

# Impact of Age on Sensorial Response of Sri Lankan Consumers on Biscuit Types

Gunathilaka U.G.S.A<sup>1</sup>, Wijewardhana U.S<sup>1</sup>, Navaratne S.B<sup>1</sup>

<sup>1</sup>Department of Food Science and Technology, Faculty of Applied Sciences, University of Sri Jayewardenepura, Sri Lanka-10250

**Abstract**— Sensory evaluation associates with the psychophysics behavior of the consumer. Hence, this research was conducted to study the effect of individual's age on the sensory profile such as appearance, odor, texture, taste and overall acceptance of five types of biscuits, namely crackers, semi-sweet biscuits, cream biscuits, savory biscuits and wafers. This relationship was assessed using a consumer panel consisting of 125 respondents, selected randomly by resorting ISO 5495:2005E sampling plan. Panelists were asked to rate the sensory attributes of the served biscuit samples over a five-point hedonic scale and collected data were statistically analyzed to determine whether there is a relationship between age and the sensorial response of the individuals. Results revealed that sensory stimuli taste, texture and overall acceptance were affected by the age of the respondent; however, appearance and odor were not significantly affected by the Age of respondents.

**Keywords**—Biscuits, Consumer Behavior, Gustatory Response, hedonic scale, Olfactory Response, sensorial response, sensory attributes.

## I. INTRODUCTION

Sensory attributes of foods are an important factor in the broad spectrum of food choice. Therefore, sensory evaluation has become an integral part of the food industry. Even though electronically capable devices are developed to gauge the sensory attributes of food items, human sensitivity on the sensory attributes is the deciding factor in food choice. Hence, human being widely used as subjects in sensorial research (1).

The most important factor for food consumption is to obtain nutrients to maintain a healthy life (2). Besides that, people inadvertently tend to enjoy with food while eating particularly for comfort food items, which are designed to provide mental relaxation as well as to satisfy sensory organs optimally rather than merely pacifying hunger (3). Although comfort foods are not a part of the major meals, which affect the nutritional and health requirements of the consumer (4). Therefore, it is important to understand the consumption pattern of snack food types. Since the food choice is dependent on the sensorial response (5), the dietary behavior of a person can be explained by identifying the food choice over their sensory attributes.

Person's dietary behavior towards comfort food is mostly depending on the psychological conditions. Moreover, demographic factors, environmental factors, geographical factors also contribute to mold the orientation of mindset of a person towards the expected dietary attitude (6). Among those factors, age is a crucial factor which affects both physical and psychological conditions. For instance, with the aging, the sensory attributes "taste and smell" are unintentionally (7) (8) change along with the lifestyle, health conditions, values and

beliefs.

Biscuits is a major type of comfort food consumed all over the world. There are many different biscuit varieties, depending on the manufacturing process, sensory profile, composition, product types etc. (9). According to the product types, some of them are sweet biscuits, crackers, savory biscuits and wafers. Sweet biscuits include soft dough and hard dough biscuits, which are sweet or semi-sweet, savory biscuits are more similar to snack biscuits, with spicy and salty tastes, cream biscuits consists of a wide sensory profile, including different flavors and colors. But crackers have a rather narrow sensory profile, with bland taste and crunchy texture; wafers have unique properties compared to other types; they have a light texture and creamy flavor. Due to these diverse sensory phenomena in biscuits, consumer's attraction towards the biscuits would be varied over the variable "the age".

## II. MATERIAL AND METHODOLOGY

### A. Assessment of the buying behavior of biscuit types

The Sri Lankan biscuit market consists of a wide variety of biscuit types and brands. To select the biscuit variety and brand for the sensory evaluation a market survey was conducted, targeting a selected site. A market survey was conducted by collecting answers to a self-administrated questionnaire which distributed among the selected stores in the pre-designated areas in Panagoda and Homagama town belong to the Colombo district in Sri Lanka. The selected territory belongs to a semi-urban, urban and an industrialized area. Therefore, there are considerable numbers of stores, which usually carry out sales in grocery items. According to the details collected from the corresponding area, there were 26 grocery stores, out of that ten numbers of them were randomly selected and the questionnaires were distributed. When preparing the questionnaire, it was prepared by targeting the store owners. So also they were asked to indicate "high demand" biscuit brands among the customers as well as most preferred biscuits varieties among the selected biscuits type (Crackers, sweet biscuits, savory biscuits, cream biscuits and wafers, etc.). Apart from that, questions were asked to get an idea on the most preferred biscuits varieties in different age groups. Finally, the prepared questionnaire was distributed among the selected grocery owners and the answers were collected after one week.

