PAPER

CHILDREN PREFERENCES OF COLOURED FRESH CHEESE PREPARED DURING AN EDUCATIONAL LABORATORY

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ABSTRACT

Choices among young consumers are mainly driven by food preferences; in particular, a connection between appearance and acceptance of food has been highlighted, together with a general lack of knowledge of food processing. For these reasons, educational activities are important to increase scientific knowledge and awareness. The cheese-making educational laboratory described herein involved children, adolescents, and their parents/teachers in the preparation of fresh and naturally-coloured cheeses. At the end of the activity, both the colour preference and possible relation between preference and colour of cheese prepared were investigated administering a short questionnaire.

- Keywords: cheese preference, children food preference, colour preference, gender, neophobia, nutrition education -

INTRODUCTION

Food preference has a fundamental role in driving consumer's choices and habits, especially in children (COOKE, 2007; NICKLAUS *et al.*, 2004, LAUREATI *et al.*, 2015a). Therefore, the number of food products specifically developed for children is growing and this market is acquiring increasing importance (ISSANCHOU, 2015).

Consequently, the youngest consumers are frequently involved in research and development programs, since their food habits will influence choices as they grow older and because their preferences, even if partly driven by advertisements (USTJANAUSKAS *et al.*, 2014), seem to be strictly related to the sensory aspects of food (PAGLIARINI *et al.*, 2005; MUSTONEN and TUORILA, 2010).

In 1994, Moskowitz (MOSKOWITS, 1994) highlighted how a visually pleasing product tends to be more appreciated by children, as visual attributes seem to be, among different sensory characteristics, those that mainly determine its success (KILDEGAARD *et al.*, 2011; TOPCU, 2015). Indeed, children tend to create an "ideal picture" of each food product that can be related to their own idea of "good"; this picture represent a sort of reference point that can be used to dislike products whose appearance is not close to their expectation (MUSTONEN and TUORILA, 2009).

This phenomenon, called food neophobia, is defined as the fear of eating new or unfamiliar food (PLINER and HOBDEN 1992) and is related to both the quality and variety of diet (LAUREATI *et al.*, 2015b).

Nutritional education and food-related diseases prevention activities can be used for children and teenagers in order to: *i)* reduce the impact of poor food habits on health, and *ii)* avoid food neophobia, mainly responsible for refusing consumption of fruits and vegetables (WARDLE *et al.*, 2003). Moreover, a lack of awareness of procedural knowledge, both in terms of food processing and nutritional values, must be taken into account (WORSLEY, 2002), highlighting the link between traditional food preparation and sensory properties (LAUREATI *et al.*, 2006).

Nowadays, food education is mainly based on the social-cognitive theory (SCT) (BANDURA and ADAMS 1977), which incorporates the interaction of personal, environmental and behavioural factors. According to this theory, principles that are highly influential in establishing changing food behaviour in children are both models and repeated exposure.

Among the models, those that have been found to be effective in children include cartoon characters, peers, mothers, unfamiliar adults and teachers; moreover, children seem to be influenced more by the behaviour of multiple rather than single models (LOWE *et al.*, 2004). Furthermore, according to Zajonc's "mere exposure" theory (ZAJONC, 1968), repeated exposure to a specific food increases the liking and consumption of that food (COOKE *et al.*, 2011; WARDLE *et al.*, 2003B) through a mechanism that is believed to be a "learned safety" behaviour (KALAT and ROZIN, 1973). According to this theory, repeated ingestion of an unfamiliar food without negative consequences leads to increased acceptance of that food.

Several educational interventions for food have investigated all these factors, reporting promising results, especially for consumption of fruits and vegetables (EVANS *et al.*, 2012; LAUREATI *et al.*, 2014; REVERDY *et al.*, 2008). Both principles of imitation and repeated exposure characterise food laboratories aimed at involving children in food preparation, thus familiarising them with food ingredients and technologies. Furthermore, it has been reported that the involvement of children in food preparation can contribute to increasing their acceptance for that food, according to the principle of repeated exposure (CHU *et al.*, 2012).

