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Food Texture and Its Perception, Acceptance and Evaluation

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The objective of this study was to understand the term food texture and its perception, acceptance along with methodologies used for their evaluation. Texture is governed by surface response of touch in mouth, deep response of masseter muscles and potentially by auditory means.Texture assessment of food occurs inside the mouth. Texture assessment is based on individual perception of human subject which varying among them. It is well explained by various physical and sensory parameters were used for texture evaluation. Instrumental texture profile analysis continuously used measurable method can be used as a low cost, but it not mimics the inside environment of the mouth and the psychological aspects of texture. The sensory TPA which includes the dynamics of food rheology during mastication may also contain biasness. Thus it was concluded from this study that Electromyography testing were one of the reliable methods used for examine food texture.

Keywords: Mastication, perception, receptors, texture.

Texture and its perception

Texture of food is based on multi parameters; some parameters were governed when food placed inside the mouth while most of them perceived when food gets deformed during mastication and detected through several senses. There is no single and specific receptor which governs the evaluation of texture of food instead there are many receptors and tissues come in to action[1].

Texture perception is dynamic and complex process where the food gets manipulated under the forces to get fractured[2]. Textural perception of food can be estimated with the help of mastication based on physiological techniques[3,4].

Texture evaluation depends on subject's capability to analyze and explain their perceptions. Human perception of food texture is depending on three parameters visual, tactile and auditory. Visual parameter depends on previous experiences with same foods, tactile parameters depends on oral (mouth feel) and hand tactile texture perception and auditory parameter depend on food sounds. Acoustic signals related to food texture like low pitch sound correlated with crunchiness while high pitch sound correlated with crispiness [5]. Mechanical parameters which are not perceptible by human sense organs are not play an important role in texture perception [6].

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Texture of food generates a psychological response which governs the quality and acceptability of the food. Texture perception depends on the physical properties of food i.e. its nature, composition and also on the rate of food deformation in mouth [7]. Four major senses play an important role in perception of texture like discriminative touch for recognize different shape, size and texture of food, the sense of static position or movement of jaw, the sense of pain and the sensation of cold and warmth [2].

Texture perception is also explained on the basis of neurological manner in which sensory and motor components of peripheral nervous system interacts with the central nervous system[2]. The coordination between motor components is highly required so that all muscle action can be controlled as single unit[8].The term "Gestalt" defined as perception regard texture of food as a whole developed by the integration of different stimulus generated by various sense organs. The presence of one stimulus may affect the perception of another stimulus. The sensory perception and its nature may be varied from the physical properties of food and integration of all perception is subconscious[9].

The internal characteristics of food are correlated with sensory perceptions [10]. During the perception of sensory analysis, it is to be assumed that different information regard texture may be gathered due to differences in the manner in which interaction of food occurred [11].Sensory mechanoreceptors which perceive texture and mouth feel are grouped under three categories. First in the superficial structures of mouth, second in the periodontal membrane surrounding teeth roots and third in the tendon and muscles which are involved in mastication[2]. Earlier the sensory perception of texture of food was governed by their rheological characteristics [12], by the force of mastication measured using miniature load cells placed inside mouth during chewing of food [13].

Eating situation also influence the texture acceptance and preference [14]. Texture tolerance is defined as how far textural behavior of a food deviates from its expectation. It is depending on the category of food, on the particular food and on dominant characteristics of food. Some food has more texture tolerance then other foods. During breakfast less texture tolerance was found as food which serve during breakfast is the one which get easily lubricated with saliva, manipulate easily inside mouth and make a bolus for its easy swallowing and digestion. During dinner food is enjoyed and appreciated. So that most of the experiment with new texture are performed while serving dinner. During dinner more texture tolerance was found as dinner consist of many food items and there is no fear of going hungry if any particular food item is disliked. Dessert in the dinner explained the fun behavioral of textural characteristics[1].

