

# Consumers' Perception and Knowledge of Food Additives in Senegal: A Pilot Study

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## Abstract

Food safety has become a major concern for consumers, as well as a priority for regulatory authorities. Faced with the growing industrial and domestic use of food additives, many questions are being asked and concerns are being felt by consumers around the world. Consumer perception defines the acceptability or rejection of food products, and has an impact on consumption patterns and behavior. To assess the level of knowledge and perception of food additives, a pilot study was carried out on a sample of 200 people in Dakar and Saint-Louis. A questionnaire was used to assess the acceptance or rejection, use and impact of food additives by consumers in Senegal. The results revealed several aspects. On the whole, the people surveyed expressed great mistrust and even rejection of these substances added to food products. This consumer perception is shared throughout the world, as indicated in numerous surveys. It also emerges from this study that, although most consumers are aware of the existence of these additives and their uses in the home, they feel that the use of these substances in industrial production is too excessive. What's more, consumers associate food additives with numerous pathologies such as cancer, diabetes, hypertension, stroke and even sexual impotence. For some of these indexed pathologies, scientific studies have reached the same conclusions, although controversy still persists. On the other hand, for some of the other adverse effects mentioned, no cause-and-effect relationship has been scientifically demonstrated. In these latter cases, it seems that negative communication, misinformation and misconceptions have a major influence on consumer perception of food additives.

## Keywords

Consumer Survey, Food Additives, Knowledge, Perception, Senegal

## 1. Introduction

Food additives are natural or artificial chemical substances widely used in the food industry for their numerous properties. Among other things, they help to improve sensory and organoleptic quality (colorants, acid regulators, flavor enhancers), guarantee physico-chemical stability (emulsifiers, stabilizers, antioxidants) and protect consumer health, particularly against microbial agents (preservatives). However, the industrial production and use of food additives have grown considerably in recent decades [1]. In 2020, the global food additives market was valued at 26.2 billion USD, with global consumption of food additives expected to grow at an average annual rate of 2.4% per year over the period 2020-2025 [2]. This can be explained by the modernization of industrial transformation processes, but also by changes in consumption patterns. However, scientific studies have linked the consumption of food additives to the development of numerous pathologies. For example, the genotoxicity of titanium dioxide, a food colorant [3], and the cytotoxicity of sodium benzoate, a food preservative [4], have been demonstrated. In addition, according to several studies, food additives are implicated in cases of allergies [5], cardiovascular disease [6], cancer [7], diabetes [8], obesity [9], and many other ailments. States have therefore set up national and international bodies and authorities to control and regulate the use and consumption of food additives. Despite these efforts, consumer perception of additives remains very mixed. Several surveys have revealed that this situation is of great concern to consumers, leading to suspicion, concern and even rejection of foodstuffs containing food additives [10] [11]. As a result, there is growing interest in the production of natural food additives to satisfy consumer demand and preferences [12] [13]. It should be noted at this point that most of these results are the source of much controversy and criticism, based fundamentally on the research approaches and methodologies adopted [14]. These uncertainties, which have not yet been resolved, have led to the development of modern analytical methods which should help guarantee the safety and quality of foodstuffs in accordance with legislation and meet consumer requirements [15]. However, negative perception of food additives, whether justified or not, is crucial, as it conditions the acceptance or non-acceptance of a food product [16]. It can trigger the act of purchase, which is profitable from a marketing point of view, but also rejection, which can have an impact on local industrial production [17]. This is why specialized research organizations and structures have conducted studies and surveys to measure, analyze and understand consumer perceptions of these substances. One example is a recent survey by the German Federal Institute for Risk Assessment, the results of which clearly describe the level of knowledge and behavior of German consumers with regard to food additives [18]. In Korea, the same approach was adopted to assess consumers' level of information and perception of the risks associated with food additives [10]. In China, a study in the city of Suzhou examined the factors affecting the perception of food additive safety risk [19]. Other examples include the

report by France's Agence Nationale de Sécurité Sanitaire de l'Alimentation, de l'Environnement et du Travail (Anses) on the evaluation of the population's consumption habits and patterns [20], and the Food and Drug Administration's (FDA) surveys on health safety and nutrition in the USA [21]. In Africa, on the other hand, there is a lack of scientific data on consumer behavior towards food additives. This information is very important for understanding consumers' attitudes and taking the necessary steps to address their concerns. It is in this context that this study is being carried out, with the aim of assessing consumers' level of perception and knowledge of food additives present in food products.

