



Dynamics of Food from Its Structure to Texture

Sarvesh Rustagi

Assistant Professor, Department of Food Technology, Uttarakhand University, Dehradun, Uttarakhand, India, 248007

Corresponding author: sarveshrustagi@gmail.com.

Orcid: 0000-0002-1247-1040

Abstract

The objective of this study was to understand the concept of mastication. Mastication is one of the neurophysiological based complex processes, which involves the activities of masseter muscles. During mastication there is secretion of saliva which helps in the formation of bolus for swallowing. Texture was explained as a result of various structural and mechanical properties of food which are detected with the help of various senses. During the sensory analysis, texture perception is one of the important parameter. Thus there is a need of a novel technique for measuring mastication during chewing of various food products in vivo conditions.

Keywords: Mastication, chewing, masseter muscles, texture, oral.

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INTRODUCTION

Mastication could be considered as a part of wider oral processing of food. Mastication involves two basic process one is breakdown of food and another secretion of saliva. Breakdown of food depend on their chemical composition. During mastication food size is reduced and thus it transport to pharynx for swallow through three different stages [12]. During first stage food transport from front part of mouth to premolars, during second stage food size reduced and in the last stage food swallowed.

Secretion of saliva by the salivary glands mixed with food during mastication and help in the formation of bolus for swallowing. Mucin present in saliva also helps in binding of masticated food and converts them in to a coherent bolus which can be easily swallowed. When food particles bind together under the influence of viscous force, the process of swallowing occur [19]. Swallow occur only after when bolus characteristics favour swallowing [4, 21]. Food deformed and fractured due to moistening with saliva and thus easily chews and swallowed. The rate of swallowing is depending on size of food particle and degree of lubrication of food with saliva. Thus secretion of sufficient saliva is requiring for good oral processing or mastication of food.

Dynamics of food:

The complete processing of food occurs inside the mouth. Sensory receptors play an important role for bringing a neural feedback [5]. The oral processing of food require two types of forces during mastication one which bring about their disintegration during early process of chewing and adhesion during swallow. Oral processing plays an important role not only in digestion but also in food texture perception [2, 20]. Food physics rheological changes which occur during mastication and its use in the designing aspect of food [6].

The relationship between oral physiology and food characteristics was explained during the process of mastication [1, 19]. Motility of food during mastication depends on lower jaw movement, bite force, teeth, lips, cheeks and tongue. The occlusal area under lips is the place where teeth bring about fragmentation of food particles. Food gets manipulated between teeth with help of tongue and cheeks. The degree of fragmentation depends upon the occlusal area and the number of teeth. The bite force acting on the food is the result of interaction between masseter chewing muscles, movement of lower jaw and neuromuscular control of chewing.

From food structure to texture:

Texture is defined as “all of the mechanical, geometrical, surface and body attributes of a product perceptible by means of kinaesthesia and somesthesia receptors and (where appropriate) visual and auditory receptors from the first bite to final swallowing”. Perceived texture is described as a perception

of physical stimuli which are transformed into psychological senses [7]. Texture explained as a result of various structural and mechanical properties of food which are detected with the help of senses [11]. Texture is sum of complex reactions which occur during mastication of food. Texture plays an important role in the acceptance of foods by the consumers. The acceptance of food by the consumer is dependent on the rheology and texture of food. Texture during chewing was explained as a dynamic process which consists of visible characteristics of the food surface, product behaviour while handling the food stuff and in mouth sensations. Food texture evaluation is an instantaneous and complex process as it depends on various stimuli of different texture [8]. The concept of food texture is explained in terms of physiological texture and mouth feel perception [6, 12, 22].

Texture Profile Analysis (TPA):

Texture Profile Analysis (TPA) is one of the instrumental methods which is used for the evaluation of food texture based on the mechanical attributes of the food product [9]. Texture analyzers test these attributes by applying controlled forces to the food products and record their responses in the terms of force, deformation and time [11]. 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 [10]. Texture analysis depends on the sequence of three senses started with visual, followed by tactile and then mouth. Instrument test were basic and simple.

Sensory 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 scores given by the sensory judge panels [15, 16]. This method is based on some standards scales like hedonic scale, etc. for measuring the food textural parameters. This method has certain disadvantages like it is a time consuming procedure, trained panellists are required, the results can be biased, affected by ill health of judge panellist and moreover this method gives information regarding texture after consumption of the food. Sensory test were better correlate with large strain test which otherwise failure with instrumental test.

Thus there is a need of a novel technique for texture analysis of various food products based on the in vivo conditions i.e. the one which can give information regarding texture within the mouth during the process of chewing right from the first bite to final swallowing [13]. Accordingly the developed technique will be in lines with the latest definition of texture as described by International Organisation for standardization.

Electromyography (EMG):

EMG is being used in the field of physiotherapy for diagnosis of disease. Now days it is used for describing various mechanical attributes of food for their texture analysis, based on the forces which are related with movement of jaw during the process of chewing. During activation of muscles there is generation of electrical activity because of ion flow across the cell membranes which are recorded and displayed for the analysis [14].

An equal amount of ions present in both spaces of a muscle cell constitute a resting potential. During the muscle contraction there is increase of Na^+ ion inside the cell matrix causes Depolarization which is immediately restored by increase of Na^+ ion outside to extracellular space of membrane cause Depolarization [18].

During EMG the generated bioelectrical activity of the muscles are used for providing the real time information for the complete process of chewing. Mastication is one of the most complex neurophysiological processes in human. During the process of mastication the food breaks by chewing due to various forces into small molecules, which are further lubricated with saliva present in the mouth, and formed bolus which is used for swallowing [12, 17].

Texture perception is generated by the interaction between both motor and sensory nerves i.e. the result generated by sending the information through peripheral input central nervous [11]. Thus EMG method is one of the best methods for determining the texture of different food products on the basis of their chewing and swallowing behaviour [7, 8]. EMG technique gives magnitude of muscle activity, which is required for chewing food. Therefore this technique can be used to overcome the disadvantages of the texture analysis by sensory and texture analyzer method.

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