

DEVELOPMENT AND EVALUATION OF SENSORY AND INSTRUMENTAL METHODS FOR ASSESSMENT TEXTURAL PROPERTIES OF PASTA

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PhD Thesis Summary

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ABSTRACT: Sensory analysis represents the unique tool for determination of organoleptic properties of food using human senses, because it is highly correlated with the consumers' attitude. At the same time it is very reliable test for obtaining the comprehensive evaluation of foodstuffs quality. Moreover, the sensory analysis is the most important reference versus the results of chemical or instrumental methods. and their comparison enables adoption of any other method used for determination of sensory properties. Bearing in mind the complexity of the textural properties of pasta and the significance of objectivity of its methodology, this thesis conducted the objective evaluation of selected sensory textural properties of pasta and their evaluation by the instrumental methods as well.

Nine commercial spaghetti samples produced by foreign and domestic producers were chosen for the study. The selected textural properties of dry and cooked spaghetti determined by sensory and instrumental methods comprised shape.

The obtain results showed that applied instrumental methods provided reliable prediction of the objective sensory evaluation of certain spaghetti textural properties. Thus, their use may contribute to the improvement of spaghetti quality during production process. Despite the good agreement between the results obtained by instrumental and sensory methods, the instrumental methods could not be unconditionally accepted as the alternative to sensory evaluation in predicting consumers' acceptance of spaghetti on the market.

Key words: *sensory evaluation. texture properties. instrumental methods. spaghetti*

INTRODUCTION

The characteristics of spaghetti, such as colour, cooking properties, texture and flavour, are important factors affecting consumers' acceptance and spaghetti quality (Lee et al., 2002). Dry spaghetti must appeal to the consumers on the point of purchase while the cooked spaghetti should have 'al dente' quality and must meet consumers' criteria for good yellow colour retention, smooth surface, firmness and resilience. Also, spaghetti must tolerate moderate overcooking, has minimal cooking loss, and offers a pleasing flavour too (Sisson et al.,

2005; Martinez et al., 2007). In many countries where pasta is traditionally consumed, only the mechanical and textural properties are taken into consideration when evaluating the pasta, especially spaghetti. The mechanical and textural properties are associated with response to the effects of force and can be expressed as (ISO 11036, 1994; D'Egidio and Nardi, 1996. Tang et al., 1999; Bourne, 2002):

- **Fracturability** (or brittleness) – The force required to break a spaghetti sample into pieces.

- **Firmness** (or hardness) – The force required to cut through a spaghetti sample using the front teeth.
- **Cohesiveness** (or consistency) – The force of internal bond holding a spaghetti structure.
- **Elasticity** (or springiness or recovery) – The extent to which a piece of spaghetti returns to its original length when stretched.
- **Chewiness** – The length of time required to masticate spaghetti to a state of swallowing.
- **Stickiness** (or adhesiveness) – The force with which a cooked spaghetti adheres to other materials. e.g., tongue, teeth, palate, fingers.
- **Bulkiness** (or clumpiness) – The adhesion rate of cooked spaghetti strands among them; bulkiness is related to stickiness.

Sensory evaluation of textural properties still remains the most reliable method to assess spaghetti quality. Many objective methods have been developed in order to achieve simplicity and to avoid time consuming and expensive sensory evaluating which is presented by working with a human 'measuring instrument' that is highly variable (Kemp et al., 2009).

The objective of this study was to estimate the ability of sensory evaluation and instrumental texture analysis as descriptive quality parameters, and to evaluate the association between sensory and instrumental measurements.

MATERIAL AND METHODS

Samples

Nine commercial wheat spaghetti were purchased in a local food store. Samples were labeled as sample 1 to sample 9. Samples 1–7 were made from durum wheat semolina, whilst samples 8–9 were made from soft wheat farina.

Sensory evaluation

Sensory evaluation was carried out on dry and cooked spaghetti samples by a panel of

twenty trained assessors from the Institute of Food Technology, Novi Sad and the Pasta factory – Žitko, Serbia (Fig. 1). Sensory properties of spaghetti samples were evaluated by a 5-point category scale. Sensory profiling was performed using a generic descriptive analysis technique, included the selected representative properties of pasta. Each mark was described with words, using previously prepared standard cards (Pestorić, 2007; Pestorić. et al., 2008; ISO 7340, 1985; ISO 7340-2, 2008).