## 2. Materials and Methods

This pilot, descriptive, cross-sectional study involved 100 students from Gaston Berger University in Saint-Louis (northern Senegal). In addition to these participants, 100 other people were interviewed in 8 neighborhoods in Dakar: Foire, Bop, Pikine, Point E, Fass, Sicap, Diamaguene and Fann. The aim of this approach was to diversify the profile of candidates in order to gather more information. Participants were selected at random, and the objectives and conduct of the interview were clearly explained to them, who gave their consent simply by agreeing to answer the questions. A questionnaire was designed to assess consumers' perceptions and knowledge of food additives. Interviews were conducted directly and individually, with questions mainly concerning knowledge of food additives, their verification on labels, their acceptance or potential risks to human health. Interviews were conducted in compliance with the rules of ethics and deontology. Candidates' personal information and confidentiality were respected. Participation was free, with no obligation, and candidates had the choice of answering, not answering or stopping the interview whenever they wished. As part of these studies, consumers are presented with a consent form to approve their agreement to take part in the survey. The sample was drawn at random from both the University of Saint-Louis and the neighborhoods of Dakar. The university has the particularity of having consumers from several geographical areas, with a high degree of social diversity. The survey carried out in Dakar enabled us to reach a variety of households and subjects who do not necessarily have a high level of education. As far as numbers are concerned, this is just a pilot study, the results of which will enable us to go on to a much larger scale. The survey questionnaire was implemented in Sphinx Tuite software. At the end of the interviews, the data collected on the survey forms were recorded and processed using this software.

## 3. Results and Discussion

### 3.1. Survey Location and Subject Profile

The survey involved 200 subjects equally distributed between Saint-Louis and Dakar (**Table 1**). Overall, our sample was composed of 51% women and 49% men. The age of participants in this study ranged from 13 to 75 years. The average

**Table 1.** Survey areas and profile of consumers interviewed.

	Total	Men	Women
<b>Survey areas</b>			
Saint-Louis University	100	52	48
Dakar neighborhoods	100	46	54
<b>Age range (year)</b>			
Less than 20	14	5	9
[20 à 30[	138	78	60
[30 à 40[	19	5	14
[40 à 50[	13	2	11
[50 à 60[	6	4	2
More than 60	10	4	6
<b>Education level</b>			
Primary school level	29	10	19
High school	54	28	26
University level	117	60	57

age of the consumers surveyed was 28. The age group between 20 and 30 is the most widespread (69%), with students being the most common. Analysis of **Table 1** shows that the level of education of the subjects is relatively high. In fact, 14.5% of respondents had primary school education, 27% secondary school education and 58.5% university education.

### 3.2. Consumers' Level of Knowledge of Food Additives

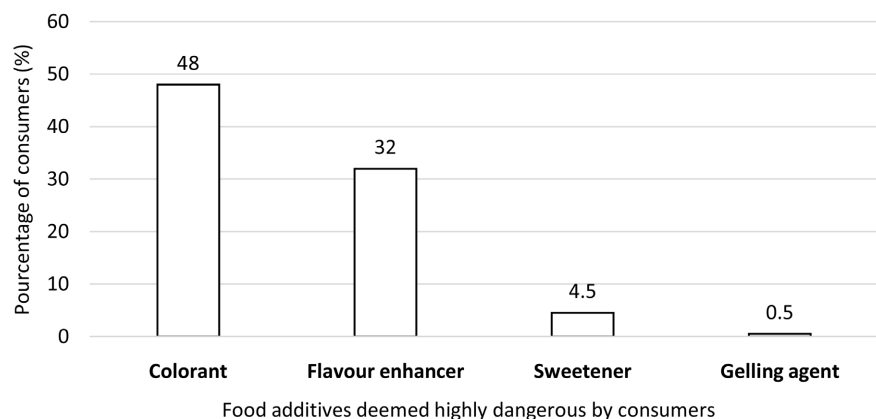
This study reveals that 74% of subjects are aware of the existence of food additives in products marketed in Senegal. The level of education of the subjects surveyed, the majority of whom are university-level consumers, could validly explain this result. Furthermore, the survey shows that the majority of consumers are aware of the industrial use of food additives. 64% of subjects claim to read food labels, but only 23% can correctly identify the additives on the labels. This latter difficulty was noted in consumer surveys in Ireland [22] and Korea [10], who expressed their limitations in identifying food additives on labels. In addition, the verification of label information is sometimes neglected by users of industrial food products. In this respect, a study carried out on a cohort of 280 people at the University of Mauritius showed that only around 19% of consumers surveyed at the University of Mauritius claimed to actually check product labels [23]. These observations are not generalized, as in other studies it has been noted that some consumers are very observant of food labels. This is the case with the results of investigations carried out at the University of Oslo, which show that additives are the ingredients most frequently checked on labels by