Texture and Its Relation to Consumer Behaviour and Acceptance

There are various factors like social, cultural, physiological and psychological which governed the attitudes to texture[14]. Lower socio economic classes are very conscious about their look while eating food and thus bring with negative attitude. Unsatisfied past experience also bring about rejection of texture of food. Learning of textured of food is a continuous process [1].

Texture parameters are associated with liking and disliking characters based on physiological and cultural characters. Various liked and disliked characteristics were used during explanation of food texture like crisp and tough; crunchy and soggy; tender and lumpy; juicy and crumbly; firm and slimy [14]. Textural contrast also plays an important role in the acceptance of food based on the eating experience and excellence of food preparation[1].

Different countries use different textural characteristics for food like Japan uses crispy, crunchy, hard, soft and sticky food while Americans uses crispiness, crunchiness, tenderness, juiciness and firmness [14].The image of the food product reflects its food properties. Foods with soothing and relaxing to the human and creamy while food product with energy and aggressiveness should be firm and crispy. The size of serve also affects the textural perception of food [1]. On psychological basis if the appearance of food product is not met with expectation or with the past experience, food is generally rejected. Gummy or slimy food with hard particles or lumps is generally rejected.

The acceptance of food by the consumer is dependent on the rheology and texture of food [15].Food texture is one of the dominant factors which affect the food choice [14]. Food texture is an important factor for food palatability and thus

affects food eating behavior[16]. Food texture is defined as the combined sensation derived from various receptors present inside the mouth after taking the food and its relate to the physical properties of food sample like density, viscosity and surface tension etc. [17].

Texture is one of the important parameter of sensory evaluation. Texture cannot be treated as absence of defect while it should be treated as attribute of freshness, excellence of food preparation and enjoyment of eating[1].Texture governs the palatability, quality and safety of food [18]. Texture of food also used as an indicator for quality parameter. For example, freshness of food is governed by its texture.

Food texture and mouthful are the two important characteristics for consumer food preference and acceptance[2]. To maintain the quality of food and consumer acceptance food industries must examine textural characteristics of their food products[19].Texture of food is generally taken for granted and consumer does not comment on it unless they were asked with specific questions regard texture of food.The acceptance of food on the basis of its textured depends not only on the consumer but also on the food properties and eating behavior. Consumer does not pay so much attention on the food for its sensory and nutritional returns until the food yield pleasant flavor[20].

On the basis of consumer texture profile, ideal textural characteristics of food are determined. The deviation of the test food from the target food is calculated for determining the ideal texture. The difference among them explains the area of improvement. Closer to the ideal point explain increase the degree of liking of food. Thus textural parameters correlate with bad and good identify compare to the ideal; make negative and positive impact on acceptance of food.

Parameters used during food Texture Evaluation

Texture is used for solid and semisolid food while mouthfeel is used for describing the feeling properties of food inside the mouth. Food texture is governed by mechanical, geometrical and others surface properties which are perceive by means of various receptors [21].Mechanical characteristics were explained in terms of physical and sensory manner as shown in Table 1 and Table 2.

Geometrical characteristics are further classified on the basis of particle size (griffty, grainy, coarse) and shape (fibrous, cellular, crystalline) while other characteristics are further classified in to primary parameters i.e. moisture (dry, moist, wet and watery), fat content and secondary parameters like oiliness and greasiness [1].

Table 1. Various parameter of texture based on physicalmanner (Szczesniak, 2002)[1]

S.no	Parameer	Defination
1	Hardness	As the force required for breaking of food sample into many small pieces by molar teeth during first bite which can vary from soft, firm to hard.
2	Adhesiveness	As the force which is required to reduce the adherence between the food material and the surface with which it is in contact. On the basis of adhesiveness food can be sticky or tacky gooey.
3	Cohesiveness	As the limit to which a given food sample deformed before it breaks.
4	Springiness	As the rate at which the deformed food material gets back in to its original condition when the applied force is removed from them. On this basis food can be divided in to two categories i.e. plastic and elastic.
5	Gumminess	As the amount of energy which is required for the disintegration a food sample which is semi solid in nature for its swallowing. Its value classified as short, mealy and pasty gummy.
6	Brittleness	As the force which is required by the food material for its fracture. It is also called brittleness, which can be varied from crumbly, crunchy to brittle.
7	Chewiness	As the amount of energy which is required for the chewing of solid food for its swallowing. On the basis of chewiness food can be classified in to Tender, chewy and tough.

