptance of new food products.

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SEGMENTY KONSUMENTÓW GENERACJI Z ZRÓWNOWAŻONEJ ŻYWNOŚCI Z OWADAMI JADALNYMI: INTEGRACYJNY I PORÓWNAWCZY PRZEGLĄD LITERATURY

S u m m a r y

Wprowadzenie: Celem opracowania jest syntetyczna i krytyczna analiza literatury dotyczącej segmentacji konsumentów Generacji Z w kontekście gotowości do konsumpcji zrównoważonej żywności zawierającej jadalne owady. Zastosowano przegląd integracyjny obejmujący publikacje z lat 2015 ÷ 2025 indeksowane w bazach Scopus, Web of Science, EBSCO oraz BazEkon. Analiza objęła badania ilościowe, jakościowe oraz eksperymentalne dotyczące zrównoważonej konsumpcji żywności z owadami i segmentacji konsumentów. Synteza wyników została przeprowadzona w logice porównawczej, z uwzględnieniem podejść psychograficznych i behawioralnych.

Wyniki i wnioski: Wyniki wskazują na wysoką deklaratywną orientację prośrodowiskową Generacji Z, której nie towarzyszy pełna implementacja w zachowaniach konsumenckich. Analiza międzybadawcza ujawnia powtarzalność struktur segmentacyjnych, niezależnie od kontekstu geograficznego i metodologii. Dominacja danych deklaracyjnych, częste wykorzystanie prób niereprezentatywnych oraz brak standaryzacji zmiennych ograniczają porównywalność wyników i możliwość generalizacji. Przekrojowy charakter większości badań uniemożliwia ocenę stabilności segmentów w czasie. Wyniki wskazują na potrzebę badań długookresowych, międzykulturowych oraz integrujących dane deklaratywne z rzeczywistymi zachowaniami konsumenckimi. Ponadto, stwierdzono konieczność dostosowania komunikacji do poziomu neofobii oraz percepcji ryzyka, a także preferowania form produktowych minimalizujących widoczność owadów. Opracowanie wnosi wkład poprzez integrację rozproszonych wyników badań oraz ich syntezę segmentacyjną. Identyfikuje powtarzalne typologie konsumentów oraz porządkuje determinanty akceptacji zrównoważonej żywności z jadalnymi owadami, tworząc podstawę dla dalszych modeli badawczych.

Słowa kluczowe: badania segmentacyjne, synteza międzybadawcza, ograniczenia metodologiczne, zrównoważony rozwój, młodzi konsumenci ☒