For all these reasons, food educational interventions can play a relevant role in driving choice, interest and preference of children through better awareness of both sensory characteristics and technological process of traditional food products (MUSTONEN and TUORILA, 2010).

The educational cheese-making activity reported herein, called *Cheese making in one hour*, was conceived by a committee of referees as part of the Festival della Scienza 2014 (which took place in Genoa, Italy, from October 24 to November 2, 2014) and is considered as a "teaching tool" in order to increase scientific information about the cheese-making process.

This practical laboratory took the form of a family entertainment during which children and parents or teachers could share principles of traditional cheese making, spending some family or educational time away from daily work, but related to increased knowledge of food science.

The activity involved children, teenagers and adults (age from 6 to 87 years) in the traditional preparation of a fresh "*primo sale like*" cheese. Cheeses were naturally coloured (using turmeric, rocket and beetroot juice), and in order to keep the attention of participants, each was actively involved in the process by preparing his/her personal small cheese.

At the end of the activity, both the colour preference and possible relation between the colour of cheese prepared and preference were investigated by administration of a short and simple questionnaire.

MATERIALS AND METHODS

The cheese-making activity involved 738 participants (395 females and 343 males) with an age between 5 and 87 years and divided in groups of no more than 30 individuals. Both families and school classes could participate in the activity by asking the Festival staff to make

Table 1 - Natural dyes and their amounts are reported together with the final colour of each cheese and its visual aspect.

Cheese colour and appearance		Dye	Amount (g/L of milk)
	Yellow	Turmeric	5
	Pink	Beetroot juice	20
	White and green	Rocket	20

a reservation; given the popularity of the Festival, mainly represented by children and partly by parents/teachers, a large number of participants were enrolled. Each participant had an active role in the laboratory, giving his/her contribution to one of the 4 phases of cheese making: 1) adding starter, rennet and natural flavour to milk; 2) curd cutting and synaeresis; 3) curd breaking and purge; 4) cheese shaping. During the Festival, the laboratory was repeated at least 3 times a day by 4 previously-trained scientific facilitators. Due to the fact that the cheese-making laboratory should last only one hour (related to the timing of the Festival), one pot (Bartscher GmbH, Germany) was dedicated to each of the 4 main phases; in this way, participants could move from one pot to the next instead of proceeding step-by-step using a single pot such that each of the phases could be observed in a short length of time.

Cheese-making phases

1) Starter, rennet and milk natural flavouring

Fresh whole cow milk was heated to 36° C and 17 g/L of natural whole yoghurt was added as a starter. In order to produce coloured cheeses, different natural dyes were added (rocket, turmeric and beetroot juice) as reported in Table 1. While turmeric and beetroot juice were added to the milk 30 minutes after the addition of starter, together with 0.5 ml/l milk of liquid rennet (80% chymosin, 20% pepsin, provided by Graco), rocket was added during the last step of cheese shaping.

2) Curd cutting and synaeresis

After enzymatic coagulation, due to the addition of liquid curd, the gel obtained was cut into 4 × 4 cm squares, and 30 minutes later participants could observe the phenomena of curd synaeresis.

3) Curd breaking and purge

The squares of curd were broken into pieces of approximately 1.5 cm; during this phase, rocket was added (20 g/l milk) for preparation of green cheese.

4) Cheese shaping

Finally, the small pieces of curd were collected in dedicated shaper (60 g cheese shaper in polypropylene and polyethylene, Tecnolatte srl, Italy) by each participant as shown in Fig. 1.

Fig. 1 - Children at the cheese-making educational laboratory, during collection of a yellow-curd into a dedicated shaper.

5) Questionnaire

At the end of the cheese-making laboratory, each participant was administered a dedicated and simplified questionnaire. The questionnaire contained a first part regarding personal information: age and gender. Next, each participant was asked to provide information on: *i)* which colour of cheese he/she preferred and *ii)* which one he/she prepared. The filled questionnaires were collected in three dedicated paper boxes, one for each cheese colour.