Mouthfeel textural parameters like astringency and juiciness play a significant role in textural characterization of liquid beverages [22]. Astringency is the tactile sensation [23]associated with ability of certain chemical to bind and precipitate salivary mucus proteins that lubricate mouth [24]. During mastication the amount of juice which is released from food is described as juiciness.

Texture Evaluation

Texture Profile Analysis

For qualitative and quantitative analysis of food, texture should be studied in depth using the application of imaging and simulation techniques. The role of computer makes a significant advance in this research area. Texture Profile Analysis (TPA) is one of the instrumental methods[25] which arebasic and simple thus used for the evaluation of food texture based on the mechanical attributes of the food product. Texture profile method test the food sample twice under the compression and then record the force deformation curves.Textural profile method classified the textural attributes in to initial, masticatory and residual part [26].Texture analyzer test these attributes by applying controlled forces to the food products and record their

Table 2. Various parameter of texture based on sensory manner (Szczesniak, 2002)[1]

S. no	Parameter	Defination
1	Hardness	As the force between tongue and palate for compression of a food sample,
2	Viscosity	As the force which is required to draw liquid from a spoon over the tongue. On the nature of food, it can be varying from thin to viscous.
3	Adhesiveness	As the force required for removing the adhesive food material adhere to the mouth.
4	Cohesiveness	As the extent up to which food sample compressed between the teeth before it ruptures.
5	Springiness	As a level up to which food get back in to its original shape,
6	Gumminess	As denseness of the food product which remains exist throughout the process of chewing.
7	Brittleness	As the force with which food get cracks.
8	Chewiness	As the time required for the chewing of food under the effect of constant force.

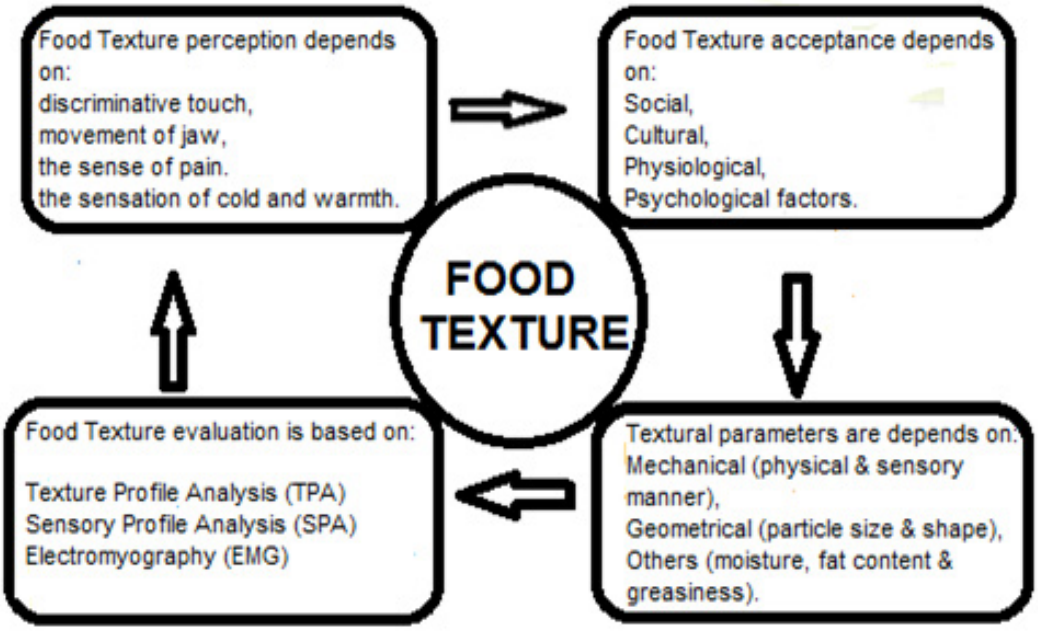

Fig. 1. Concept of Food Texture

responses in the terms of force, deformation and time.

