Odours / colours relation: semantic or perceptive association, interests for packaging conception?

M. Jacquot, D. Michel, S. Desobry, J. Hardy
Laboratoire de Physico-chimie et Génie alimentaires, ENSAIA – INPL, Nancy (France)
Corresponding author: M. Jacquot (Muriel.Jacquot@ensaia.inpl-nancy.fr)

ABSTRACT

This study is the result of collaboration between scientists and a chromatic-plastics artist. The aim is to contribute to a better comprehension of association principles between odour and colour, to compare an artistic and a scientific approach and finally to test a marketing application of the approach in design of packing. For that, we gathered a panel of 110 naive judges, i.e. not selected and not involved with the sensory evaluation. A procedure of test was developed making it possible to work the relation that binds odour and colour in absence of explicit identification. No moment, it is requested from the judges to recognize and name the test odours. The expression of olfactory perception is done exclusively by the choice of a colour in various colour work charts. Methodology is always the same, an odour is proposed to the judge and the judge should choose a colour which best characterizes it as well as possible. In the first part of the study, the basic problem is to know if during an olfactory perception, does the choice of a colour as sensory answer always rest on a semantic reasoning (odour → context → is colour) or sometimes it is more perceptive (odour → colour) such as finds in synesthesic phenomena. In the second time, we were interested to compare a chromatic, aesthetic analysis comparable with that of a designer and a scientific, statistic analysis of the results. The objective of this comparison is to test the representativeness of the aesthetic analysis of a feeling. Lastly, we applied this technique of association odour and colour in design of packaging by testing, on consumers, the message carried by coloured carts reproducing the sensory characteristics of 4 cheeses typical of the four French cheese families meaning the fresh cheeses, soft cheeses, pressed cheeses and finally blue cheeses. The results obtained highlighted the presence of a strong semantic bond between familiar odour and colour. Even in absence of expressed recognition, the judge selects a colour, which points out the source of the odour. For the low familiarity odours, like ammonia or resin, the logic of association is different. The judges choose a colour representing the hedonic note of the feeling. There is no more linked with the source. Lastly, the in situ study on complete products shows the potential of this association logic. This series of experiments demonstrates that it is possible to represent sensory properties such as the odour or the flavour by an association of colours. Consumers interpret the coloured carts correctly. Those carts could thus be an interesting tool to develop in design of packing in order to create new conditionings closely related to the intrinsic characteristics of the product.

1. INTRODUCTION

This work aims to better understand the relation between odours and colours. The study asks the question “when you smell an odour and have to choose a colour, is it always a semantic association (odour → context → colour) or sometimes more perceptive like in synesthesic association (odour → colour)?” (Palmieri et al 2002)

To explore this question, eight odours have been chosen, five familiars, easily identified by the context: flower, peach, herbaceous, wood and potato and 3 more complex, less familiars: ammoniac, cellar and resin. For the first odour group, the concentration is equilibrating allowing us to conclude that only the olfactory sensibility is activating. In the second case, the stimulation is olfactory and trigeminal for ammoniac, and only olfactory for resin, but in both, a representation of the odour is difficult to find.

In the last part of the study, a practical application of this odour / colour associative approach is tested for packaging design use. Coloured cards are established for four French cheeses (fresh, soft, blue and pressed cheeses) in agreement with their sensory characteristics (aroma and taste). Cards are

presenting with a sample of each cheese and consumers should associate the right card with the right sample.

2. METHOD

The tests are conduced with a panel of 110 consumers in a sensory analysis room. During the first part, the odours are presented concealed, one after another in random and the judge are asked to choose a colour inside a chart of 72 standard samples of colour as 2cm x 2cm squares from Pantone® on white cardboard page. This chart covers all the Lab chromatic space, arranged with a first achromatic colon and then a spectral presentation from red to violet and lightness increasing towards the top (figure 1). Then, the judge unmasks the odour's name and confirms or modifies his choice. In the last part of the experiment, the judge has to choose again a colour but inside a new chart of 24 colours, presenting the artist colour choice for each odour, in three different values light, dark and medium (figure 2).