### B. Assessment of the effect of age on the sensorial response of individuals in the consumer panels for selected biscuit types

Biscuit types can be categorized into crackers, semi-sweet biscuits, savory biscuits, cream (filled) biscuits and wafers

according to product categories. These categories include the highly consumed biscuit varieties in the Sri Lankan market. These biscuit types have different nutritional as well as sensory properties. Therefore, the preference for the biscuit types may vary among the individuals according to their age.

*C. Selecting the panelists for the sensory evaluation*

The site belongs to the western province of Sri Lanka which include Homagama and Panagoda area, was selected using the google map to conduct the study. According to the department of census and statistics, it has about 7354 residents. As declared in the ISO 5495:2005E standards, 125 panelists were randomly selected from that population for a consumer panel. When implementing the sampling plan, unable to get even representation for each age group because age was an uncontrollable variable of the selected respondents. When selecting the consumer panel, strictly followed the guidelines pertaining to the criteria described in sensory testing. Further, made sure not to take respondents suffering from diseases such as colds, diabetics, mouth cancers, as well as addictions for smoking, alcoholic beverages, chewing beetles etc. And also the panelists should not be exposed to for a long time to drug courses. And also the residents in the selected area represent all of the age groups (15-30, 30-45, 45-60 and 60-75) appropriately. Thus the data collected in the study are more reliable.

*D. Preparation of the samples*

Using the data collected from the market survey, five types of biscuits were selected on the basis of biscuit categories. Those categories are given in the table 1 along with the corresponding three digits numerical numbers.

TABLE 1. Selected biscuit types and their variety with the corresponding three digits number

Biscuit type	Selected Variety	Sample Number
Crackers	Cream Cracker	101
Semi-Sweet Biscuits	Marie	102
Cream Biscuits	Chocolate Cream Biscuits	103
Savoury Biscuits	Savoury Nuts Biscuits	104
Wafers	Vanilla Wafers	105

*E. Sensory analysis*

The scope of this study was to determine the perceptual response of the respondent in different age categories pertaining to the sensory stimuli such as appearance, smell, texture, taste and overall acceptance of selected biscuit types as given in table 1 and respondents were asked to indicate their choice over five point hedonic scale.

*F. Setting the atmosphere for the sensory evaluation*

Necessary condition for the sensory evaluation was accomplished in compliance with ISO 8589:2007 standards. It was carried out in a calm and quiet environment in the resident of the respondent within the time period of 9.00 to 11.00am and 2.00pm to 4.00 pm, avoiding the meal times and busy work schedules. Moreover, made sure to carry out the evaluation under the circumstance, where the panelists were undisturbed (tired, rushed, hungry, hurry etc.).

*G. Sensory evaluation*

Panelists were initially asked to assess visual characteristic-appearance (color) of the samples while taking 20 seconds breaks between two samples. Thereafter, the olfactory attribute, therein the panelists were asked to take three deep and quick sniffs from the samples without touching the skin of the nose and then to breathe in clean air at least for 20 seconds before moving to the next sample. The sensory attribute “texture” was assessed by touching the samples as well as getting the mouthfeel. In the case of sensory stimulus taste, about 25 -30g of biscuit from each type was served and panelists were instructed to rinse mouth with clean water and too asked to get at least 20 seconds break after testing a sample to overcome sensory fatigue. Finally, after assessing the appearance, smell, taste and texture of the samples, panelists were asked to rate overall acceptance of each sample according to the five point hedonic scale.

