

# Processed foods from the consumer's perspective

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## Abstract

The various systems for classifying processed foods attempt to assess the nutritional quality of foods based on their degree of processing, but no system yet exists that takes all the different aspects into account. Consumer perception of processed foods is an important aspect to take into consideration because it is consumers who decide whether to purchase or eat these foods. This preliminary study surveyed consumers to investigate what they look for when shopping for food, what is important to them in processed food and what characteristics they associate with processed food. The study discusses the extent to which indicators used in the IARC, NOVA, SIGA, IFIC and UNC classification systems correspond to the attitudes of the consumers surveyed towards processed foods.

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## Introduction

Food processing makes access to safe, affordable and tasty food possible all year round [1]. Achieving these quality criteria requires a wide range of technologies and processing methods that have different effects on the food – altering it to varying degrees, from slightly to drastically [2–3]. The result of this is that the nutritional quality of an unprocessed product often differs from its processed counterpart. The effects of processing can be nutritionally beneficial or detrimental [2]. On the one hand, processing can increase the digestibility of food components and also increase the bioavailability of nutrients. On the other hand, processing can decrease nutrient content [4]. Furthermore, the application of heat can produce harmful compounds such as acrylamide or heterocyclic amines [4–5].

Numerous studies have indicated that high intake of highly processed foods is associated with an increased risk of various diseases such as metabolic syndrome, cardiovascular disease and all-cause mortality [6–7]. For this reason, various classification systems have been developed in recent years in an attempt to assess the nutritional quality of processed foods. Despite these efforts, classification is still the subject of scientific debate and there is currently no generally recognized system.

The extent to which these classification systems take consumer perceptions into account is unclear. Consumer perception is however crucial, since the decision to purchase or consume lies with the consumer. Studies have shown that consumers perceive highly processed foods as being less beneficial to health than minimally processed products [8–9]. This means it is particularly important to take a differentiated view of the degree of food processing and the associated possible effects on health [6–7]. For consumers, the use of additives is particularly important. In a study by Zugravu et al. (2017), 75% of survey respondents were against the use of additives and were willing to pay more for products without additives [10]. Broadly speaking, many consumers have a preference for more natural products, but this preference is often based on beliefs rather than rational facts [11].

Consumers primarily associate “naturalness” with the absence of ingredients that they have a negative perception of, rather than with the presence of natural raw ingredients [12]. Consumers value minimal processing and the absence of additives [12–13]. However, there have been varying assessments of the extent to which consumers pay attention to additives when shopping for food. In a 2017 study, 67.2% of participants stated that they paid attention to additives in the ingredients list [10]. In contrast, in a 2023 study, only 13% of respondents stated that they paid attention to the ingredients list when buying processed food [14].



Classification system	Number of processing steps	Type of processing method	Number of ingredients	Convenience level	Use of additives	Percentage (%) of foods with the highest level of processing according to [16]
IARC – Europe	3					47.4
IFIC – USA	5					17.7
UNC – USA	7					15.2
SIGA – France	10					–
NOVA – Brazil	4					10.2

Table 1: Comparison of classification systems for food processing based on Behnilian et al., 2023, p 25 [2] and Araújo et al., 2022, p 9 [16]

■ sometimes mentioned; ■ taken into account; ■ decisive criterion; – no mention

Therefore, the preliminary study presented here uses a random sample to investigate which characteristics consumers associate with processed foods, what they look for when buying these products and what is important to them. This approach is intended to enable initial conclusions to be drawn about which determinants could influence consumer perceptions of processed foods.

### Categorization of processed foods

Classification systems for processed foods divide them into various categories [2], however the various systems use different methods that take different factors into account (for an overview see ♦ Table 1). These factors may include the type, purpose, degree and location of processing [15–16]. A study by de Araújo et al. compared five classification systems: IARC, NOVA, IFPRI, IFIC and UNC. Foods were assigned to the various processing steps of the different systems. The IARC system classified 47.4% of the foods as belonging to the highest level of processing, whereas only 10.2% of the foods fell into this category according to the NOVA classification [16]. This illustrates how much the systems differ in their assessment of processed foods and indicates that each system has its weaknesses.

