Apple pastille: Correlation between features extracted from texture image analysis and sensory characteristics

Fakhri Shahidi, Mohebbat Mohebbi, Milad Fathi, Roya Rezaee, Safieh Khalilian
Department of Food Science and Technology, Ferdowsi University Mashhad, Iran

Pastille was prepared from apple puree, citric acid, sorbitol and mixture of different hydrocolloids such as starch, pectin and gelatin by using modified traditional technique. Drying was carried out at room temperature. The final texture perception of pestil depends on the formulation, processing method and microstructure of the product. In this study, changes in texture perception evaluated by trained judges, were predicted from texture image features including contrast, entropy, homogeneity and correlation .

Keywords: Textur image analysis- Pastille- Gelatin-Pectin-Apple

1 INTRODUCTION

Gummy candies are included in many confectionery products, such as jellies, pastilles and wine gums. The texture of gummy candies is achieved by using various gelling agents, such as gelatin, starch and pectin. Pectin is a naturally-occurring polysaccharide, mainly extracted from citrus peel and apple pomace. Highly methoxylated pectins are used to form gels in acidic media of high sugar content. The texture of pectin based gums is soft and short but less chewy compared to gelatin based gums.

The most important ingredients in gummy candies are sweeteners. Sucrose, glucose and corn syrups (as glucose replacer) are commonly used in confectionery. Corn syrups or glucose syrups are formed by more or less complete hydrolysis of starch, leading to mono and oligosaccharides.[1].

Starch is a member of the 'polysaccharide' group of polymers. As a multifunctional and user-friendly ingredient, starches are found wide applications cross the food and beverage industry. Starches are found in a wide range of confectionery products, contributing from soft through to hard gels, and from brittle through to chewy textures [2].

The sensory analysis is often used for the formulation process of new products or the optimization of exciting products. The sensory preference testing is the most suitable response but physical measurements seemed necessary to complete the experimental design [3].

In this study, an effort is being made to predict changes in texture perception evaluated by trained judges from texture image features including contrast, entropy, homogeneity and linearity.

2 MATERIALS AND METHODS

2.1 pastille preparation

Since apple pomace is rich in pectins, it is sutiable for jelly products [8]. Gelatins do not exist in nature but are derived from the parent protein collagen by processes which destroy the secondary and higher structures with varying degrees of hydrolysis of the polypeptide backbone. Gelatin is usually used at relatively low concentrations in the manufacture of sweets, marshmallows and a whole range of dessert products. The major reasons for its widespread application in the food industry are its high-quality gels in dilute solution with a clean 'melt in the mouth' texture· At higher concentrations it gives elastic gum-like textures which is slowly dissolved in the mouth [4].

Pectins are present in many fruits in variable amounts and qualities. The traditional use of pectin has been as a gelling agent, and this has largely dictated the types of fruit from which commercial grades can be manufactured. A major consideration is the availability of fruit by-products in sufficient quantity and quality. High methoxyl pectins will gel only in the presence of sugars or other co-solutes, and at a sufficiently low pH, so that the acid groups in the polymer are not completely ionised. Both gel strength and setting temperature are influenced by these factors. The gelation of high methoxyl pectins is also time-dependent, and setting temperatures will therefore depend on the rate of cooling [5]. Pastille production was carried out in different steps including: mixing ingredients, heating, adding starch gel, cooking, pH adjustment, cooling and drying at room temperature.

2.2 Image texture analysis

Digital images of the microstructure of pastilles were captured from the microscope camera (Dinolite, China) at a 640×480 pixel resolution and at 50× magnification. Image features namely, entropy (*E*), homogeneity (*H*), correlation (*COR*) and contrast (*CON*) were computed using a program developed in MATLAB 7.0, based on following equations (Eqs. 1 - 4) [6]:

$$E = \sum_{i-0}^{N-1} \sum_{j-0}^{N-1} P(i,j) \log P(i,j) \quad (1)$$

where μ_x, μ_y and σ_x, σ_y are the mean and standard deviation, respectively of the sums of rows and columns in the matrix, which was generated from an image by estimating the pair wise statistics of pixel gray level. P is probability of occurrence of gray levels whit respect to relative spatial pixel position.