STATISTICAL ANALYSIS

Preference data were analysed according to chi square test ($p>0.05$). Statistical analysis of data was carried out using the SAS/STAT statistical software package version 9.3.1. (SAS Institute Inc., Cary, USA).

RESULTS

The cheese-making laboratory was visited by 1900 participants. Many questionnaires were incomplete, while some participants preferred to not give their opinion. Data from 738 participants was collected considering the gender dimension and 5 age subgroups (1: 5-7 years old, 77 participants; 2: 8-10 years old, 142 participants; 3: 11-13 years old, 182 participants; 4: 14-18 years old, 203 participants; 5: >18 years old, 134 participants); subsequently, the visual preference for one of the three coloured cheeses was considered, as reported in Table 2. Data were divided in the 5 subgroups reported above, selected mainly according to different stages of cognitive development (GUINARD, 2001). In addition, different food preferences and consumption behaviour observed in these age groups confirmed that this type of age subdivision is relevant (LAUREATI *et al.*, 2015).

Considering colour preference, regardless of age, the majority of participants preferred the white and green cheese (333 vs. 243 yellow and 162 pink; chi square=59.49; $p<0.0001$), which could be considered as the most "traditional" because it is present on the Italian market, rather than pink or yellow cheeses, and probably seen for the first time during the laboratory activity by the most of the respondents.

As reported in Table 2, sorting by age, it could be seen that the youngest participants (between 5 and 7 years old) chose the pink cheese as their favourite, while next oldest age subgroup (8 to 10 years) preferred yellow. Subjects from 11 years old and older chose the white and green cheese as their favourite, as did the overall population.

This result may be associated with both the attractive effect of colours on the children and to the tendency of the youngest, as observed by Moskowitz (MOSKOWITZ, 1994), to prefer food products with a pleasing appearance. Starting from the age of 11, children started to prefer, in accordance with adults, the white cheese mixed with rocket.

Moreover, the youngest children's preference can be explained by food neophobia, which is particularly high for fruits and vegetables, reaching its highest level between 2 and 6 years (PELCHAT and PLINER, 1995; PLINER, 1994; PLINER and LOEWEN, 1997; LAUREATI *et al.*, 2015c). It then tends to decrease when children move towards adolescence (ADDESSI *et al.*, 2005), finally becoming relatively stable in adulthood, probably because of an increased number of food experiences (COOKE and WARDLE, 2005).

On the other hand, the preference of older respondents for a white cheese enriched with a vegetable (rocket), may be linked to a low acceptance of adults for an innovative food, while its dislike among the younger interviewees could be related to the visual presence of rocket inside cheese (RUSSEL and WORSLEY, 2008; LAUREATI *et al.*, 2015).

It has already been demonstrated that traditional food products have been always recognised by consumers as linked to a specific geographical origin and highest sensory quality (GUERRERO *et al.*, 2009); as a consequence, this cheese was probably considered much more similar to product already on the Italian market compared to the pink and yellow ones.

Table 2 - Non-parametric statistical analysis of data to identify significant differences in preference of cheese colour by age. Data were analysed using a Chi square test.
Interviewees were subgrouped by age: 5-7, 8-10, 11-13, 14-18, >18 years.

Age subgroup (years)	Preferred cheese			Total	Chi square	df	P value
	Yellow	Pink	White and green				
5-7	27	35	15	77	7.9	2	0.02
8-10	69	28	45	142	17.9	2	0.00
11–13	59	34	89	182	25.0	2	0.00
14-18	57	44	102	65	27.4	2	0.00
>18	31	21	82	134	47.9	2	0.00
All	243	162	333	738	59.5	2	0.00

Table 3 - Non-parametric statistical analysis of data to identify significant differences in preference of cheese colour by gender and age. Data were analysed using a Chi square test.
F= female; M=male; df=degrees of freedom. Interviewees were subgrouped by age: 5-7, 8-10, 11-13, 14-18, >18 years.