*H. Statistical analysis*

The sensorial response of the respondents on types of biscuits was subjected to statistical analysis to determine the possible relationship between the sensory attributes and the age of the respondent. IBM SPSS 21.0 version statistical software was used for the analysis of data at 95% confidence level. Since the sensory panel used for the evaluation was a consumer-based untrained panel, Friedman statistical test method was used to analyze the data.

III. RESULTS AND DISCUSSION

The results obtained from the sensory evaluation pertaining to the five sensory attributes of five types of biscuits were ranked corresponding to the age groups according to the methodology of Friedman statistical test method. The mean rank obtained for the respective sensory attributes of biscuit types were used to depict the perception of respondents in different age groups graphically and outcomes of the study are shown in figure 1, 2, 3, and 4.

*a) Perception of the respondents for the sensory attribute “appearance” of biscuit types against age groups*

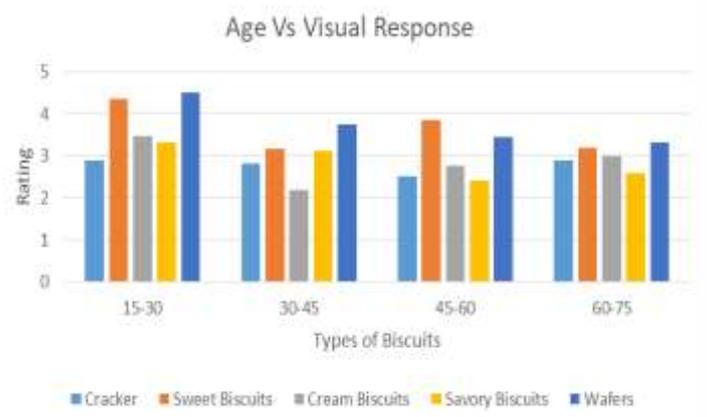


Fig. 1. Response of respondents for the Appearance of the Biscuit types.

According to figure 1, there isn't much difference in rating for the sensory stimulus of the appearance of biscuits types

among the age groups. However, most of the respondents prefer to have wafer biscuits except the age group 45-60 which prefer to have semi-sweet biscuits more. In the case of age group 30-45, which preference for the cream biscuits was slightly less than that of other age groups in the study.

b) Sensory perception for the attribute “odor” of biscuit types against age groups

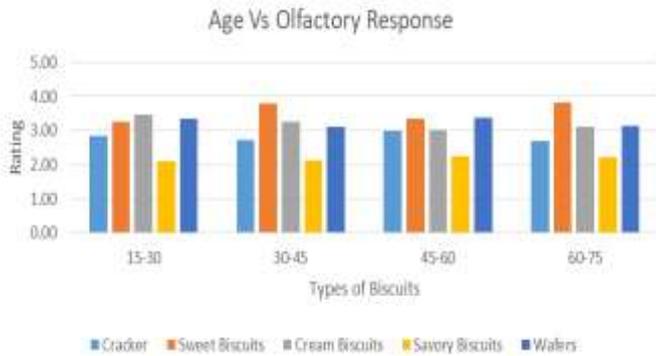


Fig. 2. Response of the respondents for the fragrance of the Biscuit types.

Figure 2 depicts the perceptual response of the respondents in different age groups towards the sensory stimulus smell for the four types of biscuits. Therein, the graphs graphically illustrate that there is no considerable difference in smell between the biscuit types and age groups. However, most of the respondents prefer to have the fragrance of the semi-sweet biscuits except the age group 15-30 and 45-60 which prefer little more for smell of cream biscuits and wafers respectively.

c) Sensory perception towards the texture of biscuits among different age groups

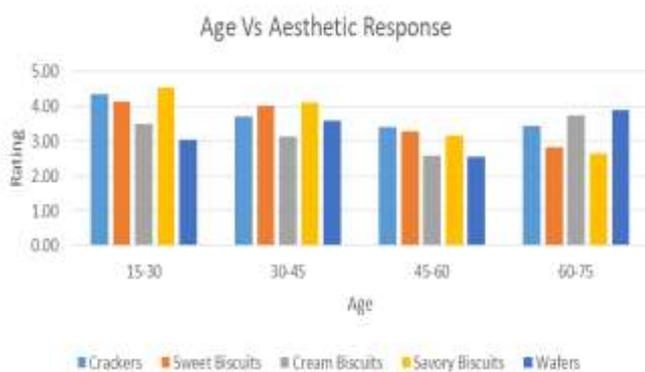


Fig. 3. Response of the respondents on the Texture of the Biscuit types.

