

# Aromachology Related to Foods

Subjects: Biology

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Smell is the second-most used sense in marketing strategies in the food industry. Sensory marketing appeals to the senses with the aim of creating sensory experiences and converting them into specific emotions associated with a specific product. There is a strong relationship between sensory marketing, aromachology, and neuroscience. In this review, studies were searched on the use of scents in food experiences such as restaurants and food establishments, and a critical evaluation was performed on their aims, target population, place of the study, scents tested, foods tested, and measured parameters, and the main findings were reviewed. Case studies carried out by private companies are also presented.

Keywords: scent ; neuroscience ; sensory marketing ; consumer

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## 1. Introduction

Smell/aroma is directly related to human emotions; it is the main trigger for human emotions after sight. In fact, it has been reported that 75% of human emotions are created through smell/aroma <sup>[1]</sup>. The olfactory bulb is part of the brain's limbic system (seat of emotions, desires, and instincts), and that is why smells can trigger strong emotional reactions. This explains the strong link between smells, emotions, and memories. In practice, it is possible to use this evidence to influence and promote certain feelings <sup>[2]</sup>. Herz <sup>[3]</sup> reviewed scientific studies on the mechanisms mediating the effect of odours on mood, physiology, and behaviour. Two main types of studies were reported—one investigating pharmacological and the other psychological mechanisms of action. The author concluded that the psychological interpretation of odour effects was the most comprehensive interpretation, showing that odours have clear psychological effects.

Scents use has been evaluated for different purposes such as sensory marketing of different goods or services, well-being, cosmetics, etc. <sup>[4]</sup>. Regarding our field of interest, foods and food-related stores and environments, scents have been tested for several purposes: to study their impact on appetite, food consumption, food sales, evaluating shopping experience, etc. Sensory marketing can be defined as marketing that involves the senses of consumers and studies the perception, emotion, learning, preference, choice, evaluation, knowledge, judgment, and purchasing behaviour based on the senses <sup>[5]</sup>. Sensory marketing appeals to the senses with the aim of creating sensory experiences and converting them into specific emotions associated with a specific product.

Smell is the second-most used sense in marketing strategies in the food industry <sup>[6]</sup>. Therefore, aromas play an important role in marketing strategies <sup>[6]</sup>. The memory of smell is the most intense of all the senses, and only about 20% of olfactory sensations are forgotten. Human beings even maintain very old memories and feelings related to smell <sup>[1]</sup>. Aroma marketing has two main modalities: (i) the use of the unique smell/aroma of the product itself, with the possibility of creating an aroma that identifies the company with the product/brand and (ii) the use of an ambient smell/aroma in spaces (restaurants, supermarkets, small shops, public spaces) <sup>[2]</sup>.

Ambient scent is defined as a scent that is present in the environment but does not emanate from a particular object <sup>[2]</sup>. These ambient scents have been classified based on (i) the affective quality of the aroma (how pleasant the aroma is), (ii) the level of arousal of the aroma (how likely is it to elicit a physiological response), and (iii) the intensity of the aroma (how strong it is). Several authors pointed out that stores that use ambient scents give their customers the feeling that they spend less time looking at products and trying them <sup>[7][8]</sup>.

In the 1970s, fragrances began to gain prominence as a tool for retailers aiming to improve the indoor environment by introducing specific scents <sup>[9]</sup>. Origins of olfactory marketing seem to be in the 1980s when British supermarkets realised that fresh baking bread aromas increased selling bread and other products <sup>[10]</sup>. This moved them to introduce bakery as a new department area. However, the difficulty of introducing aromas in a supermarket for increasing sales can be illustrated by the fact that customers can smell fresh bread aromas and buy the bread but can prevent them from buying

other goods <sup>[6]</sup>. This reduction in their willingness to buy is due to the fact that their sensory perception and emotions are, to some extent, satisfied by purchasing the bread <sup>[2]</sup>. That is a case based on the scent of a product itself. However, most recent studies have focused on ambient aroma, and analysed the influence of aroma on the purchase intention of consumers <sup>[2]</sup>.