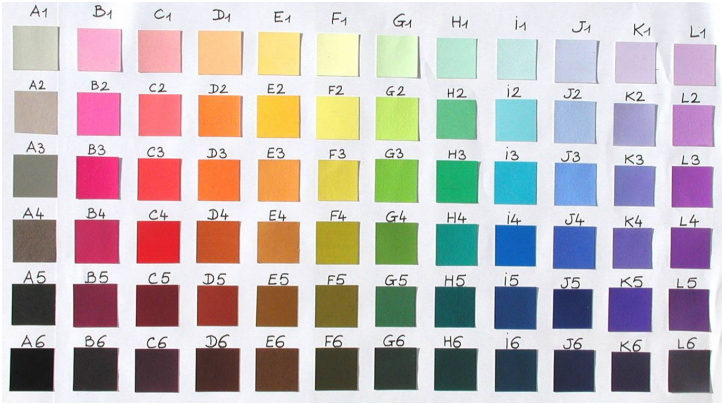


Figure 1: 72 colours chart

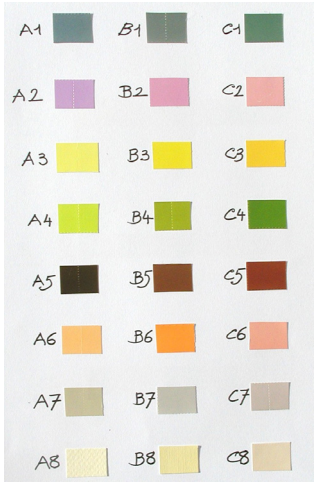
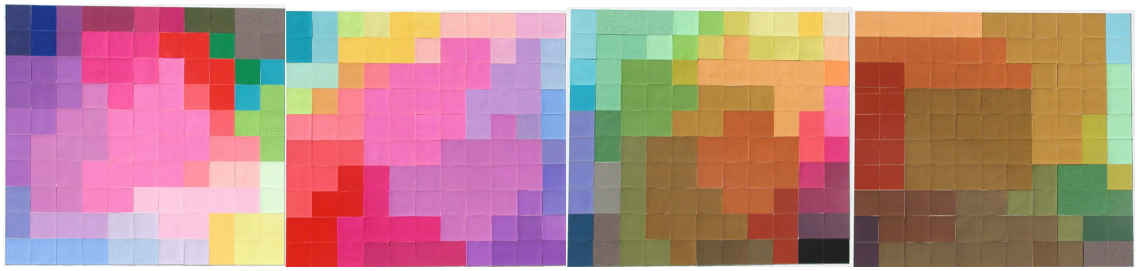


Figure 2: artist colour chart

3. RESULTS

A khi^2 statistical test is made on the results of the first trial with masked odour's name (T1A) and of the second trial with unmasked names (T1B). The colour choices repartition is not random ($p<0.01\%$). The colour merging shades percentages are calculated from khi^2 contribution table and correspond to the sum of observed responses frequencies significativelly higher ($\alpha=0.01$) than theoretical frequencies.

Without knowing the odour's name, consensus level, ranging from 12% to 19% for 1 colour and from 35 to 55% for a merging shade of colours, are obtained. The selected colours are closely connected to the odour's source. It is orangey for peach, brown for wood, beige for potato, mauve for flower and green for herbaceous. Knowing odour's name increases consensus percentages. For the T1B test, percentages range from 18 to 38% on 1 colour and from 65 to 83% on colour merging shades. The colour's name knowledge does not completely modify judge's colour hue choice but only adjust the chromaticity. To illustrate those results, an aesthetic representation of judge's choices is presented in figure 3 for flower and wood. Even without a correct sensation verbalising, those odours are very closely linked to their source. The association mechanism appears to be mostly following a semantic procedure: odour → context → colour.



Flower a *Flower b* *Wood a* *Wood b*

Figure 3: 110 colour choices for respectively flower and wood without (a) and with (b) the name of the odour

However, this phenomenon is not as clear for the three last odours, cellar, resin and ammoniac. The next table presents responses organisation for those odours (Tab.2).