This method has certain disadvantages like this method could not be used for texture analysis heterogeneous foods. It does not mimic the in vivo conditions of the mouth i.e. it does not consider the effect of saliva and temperature of the mouth on texture of food. TPA also does not include the psychological, physiological and environmental attributes while determining the texture of foods and moreover this method gives information regarding texture of food before its consumption. Instrumental methods which are used for accessing the texture of food not mimic the rate of deformation (force), dynamic of oral movement, salivary action and thus give low rate of correlation with subjective analysis as each subjectused different parameters for governing the texture assessment [27]. Instrumental methods not represent the actual state of mastication [28].

The complex mechanism of rate of deformation of food inside mouth cannot be estimated by single mechanical based instrumental method [29]. Instrumental analysis of texture also operates at low rate of deformation as compare to force that present in human mouth [30]. Instrument use single measurement for examine texture of food while texture should be assessed progressively during chewing [31]. Most of the information regard tenderness was governed by first bite but there are evidences which states that more than first bite is required for examine the tenderness of meat [28].

Sensory Profile Analysis

During the sensory analysis, texture perception is one of the important factors. Sensory analysis method is used for determining food texture on the basis of some standard scales [32] and also on the selection of panel members [33].

Earlier the sensory perception of texture of food was governed by their rheological characteristics [12], by the force of mastication measured using miniature load cells placed inside mouth during chewing of food [13].

The internal characteristics of food are correlated with sensory perceptions[34, 35]. During the perception of sensory analysis it is to be assumed that different information regard texture may be gathered due to differences in the manner in which interaction of food occurred [36]. Both instrumental as well as sensory method now move from single point analysis to multipoint as many attributes are quantified at a same time [37]. Multiple sensory attributes are used for the characterization of mastication [38].

Individual sensory analysis of food is one of the biggest problems in the sensory scientist

Table 3. Various definition of Food Texture.

S. no	Definations	Authors
1	Texture was defined as all of the mechanical, geometrical, surface and body attributes of a product perceptible by means of kinaesthesis and somesthesis receptors and (where appropriate) visual and auditory receptors from the first bite to final swallowing.	ISO, 2008. [52]
2	Texture was defined as mechanical, geometrical and surface characteristics which are perceive through various sense organs.	Bourne, 2002. [53]
3	Texture was explained in terms of physiological texture and mouth feel perception.	Guinard & Mazzucchelli, 1996. [2]
4	Texture was defined as a sensory perception of food structure which changes due to the action of applied forces along the presence of senses like vision, hearing and kinaesthesia.	Szczesniak, 1990.[9]
5	Texture was described as changes which were observed in terms of sensory and functional attributes due to mechanical and structural manifestation in food properties.	Szczesniak, 1963. [25]
6	Food texture is a response which is generated due to interaction of the food with some part of the body.	Bourne, 1975. [54]
7	Texture was described as combined effect of psychology and physiology.	Brown et al., 1996. [11]

community. Variation in sensory perception can be due to difference in the genetic makeup of an individual for sensory receptors, sensory experience to discriminate between stimuli, the way used to describe or define different sensory sensation parameters and sensory reporting [11]. This method has certain disadvantages like it is a time consuming procedure, trained panelists are required, the results can be biased, affected by ill health of judge panelist and moreover this method gives information regarding texture after consumption of the food.

To avoid such variation numerous techniques are used like screening of human subjects, training of panelist, use of standardized methodology for examine sensory parameters and testing with specific sensory test [33]. Sensory evaluation and consumer testing is one of the reliable methodology used for examine food texture.