As illustrated in figure 3, the texture of different types of biscuits is considerably varied among the age groups. While age groups 15-30 and 30-45, like the texture of savory biscuits more, age group 45-60 prefers more on the crackers and semi-sweet biscuits comparatively the other types. However, the age group 60-75 prefers much for the texture of wafers.

d) Sensory perception towards the taste of the biscuits against age groups

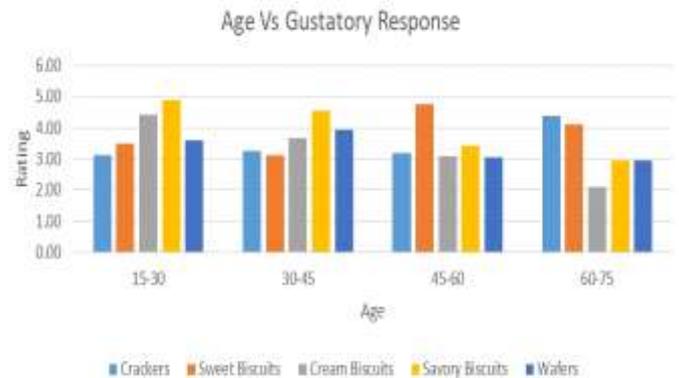


Fig. 4. Response of the respondents on Taste of the Biscuit types.

According to figure 4, Taste shows considerable differences among the biscuit types against age groups. According to the results, age group 15-30 and 30-45 prefer the taste of savory biscuits and cream biscuits, while the age groups 45-60 and 60-75 prefer much on semi - sweet biscuits and crackers respectively.

e) The sensory stimulus overall acceptance of biscuits types against age groups

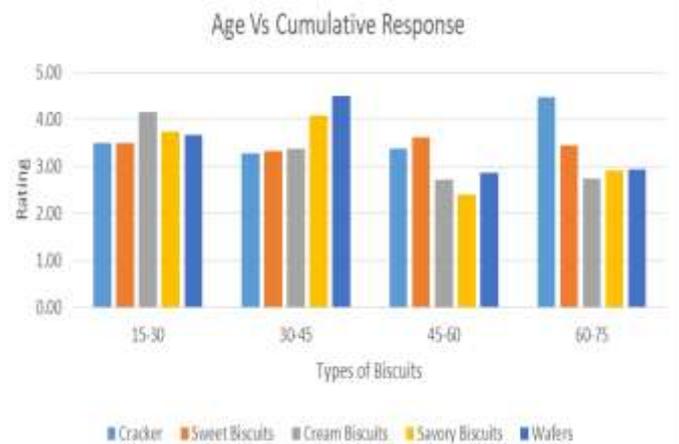


Fig. 5. Response of the respondents on Overall acceptance for the biscuit types.

Figure 5 indicates that, Overall acceptance for the biscuit types is varying against the age of the respondents. According to the outcome of the study, age group 15-30, 30-45, 45-60 and 60-75 prefer cream biscuits, wafers, semi-sweet biscuits and crackers respectively.

To further validate the outcome of this study, the ranking data were further analyzed according to Friedman non-parametric statistical test method and results are given in table 2.

TABLE 2. Calculated P value for 5 sensory attributes of five types of biscuits against age

Sensory Attributes	Age Groups			
	15-30	30-45	45-60	60-75
	N (Sample size)			
	31	38	29	27
P Value				
Appearance	0.262	0.001	0.689	0.348
Odor	0.231	0.546	0.045	0.345
Taste	0.043	0.006	0.038	0.041
Texture	0.015	0.028	0.041	0.001
Overall Acceptance	0.006	0.016	0.024	0.000

If calculated p value is less than 0.05, there is a significant difference between biscuit types at 95% confidence level.

