

## The application of PLS regression to study the relationships between Sensory and texture characteristics

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**Introduction:** Roasting is one of the processing steps involved in the nut industry to improve the flavor, color, texture and overall acceptability of the product. Peanut is a fruit or pod of the order Leguminosae and contains 47–50% oil, 25–30% protein and is an essential source of minerals and vitamins; thus it makes a substantial contribution to human nutrition. Peanuts are readily acceptable as a cheap protein source and popular snack item that can be eaten alone or combined with other foods. Recently, peanuts have gained much attention as functional food and roasted peanuts is one of the most popular snack foods, in which roasting is a key step in the process and directly impacts the quality (crispness, taste, and flavor) and shelf-life of the final product. Understanding of the roasting process is of interest because roasting is a critical processing step not only for peanuts, but many other food products such as coffee, cocoa, grains and other tree nuts. Roasting is a process to develop color, flavor and textural characteristics of product through chemical reactions, therefore proper roasting is critical to flavor and texture development as well as nutritional content of the final product.

**Materials and methods:** In this study, dried Goli peanuts were supplied from a local market in Minodasht, Iran in 2015 and stored at 4°C until processing. The average moisture content of peanut kernels was measured as 5.1 % (d.b.). Kernels were sorted manually to get the uniform sizes for roasting. 100 g peanut kernels were soaked in 500 ml of 25% salt solution for 30 min. After soaking, the salt solution was drained using a strainer and the excess water was removed by a cloth filter. After soaking, the moisture content of soaked peanut kernels increased to 8.27 % (d.b.). For roasting, three temperatures (140, 160 and 180°C) and three times (10, 20 and 30 min) and constant air velocity (1 m/s) were applied. Roasting was performed in a hot air roaster equipped with a controller to adjust the roasting temperature. After roasting, the whole kernels were allowed to cool at room temperature (23 ± 2°C). Roasting process was performed in 3 replications. Instrumental texture measurements (Uniaxial compression test) were carried out at room temperature using a TA-XT Plus Texture Analyzer using cylinder probe (diameter 25 mm) on peanut halves. The textural parameters of peanut halves were expressed as fracture force (initial peak or first fracture force (N)), hardness (highest peak compression force (N)), initial tangent modulus or apparent modulus of elasticity that shows sample rigidity in the linear part of the force-deformation curve (N/m) and compressive energy or area under the curve for the compression that is the work (N×m) required to attain deformation, indicative of internal strength of bonds within product. Sensory attributes including colour, texture, flavor, odour, total acceptance and final acceptance were assessed according to a five-grade hedonic scale (5 points – the best, 1 point – the worst). A completely randomized factorial design was used to evaluate the results and analysis of variance (ANOVA) was carried out to compare the mean values. All significant differences were reported at  $P \leq 0.05$  levels. Minitab statistical software (Minitab Release 16, Minitab Inc., USA) was used for all statistical analyses in the present research. However, MSTATC (Version 2.10, Michigan State University) was used to determine significant differences.

**Results & discussion:** Roasting is one of the most important steps in peanuts processing that leads to the development of the desired aroma, taste, texture and color of the final product. The results showed that increasing the roasting temperature and time decreased the fracture force (75.19–45.92 N), instrumental hardness (81.74–48.90 N), apparent modulus of elasticity (7.508-5.446 N/s), compressive energy (469.0–199.1 N.s) and improved the sensory characteristics of peanut kernels. During roasting process, moisture content of peanut kernels decreased and they became more crumble and fragile which causes to break easier and moisture reduction helps to create a desirable crisp texture. The results of the consumer test showed that the roasted peanut kernels have good acceptability for color (4.50), texture (4.15), flavor (3.89), odor (4.05), total acceptance and final acceptance (3.97) on roasting temperature and time (160°C and 30 min). The results obtained for VIP

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coefficients (standard coefficients) in PLS regression for fracture force, instrumental hardness; apparent modulus of elasticity and compressive energy variables indicated that apparent modulus of elasticity could be able to predict the individual sensory attribute of peanut kernels except color. PLS results showed that apparent modulus of elasticity could successfully predict quality sensory characteristics of peanut kernels. Thus, instrumental apparent modulus of elasticity could be replaced with sensory analysis for evaluation the quality of peanut kernels.

**Keywords:** Roasting, Sensory evaluation, PLS regression, Peanut kernels