### Definition of processed foods

In order to categorize processed foods, it is first necessary to define what a processed food is. The first step is to define what constitutes an unprocessed food. According to Regulation 852/2004, “unprocessed products means foodstuffs that have not undergone processing, and includes products that have been divided, parted, severed, sliced, boned, minced, skinned, ground, cut, cleaned, trimmed, husked, milled, chilled, frozen, deep-frozen or thawed” [17]. According to this definition, the original raw product may be altered in some way without being considered processed. Poti et al. (2015) provide a different definition. According to them, food processing is “any process that alters the natural state of food, e.g., freezing, drying, grinding, preserving or mixing, or adding salt, sugar, fat or additives” [18]. Therefore, there is no standardized approach to categorizing a foodstuff as processed or unprocessed, and categorization is based on different points of view. In addition to technical and nutritional considerations, consumer perception should also be taken into account, since consumer perception is a key factor in the decision to purchase processed foods, which means it is key to processed food intake.

### Study question

This preliminary study focuses on consumer perceptions of processed foods. It investigates three research questions:

- What characteristics do the consumers surveyed associate with processed food?
- What aspects of processed food do consumers pay attention to when buying it?
- What other aspects of food are important to them when shopping for food?

The results will be used to discuss the extent to which the various classification systems take account of the perceptions of the consumers surveyed.

## Methodology

### Data collection and survey

Based on the NOVA, IFIC and UNC, SIGA and IARC classification systems, indicators were identified according to which processed foods can be categorized.

These were

- the type of processing method and
- the degree of processing (determined based on the number of processing steps, the number of ingredients and additives and the convenience level).

A questionnaire was then developed to measure the extent to which the consumers associate these indicators with processed foods. The method for deriving the items from the indicators is shown in ♦ Table 2. A five-point Likert scale was used to assess how important these indicators were and how much attention consumers paid to them when shopping for food. The clarity and completeness of the questionnaire were checked in a pre-test with 4 participants. The questionnaire took five to ten minutes to complete. An empirical survey



was conducted as part of a preliminary study with consumers in the form of an online survey. The survey was conducted from 3 May 2023 to 17 May 2023 using the LimeSurvey program. As the present study is a preliminary study, which serves to test and improve the questionnaire design and to obtain an initial assessment of consumer perception, the access link was distributed using the snowball sampling method, since there was no need for a representative sample.

### Statistical evaluation

The data were evaluated using the SPSS 28.0 software. The importance attributed to each aspect and the attention paid to it were determined using frequency analyses. Correlations were calculated to iden-

tify associations between the indicators. Since the data were ordinal scaled data, the Spearman correlation coefficient was used.

## Results

### Description of sample

Incomplete questionnaires were excluded from the evaluation. The sample size was  $n = 186$  participants. The minimum age for participation was 18 years. ♦ Table 3 shows

Determinant in the categorization system	Items		Justification
Number of processing steps	Several processing steps	Question 1	All classification systems divide food into different levels of processing, and this is the main focus of these systems. The study investigates the importance of multi-stage processing for the consumers surveyed and whether this is considered a characteristic feature of processed food.
	It is important to me that a processed food has undergone as few processing steps as possible.	Question 3	
Type of processing method	When I buy food, I pay attention to the type of processing used to make it.	Question 2	This item is intended to determine the extent to which the determinant "type of processing method", which most classification systems take into account, is also taken into account by consumers.
Number of ingredients	I pay attention to the ingredients list when I buy food.	Question 2	The attention paid to the ingredients list is determined in order to assess the attitude-behavior gap. The importance attached to this was recorded to assess attitudes and the attention paid to it to assess behavior. Both aspects are compared in the analysis. The item "Importance of the number of ingredients" is intended to show the importance of the determinant "number of ingredients".
	It is important to me that a processed food has as few processing ingredients as possible.	Question 3	
Convenience level	Ready-to-eat food	Question 1	Ready-to-eat food has usually undergone some form of processing, which is why the determinant "Convenience level" was recorded as a characteristic.
	It is important to me that a processed food has the highest possible convenience level.	Question 3	The item is intended to identify how the importance attached to a high convenience level is assessed.
Use of additives	High/low number of additives	Question 1	This item is intended to identify the extent to which the determinant "Use of additives", which is taken into account in three classification systems, is considered a characteristic of processed foods by the consumers surveyed. Participants were asked about both sides of this characteristic to identify the direction.
	When I buy food, I pay attention to whether additives have been used.	Question 2	The attention paid to additives and the importance attached to them was recorded in order to determine their significance and the attitude-behavior gap. The importance attached to this was recorded to assess attitudes and the attention paid to it to assess behavior. Both aspects are compared in the analysis.
	It is important to me that the number of additives is as low as possible.	Question 3	
Determinant not included in the categorization systems	Long/short shelf life	Question 1	Although shelf life is not explicitly mentioned in the various categorization systems, it is an important consideration when shopping for food [19]. Some processed foods such as to-go products have a short shelf life, whereas others, such as canned foods, have a long shelf life. Since the focus is on what consumers primarily associate with processed foods, the consumers were asked about both sides of this (long and short shelf life).