Table 2: result of the association odour / colour for cellar, ammoniac and resin without (A) and with (B) the odour's name

Odours	Test	Colours		%
Cellar	A	A1		13
	B	A4		21
Ammoniac	A	A1		15
	B	A1		24
Resin	A	G1		10
	B	A1, A4		9

In the previous analysis, the knowledge of odour's name leads to a concentration of choices on three or four colours increasing consensus percentages. This not appears for cellar, resin and ammoniac (tab.2). The odour's name does not help the judge to choose a colour. Percentages stay low almost for resin, where the mode of the repartition completely changes between T1A and T1B. Moreover, like for others odours, it is difficult to establish colour-merging shades, because the distribution is not monomodal. In those conditions, results classifications according to the hue and hue value are made. It appears that there is no dominant hue. The first colon of the 72 colours chart is the most selected by 38% of judges for cellar, 42% for ammoniac and 22% for resin, with a light hue value for ammoniac and a dark one for cellar and resin.

It is usual to accept that sensory sensation is the result of three components. First, the hedonic note, this odour is pleasant or unpleasant. Then, the judge estimates the perceived quality of the odour; it is flower, wood, peach… The last information is the intensity of the odour. According to this physiological answer organisation, it seems that for the three last odours, cellar, ammoniac and resin, the judges picked up a colour representing the hedonic part of the sensation and not the quality of odour. This observation is in agreement with previous work done on correlation between familiarity, intensity and hedonic rating of odour (Distel et al 1999). The hedonic evaluation of odour is the base of classification in naïve subjects appreciation (Sicard et al 1997). This interpretation allows us to think that if the hedonic tone is strong as with very unpleasant odours, it produces a block in the semantic pathway and the odour / colour association becomes more perceptive.

In the second part of experiment, the choice of an artist in colour / odour association is compared to the choice of consumers. Results are presented in table 1. Artist choice is colour 1 for resin, 2 for flower, 3 for ammoniac, 4 for herbaceous, 5 for wood, 6 for peach, 7 for cellar and 8 for potato.

Table 1: comparison between expert and consumers colour choices

Colours	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Resin	**39**	11	4	6	**33**	7	5	5
Flower	0	**92**	12	2	0	2	2	0
Ammoniac	**35**	2	**30**	0	12	2	23	6
Herbaceous	2	0	0	**102**	4	0	2	0
Wood	8	0	0	10	**90**	0	2	0
Peach	0	4	8	0	0	**90**	4	4
Cellar	12	2	0	0	**47**	2	**45**	2
Potato	2	0	4	2	23	4	7	**68**

It appears to be clear that for the five odours of the first group (flower, peach, herbaceous, wood and potato), the choice of a colour goes through a semantic way: odour → context → colour, and this association is exactly this of the artist (table 1). Moreover, when the source is more ambiguous like for resin and ammoniac, the colour choice is no more managed by the context. However, the consensus percentage with the 72 colours chart (43% for resin, 54% for ammoniac) demonstrates that an other association type exists. Next experiments will be done to understand if this association is a perceptive one or a semantic association not through the context but through a pleasant / unpleasant colours interpretation.

The artistic approach is based on a semantic association odour / colour. The artist searches the best colour in the odour context like a designer should do. This implicates that the consumer always integrates odour / colour message like this. Previous results show that this is not always the case, mostly if the odour is unpleasant. To confirm that the global coloured message is correctly interpreted, a practical application of this odour / colour association is tested. Consumers have to associate four colour cards and four samples of French cheeses. For soft cheese, 65% of consumers associate the right card to the right sample, 85% for blue cheese, 58% for pressed cheese and 91% for fresh cheese. Right answer rating obtained demonstrated that this associative approach is understand by the consumer that is to say, that it is possible to traduce sensory attributes of product inside colour packaging.

4. CONCLUSIONS

This first series of experiments shows that it is possible to represent sensory properties such as the odour or the flavour by an association of colours. The consumer interprets the coloured cards obtained correctly. Those cards could thus be an interesting tool to develop in design of packaging in order to create new conditionings closely related to the intrinsic characteristics of the product. The theoretical part of the study on association odours / colours tends to show that it rest mainly on a semantic logic. The percentages of consensuses observed coupled to an aesthetic interpretation of the results leads us to propose a tool richer than the simple coloured card. Indeed, it is interesting to bind at the same time the associations carried out in absence of description and that obtained with the description of the odour. Thus, the consumers and the non-consumers would understand the result at the same time. Additional studies will make it possible to apply the concept to other foodstuffs like wine or spirits and validate this step of association completely. Multiplication of the answers, will allow us moreover to seek rules and leading to a modelling which will be able to be in the long term concluded by realisation of an assistance to creation data-processing tool.

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