

## PAPER

# CHILDREN PREFERENCES OF COLOURED FRESH CHEESE PREPARED DURING AN EDUCATIONAL LABORATORY

F. TESINI\*<sup>1</sup>, M. LAUREATI<sup>2</sup>, R. PALAGANO<sup>1</sup>, M. MANDRIOLI<sup>1</sup>,  
E. PAGLIARINI<sup>2</sup> and T. GALLINA TOSCHI<sup>1,3</sup>

<sup>1</sup>DISTAL, Department of Agricultural and Food Sciences,  
Alma Mater Studiorum - University of Bologna, P.zza Goidanich 60, 47521 Cesena, FC, Italy

<sup>2</sup>Department of Food, Environmental and Nutritional Sciences (DeFENS),  
University of Milan, Via Celoria 2, 20133 Milan, Italy

<sup>3</sup>CIRI, Department of Agricultural and Food Sciences,  
Interdepartmental Centre for Industrial Research in Agri-Food,  
Alma Mater Studiorum - University of Bologna,  
P.zza Goidanich 60, 47521 Cesena, FC, Italy

\*Corresponding author: [federica.tesini@unibo.it](mailto:federica.tesini@unibo.it)

## 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 syneresis; 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 syneresis

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 syneresis.

### 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	203	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.

Preferred cheese	Gender	Age subgroup (years)					Total
		5-7	8-10	11-13	14-18	>18	
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
Pink	pvalue	0.2	0.0	0.7	0.0	0.0	0.1
	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
White and green	df	1	1	1	1	1	1
	p value	0.0	0.0	0.1	0.8	0.0	0.0
	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 cheese	Age subgroup (years)	Preferred cheese				Total	Chi square	df	P value
		Yellow	Pink	White and green	Total				
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.

## ACKNOWLEDGEMENTS

The activity described in this work was made possible by the kind permission of Festival della Scienza. A special thanks goes to Emanuele Bargelli, events Creator & Coordinator for Festival della Scienza.

## REFERENCES

Addressi E., Galloway A.T., Visalberghi E. and Birch L.L. 2005. Specific social influences on the acceptance of novel foods in 2–5-year-old children. *Appetite* 45(3): 264.

Bandura A. and Adams N.E. 1977. Analysis of self-efficacy theory of behavioural change. *Cognitive Ther Res.* 1(4): 287.

Chu Y.L., Farmer A., Fung C., Kuhle S., Storey K.E. and Veugelers P.J. 2013. Involvement in home meal preparation is associated with food preference and self-efficacy among Canadian children. *Public Health Nutr.* 16(1): 108.

Cooke L. and Wardle J. 2005. Age and gender differences in children's food preferences. *Br. J. Nutr.* 93: 741.

Cooke L. 2007. The importance of exposure for healthy eating in childhood: a review. *J. Hum. Nutr. Diet.* 20: 294.

Cooke L.J., Chambers L.C., Añez E.V., Croker H.A., Boniface D., Yeomans M.R. and Wardle J. 2011. Eating for pleasure or profit: the effect of incentives on children's enjoyment of vegetables. *Psychol Sci.* 22(2): 190.

Evans C.E., Christian M.S., Cleghorn C.L., Greenwood D.C. and Cade J.E. 2012. Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 years. *Am. J. Clin. Nutr.* 96(4): 889.

Galloway A.T., Lee Y. and Birch L.L. 2005. Predictors and consequences of food neophobia and pickiness in young girls. *J. Am. Diet. Assoc.* 103: 692.

Guerrero L., Guàrdia M.D., Xicola J., Verbeke W., Vanhonacker F., Zakowska-Biemans S. and Hersleth M. 2009. Consumer-driven definition of traditional food products and innovation in traditional foods. A qualitative cross-cultural study. *Appetite.* 52(2): 345.

Guinard J-X. 2001. Sensory and consumer testing with children. *Trends Food Sci. Technol.* 11: 273.

Issanchou S. 2015. Sensory & consumer studies with special populations: children and elderly. *Curr. Op. Food Sci.* 3:53.

Kalat J.W. and Rozin P. 1973. "Learned safety" as a mechanism in long-delay taste-aversion learning in rats. *J. Comp. Physiol. Psych.* 83(2): 198.