Electromyography (EMG)

EMG is a technique which is based on calculation of muscle activity required during chewing of food [39]. EMG measures the action potential of the motor unit of masticatory muscle when they undergo contraction. EMG method uses myoelectric potential from the skin surface of human subjects and relates it with muscle activity. EMG examined for human mastication is combined action of physical and psychological studies [40, 41].

EMG is a non-invasive technique which does not interferes with normal habitual chewing [42, 43]. EMG is a technique which is used for evaluation of texture of food in mouth. EMG is a novel method to investigate the changes in texture during eating of food. EMG studied dynamic changes in food during the process of mastication. Thus it is complement to texture measurement.

The differences in the signals which were generated during chewing of food were used for the assessment of texture. EMG is a technique which is used to show the differences in the pattern for chewing food which differ in their textural characteristics [44, 45]. This technique is also being used for differentiating the chewing pattern between individuals [19, 46, 47].

EMG analysis gives better result for texture perception than instrumental method as this method brings information from mastication rhythm which showed differences among different human subjects[48, 49]. EMG is one of the repeatable techniques if homogenized conditions are maintained like by standardization of the applied methodology and analysis[50, 51].

DISCUSSION AND CONCLUSION

Texture perception is a complex process which is based on stimulus of various sense organs. Food texture plays an important role in the acceptance of the food by the consumers. Food industries always expand their knowledge for examine the texture attributes of foods. Thus there is a need of a novel technique for texture evaluation of various foods based on in-vivo conditions i.e. the one which can give information regarding texture of food within the mouth during chewing start from the first bite to final swallowing. Accordingly, the developed technique Electromyography will be in lines with the latest definition of texture as described by International Organization for standardization.

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REFERENCES

1. Szczesniak AS. Texture is a Sensory Property. *Journal of Food Quality and Preference*. 2002; **13**(4): 215-225.
2. GuinardJX,Mazzucchelli R. The Sensory Perception of Texture and mouthfeel. *Trends in Food Science and Technology.* 1996; **7**(7): 213-219.
3. Chen J. Food Oral Processing – A Review. *Journal of Food Hydrocolloids*. 2009; **23**(1): 1-25.
4. Morell P, Hernando I, Fiszman SM. Understanding the relevance of in-mouth food processing. A review of in vitro techniques. *Trends in Food Science & Technology.* 2013; **35**(1), 18-31.
5. Jessop B, Sider K, Lee T, Mittal GS. Feasibility of the acoustic/EMG system for the analysis of Instrumental food texture. *International Journal of Food Properties*. 2006; **9**(2): 273-285.
6. Kohyama K, Hanyu T, Hayakawa F, Sasaki T. Electromyographic measurement of eating behavior for buckwheat noodles.