Table 2: Derivation of the items from the determinants in the categorization systems (see ♦ Table 1)



the sociodemographic data. This sample differs from the German population as a whole based on the sociodemographic data recorded.

### What the consumers surveyed associate with processed foods

For the consumers surveyed, having several processing steps in the production process was the main characteristic of a processed food, with 84.9% citing this as the main characteristic (♦ Figure 1). 60.8% of participants considered processed food to be ready-to-eat food. More than half of the participants (55.4%) associated processed food with a long shelf life, while 7% stated a short shelf life as a characteristic. Almost 50% associated processed food with a high number of additives, whereas 15.6% associated it with a low number of additives.

### Consideration given by the consumers surveyed to various aspects when purchasing processed foods

The results show that participants pay particular attention to the ingredients list when buying food (55%) (♦ Figure 2). Of the consumers surveyed, 37% stated that they checked for additives when buying processed food, while 38% said they did not. Only 21% paid attention to the processing method, while over 40% of participants did not pay attention to this when buying food.

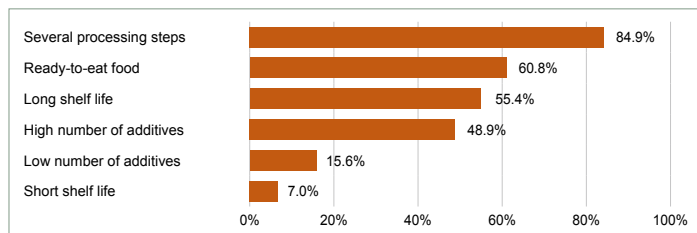


Fig. 1: Survey results (n = 186) What the consumers surveyed associate with processed foods

### Relevance of various aspects for the consumers surveyed when buying processed food

According to the results, food having a low number of additives is important to 47% of the participants (♦ Figure 3). Processed food being made up of just a few ingredients is important to 36% of participants, while 34% do not consider this important. A low number of processing steps in the manufacturing process is not important to the majority of participants (44%), while 27%

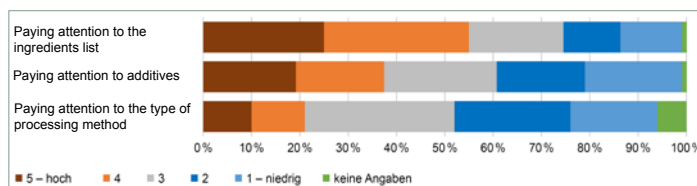


Fig. 2: Survey results (n = 186) Attention paid to various aspects by the consumers surveyed when purchasing processed foods

	Frequency	Percentage (%)
<b>Age group (years)</b>		
18–25	72	38.7
26–35	35	18.8
36–45	15	8.1
46–55	35	18.8
56 and over	29	15.6
Total	186	100.0
<b>Sex</b>		
Female	133	71.5
Male	53	28.5
Total	186	100.0

Table 3: Age and sex distribution within the sample

consider it important. Only 12% stated that a high level of convenience was important to them, whereas 41% said it was not important. Over 20% did not answer this question.

### Correlations between the items surveyed

Individual correlations between the items surveyed were investigated (♦ Table 4). Paying attention to the ingredients list correlated positively with paying attention to additives ( $r = 0.707$ ) and with the relevance of containing a small number of ingredients ( $r = 0.602$ ) and additives ( $r = 0.679$ ). The magnitudes of effect can be considered strong [20]. Paying attention to additives and the relevance of containing a small number of additives also correlate positively with a strong magnitude of effect ( $r = 0.832$ ) [20]. A further correlation was investigated between the attention paid to the type of processing method and the relevance of a small number of processing steps. There was a strong positive correlation between these two indicators ( $r = 0.718$ ) [20].