Kildegaard H., Olsen A., Gabrielsen G., Møller P. and Thybo A.K. 2011. A method to measure the effect of food appearance factors on children's visual preferences. *Food Qual. Prefer.* 22: 763.

Laureati M., Pagliarini E., Calcinoni O. and Bidoglio M. 2006. Sensory acceptability of traditional food preparations by elderly people. *Food Qual. Prefer.* 17: 43.

Laureati M., Pagliarini E., Toschi T.G. and Monteleone E. 2015a. Research challenges and methods to study food preferences in school-aged children: A review of the last 15 years. *Food Qual. Pref.* 46: 92.

Laureati M., Bergamaschi V. and Pagliarini E. 2015b. Assessing childhood food neophobia: Validation of a scale in Italian primary school children. *Food Qual. Prefer.* 40: 8.

Laureati M., Bertoli S., Bergamaschi V., Leone A., Lewandowski L., Giussani B., Battezzati A. and Pagliarini, E. 2015c. Food neophobia and liking for fruits and vegetables are not related to excess weight in Italian children. *Food Qual. Pref.* 40: 125.

Lowe C.F., Horne P.J., Tapper K., Bowdery M. and Egerton C. 2004. Effects of a peer modelling and rewards-based intervention to increase fruit and vegetable consumption in children. *Eur. J. Clin. Nutr.* 58(3): 510.

Maier A.S., Chabanet C., Schaal B., Issanchou S. and Leathwood P. 2007. Effects of repeated exposure on acceptance of initially disliked vegetables in 7-month old infants. *Food Qual. Prefer.* 18(8): 1023.

Moskowitz H.R. 1994. "Food Concepts and Products: Just-in-time Development" Food and Nutrition Press.

Mustonen S. and Tuorila H. 2010. Sensory education decreases food neophobia score and encourages trying unfamiliar foods in 8-12-year-old children. *Food Qual. Prefer.* 21: 353.

Mustonen S. and Tuorila H. "Sensory education of school children: what can be achieved?" *ChemoSense* 12(1): 1.

Nicklaus S., Boggio V., Chabanet C. and Issanchou S. 2004. A prospective study of food preferences in childhood. *Food Qual. Pref.* 15: 805.

Pagliarini E., Gabbiadini N. and Ratti S. 2005. Consumer testing with children on food combinations for school lunch. *Food Quality and Preference* 16: 131.

Pelchat M.L. and Pliner P. 1995. "Try it. You'll like it": Effects of information on willingness to try novel foods. *Appetite.* 24: 153.

Pliner P. and Hobden K. 1992. Development of a scale to measure the trait of food neophobia in humans. *Appetite.* 19: 105.

Pliner P. 1994. Development of measures of food neophobia in children. *Appetite.* 23(2): 147.

Pliner P. and Loewen E.R. 1997. Temperament and food neophobia in children and their mothers. *Appetite.* 28(3): 239.

Reverdy C., Chesnel F., Schlich P., Köster E.P. and Lange C. 2008. Effect of sensory education on willingness to taste novel food in children. *Appetite.* 51(1): 156.

Russell C.G. and Worsley A. 2008. A population-based study of preschoolers' food neophobia and its associations with food preferences. *J. Nutr. Educ. Behav.* 40(1): 11.

Topcu Y. 2015. Turkish consumer decisions affecting ice cream consumption. *Ital. J. Food Sci.* 27(1): 29.

Ustjanauskas A E., Harris J.L., and Schwartz M.B. 2014. Food and beverage advertising on children's web sites. *Pediatr. Obes.* 9 (5): 362.

Wardle J., Cooke L.J., Gibson E. L., Sapochnik M., Sheiham A. and Lawson M. 2003a. Increasing children's acceptance of vegetables; a randomized trial of parent-led exposure. *Appetite.* 40(2): 155.

Wardle J., Herrera M.L., Cooke L. and Gibson E.L. 2003b. Modifying children's food preferences: the effects of exposure and reward on acceptance of an unfamiliar vegetable. *Eur. J. Clin. Nutr.* 57(2): 341-348.

Worsley A. 2002. Nutrition knowledge and food consumption: can nutrition knowledge change food behaviour? *Asia Pac. J. Clin. Nutr.* 11: 579.

Zajonc R.B. 1968. Attitudinal effects of mere exposure. *J. Pers. Soc. Psychol.* 9 (2): 1.