In 1982, the Olfactory Research Fund coined the term 'aromachology', relevant to marketing. This area of expertise deals with the temporary effects of fragrances on human behaviour, feelings, well-being, moods, and emotions <sup>[11]</sup>. Aromachology, as defined by the Sense of Smell Institute in 1982, is the scientific discipline studying psychological and physiological effects of inhaling aromas and examining, feelings and emotions elicited by odours stimulating olfactory pathways. Aromachology research must follow empirical scientific methodology—goals, hypothesis, materials and methods (aroma, subject population number and representativity as well as the control group), and proper statistical data analysis—and be published in peer-reviewed reputable journals <sup>[11]</sup>. Under these premises, if a study is conducted using the internet, many publications that may be found regarding odour effects on mood and behaviour should not be taken into consideration since they do not follow such premises, and their results may not be taken as scientifically sound. In the present review, only studies following the requirements have been included. At present, focusing on the general scientific literature on aromachology, there are many scientific lines of evidence reporting that inhaling aromas may elicit feelings such as relaxation, sensuality, happiness, or exhilaration <sup>[12][13][14][15]</sup>. There are also scientific lines of evidence on the physiological effect of scents. As an example, in a study on rats, Shen et al. <sup>[16]</sup> presented evidence that the scent of grapefruit oil excited sympathetic nerves, innervating white and brown adipose tissues and the adrenal gland, inhibiting the vagal nerve innervating the stomach, increasing lipolysis and heat production (energy consumption), and reducing appetite and body weight in rats; the opposite effect was observed for lavender, mainly due to linalool, which enhanced appetite and body weight <sup>[16]</sup>.

The most common use of scents is for marketing purposes. Scent sensory marketing is about much more than simply spreading a pleasant fragrance in a space. It may be, starting from the brand identity of a company (and its values) and studying its target consumer, to create an aroma that exemplifies company identity (and values). The expression 'scent marketing' has been used to describe the use of essences to create an environment, and promote products or position a brand, and therefore, scent marketing can be defined as the strategic use of the olfactory experience and essences in relation to commercial products <sup>[17]</sup>. There are three types of scents used in environments <sup>[6][18]</sup> known as (i) head, (ii) heart, and (iii) basic. Head scents are generally small, light molecules that give a refreshing and invigorating sensation. These are typically fresh citrus or green notes, including lemon, lime, neroli, bergamot, grapefruit, and cooler herbal notes such as lavender, thyme, and basil. The molecules responsible for heart-like scents tend to be larger and can take anywhere from five minutes to an hour to develop. They can include different ingredients, such as flowers, spices, woods, resins, and grasses. Lastly, the basic-type scent molecules are the largest and heaviest. They are aromas such as woods, resins, oakmoss, vanilla, amber, and musk <sup>[2]</sup>.

The use of aromas in food is regulated (R1334/2008 in the European Union), and all aromas need to be approved by public authorities after following strictly regulated procedures. In the present review, we do not consider food aromas but scents used in food-related environments. Scents should also comply with safety and quality standards that are supervised by independent laboratories leading to safety certificates, such as the International Fragrance Association (IFRA) Conformity Certificate, assessed by a panel of experts from the Research Institute for Fragrance Materials (RFIM). The safety of scents is evaluated according to the intended use (odorant, skin contact, etc.).

Classical data collection on consumer studies are questionnaires to consumers; however, they cannot assess the complex set of factors affecting decision making (emotions, feelings, etc.) <sup>[19]</sup>. It is in this scenario that neuroscience tools entered the field of consumer marketing studies. Neuromarketing aims to use psychological and neuroscience tools to study subconscious processes during decision making in order to provide scientific explanations of consumer's preferences and behaviours. Main neuroscience tools used in neuromarketing are biometric measurements (body reaction measures: eye movements, facial expressions) and brain measurements. Using such techniques to measure respondents' subconscious reactions in addition to classical feedback collection techniques may provide a comprehensive perspective on consumers' perception <sup>[19]</sup>. In the present review, we will focus only on scents, even though visual factors (packaging, design, portion size, the gastronomic service used, etc.) also influence consumers' perception and food appeal. Both senses are closely related; however, little is known about their complex interactions <sup>[20]</sup>, and only a few studies combine the evaluation of both factors.

## 2. Case Studies

In addition to data from the scientific literature, we had access to real data from customer applications from a scent company, thus in the specific application of sensory marketing.

One of the studies was conducted in a small café with a patisserie serving and selling both chocolates and cakes located at Gottingen (Germany). In this café, the scent Coffee & Cake (REIMA Airconcept) was used. Due to the existing outdoor area in front of the café, the fragrance device was placed in the entrance area. This allowed the scent to waft outside a little bit as well. During the test period (7 weeks: half of the period scented and the other half without scent), customers had handy questionnaires requesting their age, sex, date of visit, time spent, and opinion on the atmosphere. In total, 30 people took part in the survey. One of the participants was not considered because the survey was not completed, in addition to another three who did not indicate the date of the café visit. Therefore, 26 participants were left. The range of ages of the participants was 33–46 years (17 females and 9 males). Nine of them (30%) were in the range between 30–40 years. The average length of stay at the café was 1 h and 8 min. During the fragrance phase, 16 people participated in the survey, while in the non-perfumed phase, 10 people participated. The rating was performed according to the German school grading system (GPA): from 1—very good/completely to 6—insufficient/not at all right. The perfumed phase was rated at 1.65 and the non-perfumed one at 1.95. Looking at the sexes, there was a small difference between the grading of the two phases among women. However, men rated the two periods much more clearly. Here, the rating during scenting was 1.61. Subsequently, men rated the atmosphere only with a grade of 2.78. This is a clear divergence and could be an indication of the influence of the fragrance. Another peculiarity can be seen by dividing the whole group by age. Odour perception was most pronounced between the ages of 30 and 40. This can be justified based on the fact that the participants between 30 and 40 years assessed the atmosphere during the scented phase with 1.72 and the unscented with 2.83. This clear difference cannot be determined in the other age groups, with a tiny difference of only 0.11 points. As another aspect observed in this age range, male participants gave much better marks than female ones. In conclusion, the most positive evaluation of the café atmosphere was obtained during the fragrance phase and especially by men.