Bioscience, *Biotechnology and Biochemistry*. 2010; **74**(1): 56-62.
7. Mathoniere C, Mioche L, Dransfield E, Culioli J. Meat texture characterisation: comparison of chewing patterns, sensory and mechanicalmeasures. *J. Texture Studies.* 2000; **31**: 183-203.
8. Gorden J. 'Spinal mechanism of motor coordination'. *Principles of Neural Science*. 1991; 581-595.
9. Szczesnaik AS. Psychorheology and texture as factors controlling the consumer acceptance of food. *Cereal Food World*. 1990; **35**(12): 1201-1204.
10. Mioche L, Martin JF. Training and sensory judgement effects on mastication as studied by electromyography. *J. Food Science*. 1998; **63**(1): 1-5.
11. Brown WE, Langley KR, Mioche L, Marie S, Gerault S, Braxton D. Individuality of understanding and assessment of sensory attributes of foods, in particular, tenderness of meat. *Journal of Food Quality and Preferences.* 1996; **7**(3,4): 205-216.
12. Scott BGW, Coppen FM. The subjective judgement of the elastic and plastic properties of soft bodies the "Differential Thresholds" for Viscosities and Compression Moduli. *British Journal of Psychology.* 1939; **128**(850): 109-125.
13. Boyar MM,Kilcast D. Food texture and dental science. *Journal of Texture Studies.* 1986; **17**(3): 221-252.
14. Szczesnaik AS, Kahn, EE. Texture contrast and combinations: a valued consumer attributes. *Journal of Texture Studies.* 1971; **15**(3), 280-295.
15. Szczesnaik AS. Sensory texture profiling. Historical and scientific perspectives. *Food Technology*, 1998; **52**(8): 54-57.
16. Kohyama K, Sodhi NS, Suzuki K, Sasaki T. Texture Evaluation of Cooked Rice Prepared From Japanese Cultivars using Two-Bite Instrumental Test and Electromyography. *J. Texture Studies*. 2016; **47**(3),188-198.
17. Matz SA. Food texture. AVI Publication. 1962.
18. Nishinari K. Texture and rheology in food and health. *Food Science & Technology Research.* 2009; **15**(9): 99-106.
19. Brown WE. Method to investigate differences in chewing behaviour in humans: I Use of electromyography in measuring chewing. *Journal of Texture Studies*. 1994; **25**(1): 1-16.
20. Munoz AM, CivilleGV. Factors affecting perception and acceptance of food texture by American consumers. *Food Review International.* 1987; **3**(3): 285-322.
21. Kohyama K, Sasaki T, Hayakawa F, Hatakeyama E. Effects of cross sectional area on human bite studied with raw carrot and surimi gel. *J. Bioscience, Biotechnology, and Biochemistry.* 2004; **68**(10): 2104-2110.
22. Langstaff SA, GuinardJX, Lewis MJ. Sensory evaluation of the mouthfeel of the Beer. *J. Am. Soc. Brew. Chem,* 1991; **49**(2): 54-59.
23. Green BG. Oral astringency: a tactile component of flavour. *Acta Psychologica*. 1993; **84**(1): 119-125.
24. GuinardJX, Pangborn RM, Lewis MJ. The time course of astringency in wine upon repeated ingestion. *The American Journal of Enology and Viticulture*. 1986; **37**(3): 184-189.
25. Szczesnaik AS. Classification of textural characteristics. *Journal of food Science*. 1963; **28**(4): 385-389.
26. BrandtMA, Skinner EZ. Coleman JA. Texture profile method. *Journal of Food Science.* 1963; **28**(4), 404-409.
27. Mioche L, Peyron MA. Bite force displayed during assessment of hardness in various texture contexts. *Archives of Oral Biology.* 1994; **40**(5): 415-423.
28. Duizer LM, GullettEA, Fndlay CJ. The relationship between Sensory Time intensity, Physiological Electromyography and Instrumental Texture Profile Analysis Measurements of Beef Tenderness. *Journal of Meat Science*. 1996; **42**(2): 215-224.
29. Dransfield E. Instrumental measurement of meat. Meat Quality and Meat Packaging, Taylor, S. A. et al. Ed. 1996; 195-219.
30. Shama F, Sherman P. Identification of stimuli controlling the sensory evaluation of viscosity II. Oral methods. *Journal of Texture Studies*. 1973; **4**(1): 111-118.
31. Kapsalis G, Moskowitz HR. Views on relating instrumental tests to sensory assessment of food texture. Applications to product development and improvement. *Journal of Texture Studies*. 1978; **9**(4): 371-393.
32. Szczesniak AS, Brandt MA, Friedman H. Development of standard rating scales for mechanical parameters of texture and correlation between the objective and sensory methods of texture evaluation. *Journal of Food Science.* 1963; **28**(4): 397-403.
33. CivilleGV, Szczesnaik AS. Guidelines to training a texture profile panel. *Journal of Texture Studies.* 1973; **4**: 204-223.
34. Christensen CM. Food texture perception. *Advance Food Research*. 1984; **29**: 159-199.
35. Heath MR, Lucas PW. Oral perception of texture. Food structure, its creation and evaluation. Blanchard, J. M. V & Mitchell, JR. Edition, 1987;

465-481.