3 RESULTS AND DISCTION

As the drying temperatures and times were increased the moisture content and rehydration capacity were decreased. On the other hand longer drying times and higher temperatures resulted in more extensive shrinkage and ruggedness of the kiwifruit microstructure. The average values of these psychochemical properties as well as image texture features of dried kiwifruit are shown in Tab. 1. Changes in image texture features showed similar trend to physicochemical properties changes.

The correlation coefficient between moisture content, rehydration capacity and shrinkage, and image texture features are presented in Tab. 2. This table shows there are good agreements between physicochemical properties and contrast and homogeneity of image texture. While correlation coefficients between energy and correlation of images and these physicochemical properties are slightly lower.

Table. 1: Average values of physicochemical properties and image texture features of dried kiwifruit.

Temperature	Time	Sh	RC	MC	CON	COR	E	H
60	5	0.66	0.29	0.54	0.1537	0.7610	0.5227	0.9423
60	6	0.75	0.25	0.38	0.1540	0.8412	0.4130	0.9430
60	7	0.78	0.24	0.31	0.1495	0.8053	0.4407	0.9431
70	5	0.70	0.23	0.44	0.1289	0.8470	0.4938	0.9525
70	6	0.75	0.21	0.32	0.1415	0.7691	0.5473	0.9474
70	7	0.81	0.22	0.26	0.1049	0.7814	0.5721	0.9641
80	5	0.79	0.22	0.31	0.1238	0.7512	0.6056	0.9564
80	6	0.80	0.22	0.23	0.1218	0.7127	0.6525	0.9571
80	7	0.80	0.20	0.18	0.1206	0.7196	0.5741	0.9564

* Shrinkage; ** Rehydration capacity; ** Moisture content

Table 2: Correlation coefficient between physicochemical properties and image features.

Physicochemical properties	Correlation coefficient			
	CON	COR	E	H
Sh*	0.64	0.45	0.45	0.64
RC**	0.69	0.45	0.48	0.67
MC***	0.63	0.53	0.48	0.62

* Shrinkage; ** Rehydration capacity; ** Moisture content

4 CONCLUSION

In this investigation, image texture analysis was employed to describe microstructural changes of osmotically dehydrated and air dried kiwifruits, which are correlated with their physicochemical properties. The results showed that contrast and homogeneity were better fitted with these parameters. However, physicochemical properties of dried kiwifruit may also depend to some other image features.

REFERENCES

[1] Jayaraman KS, Gupta DKD: Dehydration of fruits and vegetables- Recent development in principles and techniques. Drying Technol. 10, 1 (1992) 1-50.

[2] Rastogi NK, Raghavarao KSMS, Niranjan, K: Developments in osmotic dehydration. In Emerging technologies for food processing, (Sun DW) PP. 221-223. California, Elsevier Academic Press (2005).

[3] SIMAL S, FEMENIA A, GARAU MC, ROSSELLÓ C: Use of exponential, Page's and diffusional models to simulate the drying kinetics of kiwi fruit. J. Food Eng. 66 (2005) 323-328.

[4] KERDPIBOON S, KERR WL, DEVAHASTIN S: Neural network prediction of physical property changes of dried carrot as a function of fractal dimension and moisture content. Food Res. Int. 39 (2006) 1110-1118.

[5] Qiao J, Wang N, Ngadi MO, Kazemi S: Prediction mechanical properties of fried chicken nuggets using image processing and neural network technique. J. Food Eng. 79 (2007) 1065-1070.

[6] Dan H, Azuma T, Kahyama K: Characterization of spatiotemporal stress distribution during food fracture by image texture analysis methods. J. Food Eng. 81 (2007) 429-436.