## Discussion

This preliminary study identified aspects of food that the consumers surveyed associated with processed foods, as well as aspects that are important to them and aspects that they take into account when shopping for food. The indicators examined were derived from existing classification systems in order to assess consumer perceptions of these indicators and to check their suitability for use in future studies.

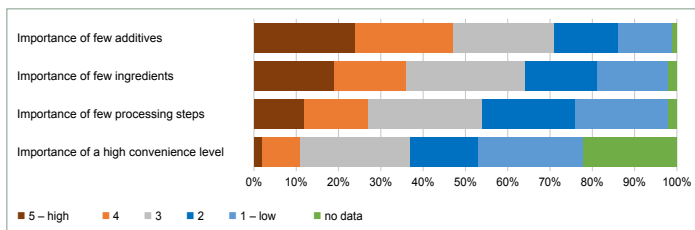


Fig. 3: Survey results (n = 186) Importance attached to various aspects when purchasing processed foods

	Paying attention to the ingredients list
Importance of few ingredients	0.602**
Paying attention to additives	0.707**
Importance of few additives	0.679**
	Paying attention to additives
Importance of few additives	0.832**
	Paying attention to the type of processing method
Importance of few processing steps	0.718**
The correlation coefficient (r) is indicated in each case; **p < 0.001	

Table 4: Results of the correlation analyses according to Spearman

The first research question dealt with the characteristics that the consumers surveyed associated with processed foods. The results show that the participants in this preliminary study consider the main characteristic of processed food to be production through several processing steps. However, there was no precise definition of what “several processing steps” means. This preliminary study did not define “several processing steps” because it is unclear what consumers consider to be a processing step and whether this varies depending on the product. Given that the results of this preliminary study show that participants attach great importance to the number of processing steps for processed foods, it is essential that this aspect is taken into account in future studies.

More than half of the participants equated a processed food with a ready-to-eat food. This indicates that the consumers surveyed consider highly processed foods with a high convenience level in particular to be processed. More than half of the participants associated a long shelf life with processed products, whereas 7% considered a short shelf life to be characteristic of processed products. One possible reason for this discrepancy could be that there is a wide spectrum of processed foods – for example, canned foods have a long shelf life, whereas to-go products only have a short

A visual question asked at the beginning of the survey showed that 7.5% of participants defined a picked apple as processed and 31.2% defined a cut apple as processed. This illustrates how much consumers’ perceptions can differ. This provides a starting point for further research.

shelf life. For almost half of the consumers, another characteristic of processed food is a high number of additives, whereas 15.6% consider a low number of additives to be a characteristic of processed food. This discrepancy could also be due to the wide range of products. Future studies should pay particular attention to these discrepancies in order to determine the possible reasons for them.

The second research question investigated what the consumers surveyed pay attention to when buying processed food. The ingredients list seems to be particularly important here. More than half of the participants (55%) stated that they pay attention to this when shopping for food. Only a third of participants said they paid attention to additives. A survey conducted in Germany in 2017 had similar results. In that survey, 44.9% of participants said they paid attention to the ingredients list and 40.7% said they paid attention to additives in food [21]. Another survey found that 23% of participants always checked the ingredients list before buying food, 53% did so occasionally and 16% rarely [22]. This indicates that consumers pay more attention to the ingredients list than to the use of additives when buying food. One explanation for this is that checking for additives and other ingredients such as allergens requires checking the ingredients list. For this sample, paying attention to the ingredients list correlates positively with paying attention to additives. It can therefore be assumed that the surveyed consumers who pay attention to the ingredients list also pay more attention to additives. The processing method is of lesser importance to the consumers surveyed, with over 40% not paying attention to it when buying food. This could be due to the fact that they are hardly aware of what processing methods are used or of the differences between them. In the EU, it is not mandatory to specify the production process on the packaging, which means that consumers are provided with little information about the production process when making a purchase. It is not possible for them to verify the processing steps at the time of purchase.

Providing information online can positively influence brand loyalty and consumer purchasing decisions [23], which is why some companies take the opportunity to provide information about the manufacturing process used for their products online [24]. Taking some well-known companies such as Dr. Oetker, RUF and Ferrero as examples, it is clear that companies mainly use their online pres-



ence for online trading or to communicate their corporate philosophy and boost their image [25–27].