consumers, with a frequency of 60% [24]. British researcher Osborn (2015) shows in his investigations the clear interest of most consumers in consulting food product labels, but notes their confusion over the notions of natural ingredients and additives [25]. In the United States, the Food and Drug Administration (FDA) is often contacted by consumers with suspicions and questions about labels. It was in this context, for example, that the FDA was asked by 3 citizens' petitions to define the term "natural" on food labels [26]. The FDA took the view that the term "natural" means that nothing artificial or synthetic has been included in or added to a food that would not normally be found in that food [26].

### 3.3. Consumers' General Perception of Additives in Foods

Overall, 91.5% of those surveyed had a negative perception of food additives, and assumed that they represented a real health hazard. The results of our research reveal that the additives considered most harmful to human health are, first and foremost, colorants, which are perceived negatively by 48% of consumers (Figure 1). According to consumers, food colorings are widely present in industrial products, in particular various types of beverage, stock cubes and spices such as saffron. Flavor enhancers are also mentioned by 32% of consumers, who consider them to be strongly implicated in the deterioration of health. In addition, the presence of flavor enhancers in broths was deemed excessive by those surveyed, some of whom even wanted them banned. In addition, nearly 5% of those surveyed expressed distrust or even rejection of the use of sweeteners in food production. These sweeteners, supposedly present in many industrial drinks, confectionery and other products (sauce, ketchup, etc.), are considered dangerous by consumers and responsible for numerous pathologies.

These results are similar to most findings from consumer perception studies of food additives. In this sense, a qualitative study conducted by Gabor (2013) in the form of a focus group shows that the majority of participants have negative apprehensions about food additives [27]. Surveys carried out in Bucharest revealed that 76.3% of consumers oppose the use of additives, and 83.6% consider food additives to be hazardous to health [11]. Another study states that despite