36. DagetNMT, Brown, WE, Mela DJ. Inter-individual differences in intensity of perception of chocolate flavour during eating time. *Abstract ECRO meeting autumn.* 1994
37. Szczesnaik AS. Correlation between objective and sensory texture measurements. *Food Technology*, 1968; 49-51: 53-54.
38. CivilleGV, LiskaIH. Modifications and applications to foods of the general foods sensory texture profile technique. *Journal of Texture Studies.* 1975; **6**(1): 19-31.
39. Karlsson S, Carlsson GE. Characteristics of mandibular masticatory movement in young and elderly dentate subjects. *Journal of Dental Research.* 1990; **69**(2): 473-476.
40. Kohyama K, Sodhi NS, Sasaki T, Suzuki K. Texture evaluation of cooked rice prepared from Japanese cultivars using two-bite instrumental test and electromyography. *Journal of Texture Studies.* 2016; **47**(3): 188-198.
41. Wilkinson C, Dijksterhuis GB, Minekus M. From food structure to texture. *Trends Food Science and Technology.* 2000; **11**(12): 442-450.
42. Gonzalez R, Montoya I, Carcel J. Review: the use of electromyography on food texture assessment. *Food Science Technology International.* 2001; **7**(6): 461-471.
43. Kohyama K, Sodhi NS, Sasaki T, Suzuki K. Effects of milling ratio and water-to-rice ratio on mastication effort for cooked rice measured by electromyography. *Journal of Texture Studies.* 2014; **45**(6): 477-486.
44. Sakamoto H, Harada T, Mataukubo T, Takaesu Y, Tazaki M. Electromyographic measurement of textural changes of foodstuffs during chewing. *Agricultural* and Biological *Chemistry*. 1989; **53**(9): 2421-2433.
45. Pratiksha, Sodhi NS, Dhillon B, Kaur T. Association between electromyography (EMG) variables during mastication by human subjects and food texture perceptions: a study on different snacks (gajaks, biscuits and chocolates). *International Archive of Applied Sciences and Technology*. 2018; **9**(1): 33-42.
46. Brown W, Langley KR, Martin A, MacfieHJH. Characterisation of patterns of chewing behaviour in human subjects and their influence on texture perception. *Journal of Texture Studies.* 1994; **25**(4): 455-468.
47. Rustagi S, Sodhi NS, Dhillon, B. A study to investigate reproducibility of chewing behaviour of human subjects within session recordings for different textured Indian foods using electromyography. *The Pharma Innovation*. 2018; **7**(5): 5-9.
48. Kohyama K, Ohtsubo K, Toyoshima H. Electromyographic studies on cooked rice with different amylose content. *Journal of Texture Studies.* 1998; **29**(1): 101-113.
49. Rustagi S, Sodhi NS, Dhillon, B. Analysis of Masseter muscle activities acquired by Surface Electromyography for different textured Indian food products. *International Archive of Applied Sciences and Technology.* 2018; **9**(2): 51-57.
50. Kossioni AE, Karkazis HC. Reproducibility of the human masseteric jaw-jerk reflex in association with the menstrual cycle. *Journal of Archives of Oral Biology*. 1993; **38**(12): 1099-1105.
51. Sodhi NS, Singh B. and Dhillon B, Kaur T. Application of electromyography (EMG) in food texture evaluation of different Indian sweets. *Asian Journal of Dairy and Food Research*. 2019; **38**(1): 41-48.
52. ISO. Sensory analysis-Vocabulary. 5492:2008 (en). https://www.iso.org/obp/ui/#5492:ed-2:v1:en. 2008.
53. Bourne MC. Principles of objective texture measurement. MC. Bourne Ed. Food texture and viscosity: concept and measurement, New York: Academic Press; 2002: 107-188.
54. Bourne MC. Is rheology enough for food texture measurement. *Journal of Texture Studies.* 1975; **6**(2): 259-262.