According to the data given in table 2, respondents in the age groups 30-45 ( $P < 0.05$ ) exhibits a significant difference for the sensory stimulus “appearance” of five types of biscuits and only the age group 45-60 demonstrates a significant difference in selecting a biscuit type considering the smell characteristic. However, all age groups exhibit a significant difference in the sensory stimulus “taste” in selecting a biscuit type. And also, all the age groups indicate a significant difference for the sensory attribute “texture” in selecting biscuit types. Similarly, all age groups have considered biscuit types unequally when selecting the most preferable biscuit types according to the response given for the sensory stimulus “overall acceptance”.

#### IV. DISCUSSION

Sensory profile of a food item is an important deciding factor of consumer behavior. The response exhibited by the individuals on the sensory characteristics (Appearance, odor, taste, texture) of food items are affected by a number of factors. Among those factors, the age of a person is very important as it affects both the physical and psychological conditions. So that, with the aging process, people’s attitude towards food products is changing. Thus this study was focused to determine the relationship between a person’s age and the sensorial response towards different types of biscuits; because with the aging process, people’s attitude towards food products is changing.

According to the results of this study, two sensory attributes taste and texture are playing a great role in selecting a biscuit type (10). Considering the sensory stimulus texture, respondents prefer either soft texture or crispy. In the case of age, respondents in the age groups of 15-30 and 30-45, much prefer crispy texture rather than soft texture which was preferred by elder people representing the age groups of 45-60 and 60-75. With the aging, there are physical changes such as difficulties in chewing and swallowing due to weak muscle functioning and dentition. And also saliva production is reduced with aging and medications. (11) Due to these reasons, older people prefer soft and light foods which are easy to chew and digest. Proving this behavior, aged people like more the texture of semi-sweet biscuits and wafers than the other types. In the other hand, youngsters’ lifestyles are characterized by a more energetic and active phenomenon. Thus they prefer snack food with characteristics of comfort

food over nutritious food types. (12). So they intend to have biscuits with more snack based characteristics, which are described with crispy textures and inherited with an attractive & intensive sensory profile. As a whole, respondents in 15-30 and 30-45 age groups seek relaxation by snacking (13), and thus, they are going for more comforting snack foods, which are inherited with high fat and sugar (14). This behavior is encouraged with their attitudes on dietary patterns. Youngsters believe that they have less susceptibility to diseases, making them less health conscious (15). This explains the movement of young respondents’ preference for savory biscuits. With the increment of age, the order of the lifestyle increases (16), tending to a more organized life pattern while reducing the stress. So that people in the age 45-60 group consider biscuits as a regular tea complementary rather than comfort food. Thus, they prefer semi-sweet biscuits which are softer and less sweet.

Taste is a very important stimulus in selecting comfort food types. A persons’ taste sensitivity unconsciously leads him to select the food types which are much appealing to their lifestyles. According to the study, there is a notable difference in taste attribute across the age groups. With aging, there is a decrement in sensory attributes (17) (18). Usually, the sensitivity of taste buds are decreased by a considerable percentage in elders compared to young people. Thus, the aged people find most instances food is bald and tasteless. And also the vulnerability of old people to disease conditions (19) is increasing with the aging. Hence, they are really conscious about their health. Thus, elder people tend to avoid food products with a high amount of artificial additives and obviously, people perceived intensely flavored food products are unhealthier (20). Thus, they display a negative preference for savory biscuits and cream biscuits. Likewise, as age is increasing the appetite is also decreasing (21). Hence, aged people tend to avoid heavy mini meals. Therefore they avoid biscuit types with less fat and sugar such as crackers, semi-sweet biscuits, etc. which give them a less full feeling. On the other hand, young people inadvertently couple with a much busier and active lifestyle, are usually practiced to have regular mini meals. And also due to their higher sensitivity and adventurous lifestyle, they engaged with an intense social life (22). Therefore, they prefer for food types with much wider sensory properties along with various types of strong flavors. Due to these reasons, they express a preference for the taste of cream biscuits, savory biscuits and wafers.