**Figure 1.** Food additives considered hazardous to health by consumers.

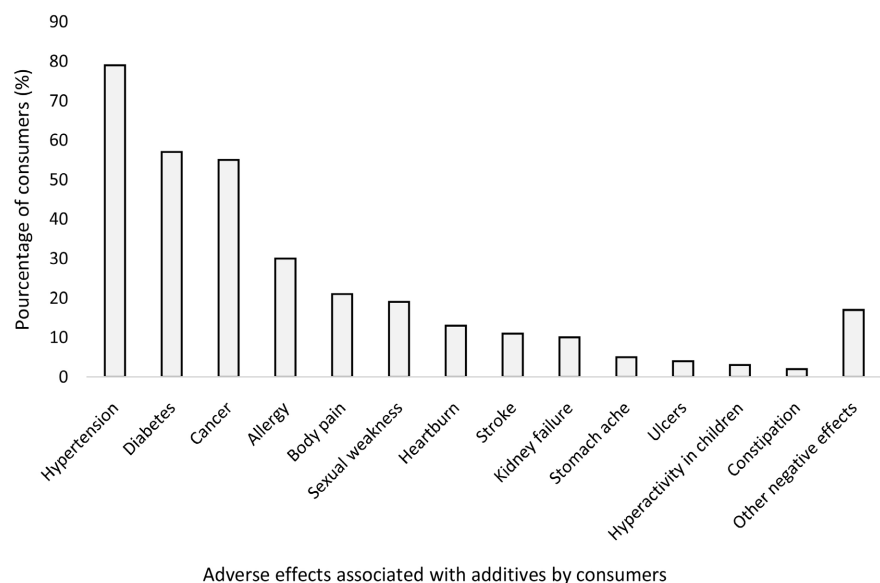
the abundance of food additives, the average consumer has a negative opinion of their use [28]. In the study by Gabor (2013), the additive groups most incriminated by consumers are preservatives and colorants [27]. In another study published in the journal *Food Control* and involving 430 consumers, the additives most incriminated were preservatives, colorants and artificial sweeteners present in food [10]. The rejection of preservatives and colorants was echoed in investigations by C. Zugravu *et al.* (2017) into consumer attitudes to food additives [11]. Indeed, the massive presence of colorants is much decried by consumers. These colorants are found in many carbonated and non-carbonated beverages sourced in large quantities from imports but also from local production, which is developing strongly in Senegal. Other studies have shown the presence of suspected or proven dangerous colorants in food products. These include tartrazine (E102), a coloring agent frequently found in confectionery, and associated with cancer [29]; and titanium dioxide E171 (TiO<sub>2</sub>), banned from use in the European Union [30] on the grounds of genotoxicity following a risk assessment study carried out by EFSA [31]. As far as broths are concerned, these results confirm the constant fears and suspicions of consumers, despite the fact that these products are highly prized by Senegalese families, who generally use them to season everyday dishes [32]. Wrongly considered as food additives per se, culinary broths are ingredients that include in their formulas a good quantity of salts [32], colorants and flavor enhancers such as guanylate (E628), sodium inosinate (E631), sodium guanylate (E627) and above all sodium monoglutamate [33]. However, this standard does not specify a maximum concentration for flavour enhancers such as monosodium glutamate; only Good Manufacturing Practices (GMP) must be respected. It should be noted that stock cubes are a major concern for African consumers. For this reason, a study to assess the level of consumption of bouillon cubes has also been carried out in Mali, with the recommendation to evaluate the risks associated with their consumption [34]. In our survey, the instant powders indexed by the consumers surveyed were industrial ingredients containing, for the most part, high levels of colorants, flavourings and sweeteners. These powders are used locally in the preparation of soft drinks, yoghurts and pastries. Most consumers consider these powders to be unhealthy, due to their supposedly artificial origin. Consumers also point to saffron spices used as a coloring agent (yellow), but also for their warm, aromatic fragrance. This association with pathologies is said to be due to a link with artificial colorings, widely decried by consumers. Contrary to these assertions, scientific studies have demonstrated the beneficial role of saffron spices, and in particular their antioxidant, immunomodulatory and antitumoral activities [35]. Furthermore, a pilot study carried out in China noted that consumer behavior and perception in terms of acceptance or rejection of additives depended on the information received [36]. Indeed, rumors and negative information conveyed about food additives lead to distrust and even rejection of these substances. In addition, the study showed that consumers with a better knowledge of food additives were much more accepting of these substances than those with no such know-

ledge [36]. In China, an investigation concluded that consumers' level of knowledge acquisition increased with the strengthening of advertising and scientific popularization [37]. On the other hand, these studies have highlighted the growing influence of the media and networks on public perception, with deviations that can easily mislead consumers [37]. In the same vein, the results of a pilot study carried out in Korea indicate that perceptions of the safety of food additives were affected by consumers' level of information, awareness and knowledge about these products [10]. This latest study suggests that communication programs familiarizing consumers with the different types of food additives need to be developed in order to increase perceptions of safety and meet consumers' information needs on food additives [10]. In addition, many consumers question the effectiveness of food additive control by the authorities in charge of this issue [36]. These observations should undoubtedly lead the competent authorities to review the communication surrounding food additives and other ingredients in order to raise consumer awareness and reassure consumers.

### 3.4. Negative Effects Associated with Food Additives by Consumers

During the interviews, it was noted that consumers associate food additives with various negative effects on human health (Figure 2).