A second food establishment was an eatery, which was part of a larger chain, offering Tex-Mex dishes, burgers, and snacks, as well as cocktails and desserts. In addition to a large guest room inside the restaurant, which extended over two floors, there was also a large outdoor area with lounge character. The interior was rustic style. The restaurant had an open kitchen, through which odours from the kitchen can waft in the guest room (fatty and roasted aromas). Two devices of the type AromaStreamer 750 with the intensity level 3 (REIMA Airconcept) were placed in the guest room (interior about 250 m<sup>2</sup>). The scent curry-pepper marinade was used to match the kitchen flavours (REIMA Airconcept). During the test period (7 weeks: first half scented, second non-scented) a questionnaire was provided to consumers asking: date, age, sex, residence time, rate the atmosphere if (pleasant, cozy, stimulating, unpleasant) and the question: how well do you feel today? In total, 54 people participated in the survey (36 females and 18 males). The range of ages 29–68 years (34 (63%) 20–30 years; 10 (18.5%) 30–40 years; 5 (9.3%) 40–50 years; 2 (3.7%) 50–60 years; 3 (5.6%) not specified). The high participation, as compared to the experience at the café, was probably due to the fact that there was a coupon worth EUR 30 to win. Four participants were excluded: three because their survey was not completely finished and one that specified a residence time of 20 h. Overall, this resulted in the usable participation of 50 people. The rating was performed according to the German school grading system, as in the previous study. In the evaluation of the data of this restaurant, there were sometimes clear differences in the rating but sometimes very marginal. The overall average of the criteria 'pleasant', 'cozy', and 'stimulating' showed that the participants rated these criteria better (average 2.33), during the scenting phase than afterwards (2.42). There were only small differences between sexes, both before and after scenting experiment, although there was a tendency for women to rate the atmosphere slightly better than men. The criterion 'unpleasant' showed only a difference of 0.08 points: during the scenting experiment, this criterion was rated at 5.42, followed by 5.50 during the non-scent phase, meaning that on both phases customers disagreed or strongly disagreed with the description of the restaurant as 'unpleasant'. A relatively large difference was seen in the question 'How well do you feel?': during the perfumed phase, the restaurant reached a mark of 1.96, while after the perfumed phase, the average rate was 2.50. The difference became clearer when splitting the ratings between women and men. Men averaged 2.07 during and 3.00 after the fragrance phase. For women, the difference with the grade 1.91 to 2.00 was only 0.09 points. This shows a markedly differentiated rating between the two periods, which is an indication of the actual effect of the scenting. The average length of stay in the restaurant was 2 h and 13 min during, and 2 h and 15 min after the scent period. Again, the difference was very marginal. Thus, it could not be proven whether the scenting had an effect on the length of stay of the guests; the only clear trend is that men felt better during the scenting phase.

Those are two real examples provided by a company in which data were collected through questionnaires for consumers. The company carries out many more types of studies to develop real applications, but the effectiveness of the scents is

directly evaluated by their clients through real sales of food products, with no need of contacting customers. Such case studies are confidential and cannot be shared to be published. We can still analyse the two case studies presented and the main difficulties of studies performed in real conditions. The present cases are evaluations of applications for a small business. Gathering 30 to 50 surveys within 7 weeks is considered quite low numbers for conducting reliable research. From the results, one may guess that the youth and men are more influenced and better discriminate whether the atmosphere is scented or not, but still, total numbers are low. In addition, it cannot be proven to what extent those participants represent regular customers of the establishment, which is probably the reason why in real conditions, total sales are the best indicators for food business, and, if possible, implicit measurements of neuroscience-related and physiologically based sensations should be considered. Small businesses need to measure whether the investment in aromatisation unit plus scents is worthwhile in the short term.