Overall acceptance is a measure of the cumulative response of a respondent for the sensory stimuli of a biscuit type as a whole. This attribute is very important as most instances it is the deciding factor in food choice. Aged people spend much serene and organized lifestyle and they require less energy compared to other ages (23). Thus, they are satisfied with much lighter food types such as crackers because they consider it as a healthier food product. Hence, old people willingly choose cracker biscuits as a result of increased health consciousness. In the case of youngsters who usually chose cream biscuits because cream biscuits having a broad spectrum of a positive sensory profile comparatively other types of biscuit. When the age of the respondents

becomes in between 30- 45 years their preference move more towards wafers and savory biscuits that are much lighter snack type of biscuits. However, busy and hectic lifestyles of the respondents in the age group 30-45, still prefer to have comfort food items with a broad sensory profile. Whereas, the respondents in this age group getting used to a much-organized lifestyle, they willfully tend to reduced frequency of having heavy mini meals compared to youngsters and accepting light snack food items. This behavior gets more intense with the aging, as demonstrated by the results. People in the age group 45-60 are more towards semi sweet hard dough biscuits, which are less caloric and considered as a tea snack, rather than comfort food. When having snacks, elderly consumers psychologically attempt to avoid the guilty feeling of being unhealthy. Hence, they select semi-sweet biscuits which are less sweet in taste and less modified with artificial additives. In the case of sensory stimuli “smell and appearance” which were not considerably altered with the aging process. However, most of the respondents in aged groups much prefer the appearance of wafers, as which is more in a lighter color than the other types. In selecting the comfort food type’s taste and texture characteristics are given more weightage than the sensory attribute “smell and appearance”. But with aging, preference for the appearance of savory biscuits and cream biscuits was gradually subsiding because these biscuit types are intensely colored and color itself unconsciously convey a perception that these biscuits are of badly flavored (24), and thus more unhealthy. Similar to the appearance attribute, smell characteristic is also less affected by the age of the respondents. There is no significant difference between the selected biscuit types against the smell. Most of the respondents have selected the biscuit type based on its aroma, developing it after baking. Since all biscuit types have been subjected to baking, developed aroma was almost same to each other because, basic materials used for biscuits are similar to each other.

Biscuits, which is comfort food is expected to have familiar and comfortable aromas (25). Aroma is a characteristic which arouses memories (26). According to the previous studies, comfortable and familiar aromas bring back comfortable memories and are capable of providing relaxation and safe feeling (27). Thus all the respondents have selected biscuit types with more familiar aromas.

## V. CONCLUSION

Age has a significant effect on the taste and texture sensitivity and the overall acceptance for all biscuit types. With the increment of the age, preference for the sweet taste is reduced. Considering the differences in texture, aged people prefer more soft textured biscuits, while youngsters move more towards crispy textures. In overall, young people prefer cream biscuits, savory biscuits and wafers and in the other hand elders like crackers and semi-sweet biscuits. Appearance and smell attributes of biscuits are not significantly affected of the respondents in different age groups. Respondents representing all age groups prefer to have a biscuit with lighter and distinctive characteristics, such as wafers. In the case of

smell, respondents in all the age groups prefer to have biscuits with the aroma, developing after baking.

## ACKNOWLEDGEMENT

The authors would like to acknowledge the support provided by all the panelists, who participated for the sensory evaluation study for their time and assistance.

