



Study of different levels of micro-algae *Spirulina Platensis* on the Microstructure and Psychochemical and Sensory Characteristics of Kiwi pastille

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Introduction: Kiwifruit (*Actinidia* sp.) has many appealing properties for consumers such as flavor, color, and nutritional content, especially vitamin C. Kiwi seems to be used as one of the major ingredients within the formulation of this category of foods.

Microalgae are nutritional and innovative natural sources that can be used in the development of novel foods. Among the known species of algae, *Chlorella vulgaris* and *Spirulina platensis* are common edible microalgae that have no side effects on health of human. The amino acid, carbohydrate, and fatty acid profiles of these microalgae are very similar to those of other food materials. *Spirulina* is a multicellular filamentous blue-green microalga, which was introduced as generally recognized as safe (GRAS) after being approved by food and drug administration (FDA). *Spirulina* can also be incorporated into common food preparations such as pastas, biscuit, bread, snack, pastille, candy, yoghurt, soft drink, causing health-promotion that are associated with microalgae biomass.

The aim of this study was to investigate the possibility of producing new product based on kiwifruit and its enrichment with *Spirulina platensis* microalgae so that this product could replace common snacks, especially the pastilles containing synthetic colors and flavors, which have increasingly been used day by day despite having a low nutritional value and causing a variety of side effects. The role of physicochemical and sensory properties is very important in producing new products which can help producers design the products suitably. Therefore, some of the physicochemical properties of the kiwi base pastille were examined in this study, as well as the formulation and enrichment of it with *Spirulina platensis*.

Material and methods: The ingredients of the formulations consist of 65% w/w kiwifruit puree, 30% w/w sweeteners (sugar, powdered glucose, invert syrup and sorbitol), 0.25% w/w high methoxyl pectin, 0.5% Agar, 0.5% Guar and *Spirulina platensis* (0, 0.25, 0.5, 1 and 2% w/w) as well. In order to produce fruit pastille based on kiwifruit puree, the kiwifruits were first washed up, peeled and cut into pieces. Then the pieces were grinded. The prepared puree was mixed with *Spirulina platensis*, hydrocolloids and sweeteners at 70°C with specific ratios. Agar was dissolved in distilled water at 90°C and added to the concerned mixture. Finally, after moderating pH to 3.4 by adding 40 M citric acid and controlling the Brix degree in constant Brix of 45, the mixture was prepared. The mixture was then poured into stainless steel mesh molds with cavity dimensions of 1.2 cm × 2 cm × 2 cm and the molds were kept at 4°C for 2 hours to form the gel. Then the obtained gel was taken out of the mold cavities and the samples were dried at 70°C for 6 hours in a hot air drier with 1.5 m/s airflow rate. Then the regarded tests were performed on the dehydrated samples. To measure pH, pH meter (Hana, Portugal) was used. The measurement of mixture Brix was performed by an optical refract meter (Carlze, Germany). The drying process of the samples was conducted in a hot air drier (Soroush Medicine Co. Iran).

Moisture, protein, fiber, lipid, ash, vitamin C, calcium and iron elements were measured according to the Iran national standard.

Texture profile analyzer (QTS25 CNS Farnell England) equipped with a software was used to determine the textural properties of the samples. Samples were compressed and decompressed in two reciprocating cycles by a round plate cylindrical probe with 3.5 cm diameter, 1 mm/s probe speed and 5 g force to 30% initial height. Histological properties obtained from force-deformation curve are as follows: Hardness, Cohesiveness, Elasticity, Adhesiveness and Chewiness.

Sensory test was performed with the judgment of 10 trained panelists. In order to evaluate the samples. A 9-

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point Hedonic method (1: very undesirable - 9: very desirable) was used. 5 sensory attributes (color, texture, flavor, odor and overall acceptance) were evaluated.

SPSS software was used for the statistical analysis of the parameters. Mean of the replicates were compared via the multi-range Duncan's test at 95% confidence level.

In order to photograph with Scanning electron microscope, initial preparation should perform on all of samples. The obtained samples were removed from the templates and were sectioned on a scale of $2 \times 1 \times 1$ mm. samples were dehydrated in ethanol solution and then dried in a critical point. Then samples with 30 nm of gold/palladium coated and were tested using SEM (model LEQ1450VP) in the maximum voltage of 15 kv. At least four images with magnification of 500, 1000, 2000 and 5000 were prepared in several different areas of the samples.

Results and discussion: The obtained results indicated that the effect of *Spirulina* was significant on the moisture content and increasing *Spirulina* concentration led to increased moisture content of the product. The results of texture profile analysis indicated that the hardness and chewiness was increased, but the cohesiveness of samples was decreased when the amount of *Spirulina* is increased. The amount of protein, vitamin C, total ash, iron and calcium was increased by increasing the amount of *Spirulina*. SEM microscopic results showed that adding up *Spirulina* is led to the reduction of the uniformity of sample's structure and then the gel matrix will be created with a larger pore. Results of sensory analysis indicate that samples containing 0.25% *Spirulina* have sensory characteristics (color, aroma, flavor and overall acceptability) than other samples.

Keywords: Texture Profile Analysis, *Spirulina Platensis*, Sensory Evaluation, Kiwi Pastille, Compounds Chemical.