Prefered cheese	Gender	Age subgroup (years)					
		5-7	8-10	11-13	14-18	>18	Total
Yellow	F	10	24	31	18	25	108
	M	17	45	28	39	6	135
	Total	27	69	59	57	31	243
	Chi square	1.8	6.4	0.2	7.7	11.6	3.0
	df	1	1	1	1	1	1
	pvalue	0.2	0.0	0.7	0.0	0.0	0.1
Pink	F	29	23	22	23	18	115
	M	6	5	12	21	3	47
	Total	35	28	34	44	21	162
	Chi square	15.1	11.6	2.9	0.1	10.7	28.5
	df	1	1	1	1	1	1
	p value	0.0	0.0	0.1	0.8	0.0	0.0
White and green	F	4	20	47	47	54	172
	M	11	25	42	55	28	161
	Total	15	45	89	102	82	333
	Chi square	3.3	0.6	0.3	0.6	8.2	0.4
	df	1	1	1	1	1	1
	p value	0.1	0.5	0.6	0.4	0.0	0.5

Sorting by gender (Table 3), no differences in preferences were seen regarding the white and green cheese, except for the oldest group (>18 years). A clear gender-related difference was, however, found for the pink and the yellow cheeses: the former seemed to be much more appreciated by females (all age classes except 14–18 years, but only if $p<0.10$ is considered as marginally significant), while the latter was favoured among males (especially from 8-10, 14-18).

In order to determine if this could influence the visual preference of participants, they were also questioned about the colour of the cheese they prepared; however, a significant association between cheese preferred and colour preference for one of the three coloured cheeses was not seen, even if some significant differences were seen among the youngest consumers (Table 4).

In particular, when sorting by age, the subgroup from 8 to 10 years who prepared the yellow cheese more frequently preferred this cheese over the others (26 of 52, chi square=7.5 p=0.02). Likewise, the subgroup from 5 to 7 years who prepared the pink cheese preferred it more frequently than others (12 of 21 choices, chi square=7.1 p=0.03). However, the older participants did not show a consistent trend of preferred cheese over than prepared.

Data from literature suggest that 7–8 exposures are needed to produce a learning effect

Table 4 - Non-parametric statistical analysis of data to assess if the colour of sample prepared could affect the overall colour preference. Data were analysed using Chi square test.
F= female; M=male; df=degrees of freedom. Interviewees were subgrouped by age: 5-7, 8-10, 11-13, 14-18, >18 years.

Prepared chesee	Age subgroup	Preferred cheese						
	(years)	Yellow	Pink	White and green	Total	Chi square	df	P value
Yellow	5-7	15	14	8	37	2.3	2	0.31
	8-10	26	10	16	52	7.5	2	0.02
	11-13	21	9	37	67	17.7	2	0.00
	14-18	18	17	30	65	4.8	2	0.09
	>18	14	9	39	62	25	2	0.00
Pink	5-7	7	12	2	21	7.1	2	0.03
	8-10	19	10	9	38	4.8	2	0.09
	11-13	9	12	18	39	3.2	2	0.20
	14-18	22	16	37	75	9.4	2	0.01
	>18	6	6	19	31	10.9	2	0.00
White and green	5-7	5	9	5	19	1.7	2	0.43
	8-10	24	8	20	52	8	2	0.02
	11-13	29	13	34	76	9.5	2	0.01
	14-18	17	11	35	63	14.9	2	0.00
	>18	11	6	24	41	12.6	2	0.00

that can influence consumer appreciation regarding a product (MAIER *et al.*, 2007). Thus, it might well be that the single exposure during the cheese-making educational activity was not enough to influence children choice.

CONCLUSIONS

The results of this study highlight how visual preference for a food, in terms of colour, changes during different stages of life. Indeed, the data demonstrates how children can be influenced by food appearance and how the aspect of a product can be related to its acceptance, especially among younger individuals; in fact, the youngest participants tended to prefer intensively coloured cheese vs. the white and green version, probably because of the presence of rocket. Moreover, the cheese-making laboratory was considered to be a useful tool in order to catch and keep participants' attention, involving them in a practical activity while sharing educational and scientific information related both to food processing (fresh cheese production) and sensory (visual) aspects.

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