## REFERENCES

- [1] Meilgaard M, Vance Civile G, Thomas Carr B. *Sensory Evaluation Techniques, Third Edition*. 2010.
- [2] Clark JE. Taste and Flavour: their importance in food choice and acceptance. *Proc Nutr Soc*. 2005; 57(04):639-643.
- [3] Spence C. Comfort food: A review. *Int J Gastron Food Sci*. 2017; 9(December 2016):105-109.
- [4] Sebastian RS, Cleveland LE, Goldman JD. Effect of Snacking Frequency on Adolescents’ Dietary Intakes and Meeting National Recommendations. *J Adolescent Heal*. 2008; 42(5):503-511.
- [5] Tuorila H, Pangborn RM. Prediction of reported consumption of selected fat-containing foods. *Appetite*. 1988; 11(2):81-95.
- [6] Ganasegeran K, Al-Dubai SAR, Qureshi AM, Al-Abed AAAA, Am R, Aljunid SM. Social and psychological factors affecting eating habits among university students in a Malaysian medical school: A cross-sectional study. *Nutr J*. 2012.
- [7] Witherly SA. Why humans like junk food. *Why humans like junk food*. 2007:02-12. <https://jamesclear.com/wp-content/uploads/2013/11/why-humans-like-junk-food-steven-witherly.pdf>.
- [8] Stevens JC, Plantinga A, Cain WS. Reduction of odor and nasal pungency associated with aging. *Neurobiology Aging*. 1982; 3(2):125-132.
- [9] Manley D. Classification of biscuits. *Manley’s Technology Biscuits, Crackers Cookies Fourth Ed*. 2011:271-278.
- [10] Bower JA, Whitten R. Sensory characteristics and consumer liking for cereal bar snack foods. *J Sens Stud*. 2000; 15(3):327-345.
- [11] Wellman NS, Kamp BJ. Chapter 21 - Krause’s Food & the Nutrition Care Process, 13th Edition. In: *Krause’s Food & the Nutrition Care Process*. 14th ed. Saunders; 2010. <http://www.us.elsevierhealth.com/nutrition/krause-food-the-nutrition-care-process-hardcover/9781437722338/>.
- [12] Chapman G, Maclean H. “Junk food” and “healthy food”: meanings of food in adolescent women’s culture. *J Nutr Educ*. 1993; 25(3):108-113.
- [13] Wood S. The Comfort Food Fallacy: Avoiding Old Favorites in Times of Change. *J Consumer Res*. 2009; 36(6):950-963.
- [14] Tomiyama AJ, Schamarek I, Lustig RH, et al. Leptin concentrations in response to acute stress predict subsequent intake of comfort foods. *Physiol Behav*. 2012; 107(1):34-39.
- [15] Lally P, Bartle N, Wardle J. Social norms and diet in adolescents. *Appetite*. 2011; 57(3):623-627.
- [16] McLaughlin T, Mills A. Where will we live when we get older? *Quality Ageing*. 2008; 9(3):15-21.
- [17] Bartoshuk LM, Rifkin B, Marks LE, Bars P. Taste and aging. *Journals Gerontol*. 1986; 41(1):51-57.
- [18] Kaneda H, Maeshima K, Goto N, Kobayakawa T, Ayabe-Kanamura S, Saito S. Decline in taste and odor discrimination abilities with age, and relationship between gustation and olfaction. *Chemical Senses*. 2000; 25(3):331-337.
- [19] Edfors E, Westergren A. Home-Living Elderly People’s Views on Food and Meals. *J Aging Res*. 2012; 2012:1-9.
- [20] Mai R, Symmank C, Seeborg-Elverfeldt B. Light and Pale Colors in Food Packaging: When Does This Package Cue Signal Superior Healthiness or Inferior Tastiness? *J Retail*. 2016; 92(4):426-444.
- [21] J. W. Age and gender dependent profile of food choice. *Forum Nutr*. 2005; 57:44-51.
- [22] Ng YK. The paradox of the adventurous young and the cautious old: Natural selection vs. rational calculation. *J Theory Biol*. 1991; 153(3):339-352.
- [23] Roberts B. Influence of Age on Energy Requirement. *Energy*. 1995; 62.
- [24] Spence C. On the psychological impact of food colour. *Flavour*. 2015.
- [25] Wansink B, Cheney MM, Chan N. Exploring comfort food preferences across age and gender. *Physiol Behav*. 2003; 79(4-5):739-747.



[26] Trygg Engen. *Odor Sensation and Memory*. 1991.

2005; 14(2):84-87.

[27] Lindstrom M. Broad sensory branding. *J Prod Brand Management*.