Nearly 80% of participants associated food additives with hypertension. A similar result was observed in a US study of 88 African-American and Latin-American patients, who found that they associated hypertension with food additives [38]. The results of a large-scale cohort study published in the British Medical Journal suggest a potential direct association between increased consumption of artificial sweeteners such as aspartame, acesulfame potassium and sucralose and an increased risk of cardiovascular disease [39]. Our findings also



**Figure 2.** Negative effects associated with food additives by surveyed consumers.

show that more than half of consumers believe that food additives can cause diabetes. In Senegal, diabetes is a public health issue. Already in 2011, the prevalence rate of diabetes in Senegal was high, particularly in the northern zone, where it reached a record 10.4% [40]. On the other hand, a lack of information and awareness can lead many people to believe that high sugar consumption is the cause of diabetes. These same ideas apply to non-energy sweeteners, which are often regarded by consumers as having the same effects as table sugar. However, this assertion has not been confirmed by clear scientific studies. The Anses, in its report published in 2016, gives recommendations in terms of sugar intake in consumption but does not establish any direct causal relationship between sugar consumption and the onset of diabetes [41]. Our survey also revealed that over 50% of consumers claim that additives are the cause of cancer. Another study shows similar results, revealing that consumers suspect carcinogenic effects from food additives, particularly artificial substances [27]. This perception is also in line with numerous research studies demonstrating the involvement of food additives in various cancers. For example, nitrate and nitrite additives are positively associated with breast and prostate cancer [42]. In addition, in the journal *PLOS Medicine*, a statistical study carried out by the *Équipe de Recherche en Épidémiologie Nutritionnelle (EREN)* in France on a cohort of 102865 consumers suggested an association between increased sweetener consumption and cancer risk [43]. The link between food additives and allergies is suspected by almost a third of consumers surveyed. In the French journal of allergology, Gallen *et al.* (2013) report that additives are regularly incriminated by patients in forums to explain various symptoms and pathologies such as allergy [44]. However, they conclude that intolerance to food additives is difficult to assert in the absence of sufficient evidence, and that biological tests are not always relevant [44]. In the same vein, other authors assert that a wide variety of food additive-related symptoms have been reported, but a cause-and-effect relationship has not been well documented in the majority of cases [45]. However, abusing the consumption of food additives, particularly for children, could increase the risk of developing allergies. Indeed, according to Yamashita *et al.* (2017), the consumption of food additives early in life may increase the risk of food allergies [46]. To further support this question, studies on allergic patients are still being undertaken to evaluate food additive sensitivity testing. Such is the case of Moghtaderi *et al.* (2016), who demonstrated the usefulness of skin testing to identify the role of food additives in allergic patients [47]. Another pathology associated with additives by consumers (19%) in this survey is sexual impotence. This statement is also frequently reported on social networks, probably in reference to broths containing food additives, reputed to be dangerous and indexed as a possible cause of sexual impotence in men. However, in the scientific literature consulted, there is no explicit mention of the involvement of food additives or culinary broths in sexual impotence. According to around 20% of consumers surveyed, various other pathologies are linked to the use of food additives. These include heartburn, stomach ache, ulcers and strokes. In the case of the latter, the



link made by consumers with food additives could be understood as a connection with arterial hypertension, widely indexed by the people interviewed.

The results of our study show that the presence of food additives in foodstuffs is a major concern for Senegalese consumers. The same is true in Europe, where an opinion poll revealed that most consumers are concerned about this issue, and that an ethical analysis of their use is urgently needed [48]. It is in this context that governments and health authorities should focus more attention on controlling and regulating the production, use and distribution of foodstuffs containing food additives. Furthermore, to reduce the risks associated with excessive consumption of food additives, it is imperative to promote natural alternatives, bioproducts that can also reassure consumers [49] [50]. Numerous studies have demonstrated the antimicrobial, antioxidant or coloring potential of products of plant, animal or microbial origin. These include plant polyphenol extracts and essential oils, which have antioxidant and antimicrobial functions. [51] [52]. The potential of agri-food by-products is currently being exploited for the production of natural additives, with the added benefit of promoting a circular economy [53].

#### 4. Conclusion

This work revealed a relatively low level of consumers' knowledge of food additives through this survey. Consumers' general perception of the use and consumption of foods containing food additives is very negative. In some cases, this mistrust is justified, as numerous scientific findings have clearly demonstrated the risks associated with the abusive consumption of certain food additives. On the other hand, this study shows that most consumers seem to be influenced by negative and often unsubstantiated information on social networks, as well as by preconceived ideas about food additives. As a result, in addition to control and regulatory bodies, it would be advisable for the relevant authorities to set up more effective information and communication systems to protect and reassure consumers. However, it should be noted that, following this pilot study, it would be interesting to extend the study to the general population, in order to obtain a better analysis of the level of knowledge and perceptions of Senegalese with regard to this subject.

#### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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