The third research question investigated which aspects are important to the consumers surveyed when shopping for food. For the participants, a low number of additives was the most relevant aspect, with 47% considering this to be important. 36% of participants considered the number of ingredients to be important. All of the classification systems considered in this study except the IARC system take this aspect into account, although additives are only taken into account by the SIGA, NOVA and UNC systems. According to the results, the consumers surveyed consider the number of additives in a product to be significantly more important than the number of ingredients. Future classification systems should therefore also take food additives into account. In addition to the number of ingredients, the nutritional quality of the ingredients could also be taken into account.

The number of processing steps and the convenience level appear to be of secondary importance to the consumers surveyed when selecting food. However, the participants in this preliminary study considered food being sold as ready-to-eat and the use of multiple processing steps to be the main characteristics of processed food. Therefore, both of these aspects should be considered in further research on classification systems, despite their subordinate importance to consumers when selecting food. The IARC, IFIC and NOVA classification systems take the convenience level into account, while only SIGA and NOVA take the processing method into account. The fact that the consumers surveyed rated the relevance of processing as low could also be due to the aforementioned lack of knowledge about processing methods.

Over 20% of respondents did not answer the question about the importance of the level of convenience, although quick and easy preparation is important to many consumers [19]. It is likely that some of the respondents were not familiar with the term “convenience level” (since the English word “convenience” was used even though the consumers were German-speaking). This is in line with the results of a consumer survey conducted in 2016. In that survey, only 56% of respondents were familiar with the term “Convenience-Produkt” (“convenience product”). Only 33% perceived these products to have a positive benefit [28]. Consumers’ ambivalence about the importance of convenience and their low assessment of the positive benefits of convenience products could be due to a lack of knowledge about the term “Convenience-Stufe” (“convenience level”) and this should therefore be the subject of further research.

Looking at the results of the individual research questions in context, it is clear that a low number of additives in food is particularly important to the participants, although only a third of them pay attention to this. This indicates that the consumers surveyed seem to want processed foods to contain few additives, but do not necessarily pay attention to this and do not see it as a decisive criterion when purchasing these products. This can be explained by the difference between attitude and behavior, known as the attitude-behavior gap. This phenomenon has already been observed in many studies in the context of food shopping [29–30]. For this sample, paying attention to the ingredients list correlates positively with attaching importance to a food containing few ingredients and additives. It is likely that the consumers surveyed

who pay attention to the ingredients list attach more importance to a low number of ingredients and additives, or they pay attention to the ingredients list for these precise reasons. This possible association should be investigated in a representative study. In this sample, paying attention to additives also correlates strongly with attaching importance to the product containing few additives, which indicates an association between these factors ( $r = 0.832$ ).

In this sample, processing methods were considered to be of low importance and consumers said they paid little attention to them. However, there is a strong correlation between the importance attached to a product having undergone few processing steps and paying attention to the processing method ( $r = 0.718$ ). It is therefore likely that participants who pay attention to the processing method attach more importance to minimal processing or would like more information on the processing method. This association should be investigated further in future studies with a representative sample.

### Limitations

This preliminary study has various limitations. Firstly, the sample analyzed is a convenience sample that is not representative of the German population. Secondly, the questions were predefined and there was no opportunity to add to them, which meant that other potentially important characteristics of processed products or relevant factors involved in the purchase of these products could not be included in the data collection. Thirdly, over 20% of the respondents did not answer the question on the importance of the convenience level, which limits the significance of the results for this question.

### Conclusion

From the perspective of the consumers surveyed in this preliminary study, the main characteristics of processed foods are multiple steps of processing and the product being ready to eat. Both of these aspects were considered very important by the participants in terms of classifying food as processed and should therefore be taken into account in future studies. According to the participants, processed products are also characterized by a long shelf life and a high number of additives. When shopping for food,



the consumers surveyed paid particular attention to the ingredients list and stated that a low number of additives is important to them. However, they said they only paid limited attention to this when making purchase decisions. Although the participants attached only limited importance to the number of ingredients, the processing method and the convenience level of the products, these aspects should not be ignored as they are the main characteristics of processed foods. This preliminary study provides initial insights into consumer perceptions of processed products, but further research with representative samples is needed.

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**Disclosures on conflicts of interest and the use of AI**

The authors declare that there are no conflicts of interest and that no AI was used to create the manuscript.

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