In addition the panel evaluated the coded cooked spaghetti samples by comparison with reference standards for firmness, chewiness, adhesiveness and surface adhesiveness, using 15 cm unstructured intensity scale (anchored at 1.5 cm and 13.5 cm with slight to very, respectively) (Kovacs et al., 1997). The anchored reference standards, terminology definitions and evaluation techniques were agreed upon by the assessors during training and the formal training before evaluation (Tang. et al., 1999; Civille and Szczesniak, 1973; AACC, 1999).

All samples were presented to panellists in the single sessions. At the start of each session panellists were given a printed response sheet with written instructions for the tests. The order of sample presentation was completely randomized among assessors, identified with three random numbers. Dry spaghetti was presented on the plastic plates, while cooked spaghetti was presented in 250-ml sealed thermal plastic cups and served at room temperature within 15 min after cooking. Spaghetti was cooked in boiling distilled water. The optimal cooking time was determined by compressing the spaghetti strand between two transparent plastic plates at different times. It was reached when the white centre of ungelatinized starch had just disappeared according to the approved AACC Method 16-50 cooking time (AACC, 1999). All properties were evaluated visually, palpatory and gustatory under daylight. Drinking water was provided for palate cleansing between each sample.

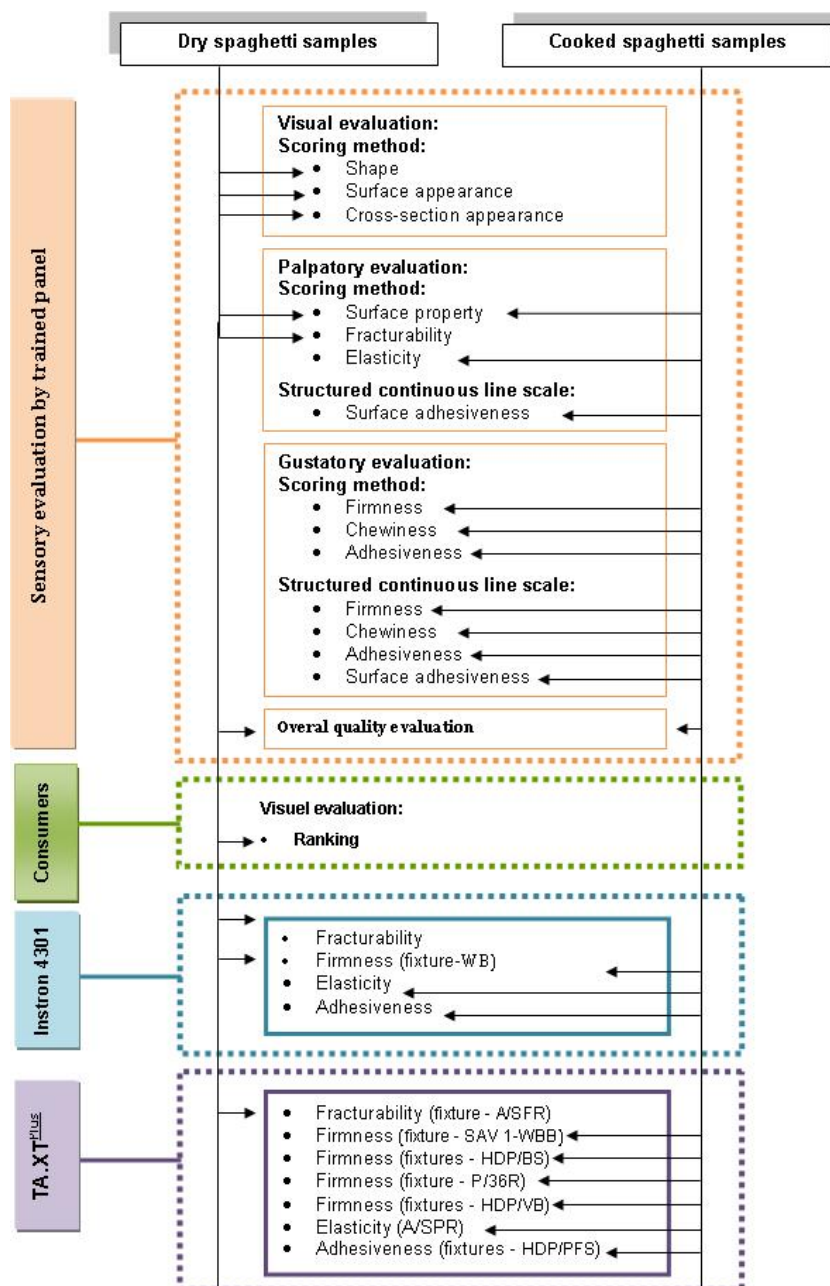


Figure 1. Experimental design

The ranking test of dry spaghetti samples were conducted by a panel of fifty consumers between 25-60 years old, selected on the basis of their availability for the assessment, interest to participate in the study, absence of aversions, allergies or intolerances, normal perception abilities, and mode-

rate preference towards this kind of products. None of the assessors had a specific training in sensory evaluation of spaghetti (Thamke. et al., 2009). Ten grams of each sample from original packing were presented to the consumers in a white basis.