### 3. Improvements, Trends, and Future Research on Aromachology Related to Food

Aromachology related to foods may have different applications; the most active fields are sensory marketing and appetite modulation. Although extensively used in non-food businesses, scent marketing would be also of great interest to food businesses, and purposes such as brand identity or specific developments to suit needs and enhance consumer satisfaction would be of interest. Much more interesting would be the use of scents for modulating appetite, which will be an interesting tool to be included in anti-obesity strategies.

*Scents in sensory marketing: Copyright of a scent as food establishment identity.* Transferring laboratory findings into products is neither an easy nor a quick process, and it is now starting to see the development of products and marketing campaigns that are properly incorporating scents into food establishments and/or experiences. Should it be possible to copyright or trademark a scent? From the perspective of marketers, an affirmative response will increase the scent marketing industry. Currently, only scents that are non-functional can be trademarked, and it is still not easy to obtain a scent trademark. As a clear example, an orange juice company could not trademark the scent of oranges, but if the same scent were adopted by an automobile or electronics company, that company might be able to prevent its competitors from copying that aroma <sup>[21]</sup>. One relevant factor to consider in scent marketing is the opinion and well-being of employees. They are exposed to the scent during their entire working session, and they should be able to feel comfortable under such conditions. Air turnover also needs to be considered, as well as air quality and airflow. Scents need to be congruent with the store location and not interfere with the scent of fresh food to avoid masking, confusing, or generating off-flavours. All those considerations are taken into account by scent companies when developing applications for their customers.

*Research effect of scents to suit specific needs: the example of food consumed in aeroplanes.* Scent branding is a well-established practice in airports and planes <sup>[22]</sup>, but it requires careful consideration. While some may find aromas soothing, others find them intrusive, and some passengers may have an unpleasant flight experience. A Spanish aircraft company has introduced an aroma called 'Mediterráneo', which mainly has notes of lemon, bergamot, and citrus blossoms. Heathrow Airport (London) applied this concept at Terminal 2, giving passengers a whiff of exotic destinations within reach of the airport <sup>[22]</sup>. There is an issue regarding airlines' food service: Food consumed on airplanes does not taste as that consumed on land. Recent studies suggested that various factors such as low pressures, the decrease of the level of humidity, and the noise perceived inside the plane may be responsible for the decreased perception. The degree of decreased perception has been determined for sweet and salty tastes: salty taste is reduced up to 30% and sweet up to 20% when foods are consumed during flights <sup>[23]</sup>. However, real causes are currently unknown, and more studies are needed under real conditions for a better knowledge of the condition. Aromachology may be explored to provide solutions to overcome such a decrease in taste perception.

*Generating general accurate scales for scent in restaurants/food establishments: data collection procedures.* Regarding methodology, the collection of data through questionnaires shows clear limitations under real conditions. Wrzesniewski et al. <sup>[24]</sup> developed a scale measuring individual differences in the affective impact of odours on places, objects, and people. Among others, one promising direction for future research would be to develop a general scale measuring the susceptibility of an individual to using scent as an input for decisions and evaluations. Efforts can be made to enhance the reliability of questionnaires; however, collecting objective data (implicit tests) would be much more helpful and reliable. In this sense, the use of neuroscience tools and physiological measurements needs to gain a place in the methodology applied to aromachology on food.

*Future needs.* Most relevant future needs include in-depth research on scents use as appetite modulators (either to tackle malnutrition or obesity), which is not the main topic of this review but a matter of high interest for consumers, and the use of neuroscience tools and physiological measurements to gather human responses trying to avoid subjective data.

Regarding marketing studies in the scientific literature, they may benefit from the development of standard methodology and recommended experimental designs (number of participants, place, time, etc.), and there is a clear need of conducting studies in real conditions (stores, restaurants, food business) with real food, as most of the available studies were conducted in artificial conditions. It has been pointed out that very few studies have been carried out in real store environments, and those studies had limitations: reduced number of participants, uneven participation during different phases, and the fact that explicit measurements have also limitations (are they given by the most representative customers? are they influenced by other factors such as noise?). Such observations point to the need of using implicit measurements (assessed by tools measuring body responses neuroscience and physiological-related parameters) and other measurements such as sales of different goods (either related or unrelated to the scent). Additionally, data collected from the stores should be compared between scented and unscented periods, as well as with data collected from the same period from the previous years or similar establishments during the same period. Air quality assessment during the studies will provide valuable information on the level of occupation of the establishment and proper ventilation conditions and health conditions for employees and customers (CO<sub>2</sub> concentration, particles in suspension, and volatiles in the air). Other points in need of attention are ethical issues, whether consumers agree with the use of food scents in food environments, and if they had to be regulated to avoid the use of scents that may mask unwanted flavours or enhance the scent of low-quality products.

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