Texture analysis

Textural properties of dry and cooked spaghetti were conducted using a Texture Analyzer – TA.XTPlus (Stable Micro Systems, Ltd., Surrey, UK) equipped with a 5 kg load cell, and a Universal Testing Machines Analyzer – Instron M 4301 (Instron-BRD, England, UK) equipped with a 5 kN load cell. On these instruments most test methods of measurements are not standardized, so the research was performed at different working conditions related to diameter, temperature, and sample preparation, load cell, pre-test-speed, test speed, and post-test speed.

Fracturability of dry, and firmness, elasticity and stickiness of cooked spaghetti samples were determined using different accessories (probes and fixtures), and in the appropriate number of replications (Fig. 1).

In addition to textural measurements, some selected of dry and cooked spaghetti were analyzed. Diameter of dry and cooked spaghetti was determined by taking measurements at the midpoint and the ends of twenty individual strands per sample. In the same way the length of strands was determined.

Statistical analysis

Results were expressed as the mean of replications $\pm$ SD. ANOVA and Duncan's multiple range tests were applied to compare means at 5% significance level. Principal component analysis (PCA) was carried out for sensory evaluation and textural analysis to investigate the within-set data and to study the relationships between the instrumental and sensory data. Pearson's correlation coefficients were calculated as a measure of the association. The analysis was made using the statistical data analysis software system STATISTICA (StatSoft, Inc., (2008), version 9.0. (www.statsoft.com)).

CONCLUSION

The evaluated textural characteristics of the

dry and cooked spaghetti, as the basis of individual assessment by the scoring method and unstructured scale, as well as the obtained statistics through the clustering of samples based on the composite impact of all aspects of the evaluated textural properties, in general were consistent with the consumers' rank. These investigations confirmed the sensory and instrumental methods were suitable and useful tools for determination of commercial spaghetti quality. Despite the good agreement between the obtained results by instrumental determinations and sensory evaluation it was concluded that some instrumental methods may be eligible in predicting the sensory assessment and thereby contribute to improving the quality of spaghetti in the process of production, but that may not be unreservedly accepted as an alternative to the objective sensory evaluation in predicting consumers' acceptance of spaghetti.

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РАЗВОЈ И ВРЕДНОВАЊЕ СЕНЗОРСКИХ И ИНСТРУМЕНТАЛНИХ МЕТОДА ЗА ОЦЕНУ ТЕКСТУРНИХ СВОЈСТАВА ТЕСТЕНИНЕ

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- Извод из докторске дисертације -

Сажетак: Сензорска анализа представља јединствено средство за праћење органолептичких својстава хране уз примену људских чула, јер је најближа потрошачкој оцени и уједно веома поуздан тест у пружању свеобухватне оцене квалитета прехранбеног производа. Она представља најважнију референцу наспрам резултата добијених хемијским или инструменталним методима и њиховим поређењем омогућује прихватање, одабир или побољшање било којег другог метода. Имајући у виду сву комплексност текстурих својстава тестенине, као и важност објективизације појединих њених сегмената у циљу задовољења тржишта, праћења производње и задовољења важећих одредби правилника и прописа, у овом раду спроведена је објективна сензорска оцена одабраних текстурих својстава тестенине, као и њихова оцена применом инструменталних метода. Испитивања су спроведена на комерцијалним узорцима сушене тестенине облика шпегете, пореклом од домаћих и страних произвођача, најчешће присутних у већим тржним центрима наше земље. Поред анализе хемијског састава и својстава при кувању, на формираном сету узорака шпегета спроведена су испитивања одабраних текстурих својстава сушених и куваних облика применом сензорске оцене и инструменталних одређивања. Упркос добрим слагањима резултата добијених инструменталних одређивањим и сензорском оценом од стране панела одабраних оцењивача, дошло се до закључка да поједини инструментални методи могу наћи добру примену у предикцији објективне сензорске оцене појединих текстурих својстава и тиме допринијети побољшању квалитета тестенине облика шпегета током технолошког процеса производње, али да не могу безрезервно бити прихваћени као алтернатива објективној сензорској оцени у предикцији потрошачке прихватљивости овог прехранбеног производа на тржишту.

Кључне речи: сензорска анализа, текстурих својства, инструментални методи, шпегета

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