Influence of dry and wet osmotic dehydration on colour and texture of a spread kiwi product

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ABSTRACT
Development of new products which present a good organoleptic quality but also offer other advantages such as the incorporation of healthier ingredients is currently a priority in the food industry. It is also important that the elaboration method of these products is as soft as possible to preserve the maximum characteristics and nutrients of fresh fruit. In this sense, the elaboration of healthy spread fruits by osmotic dehydration is an excellent option due to the high quality of the products obtained as compared with other drying methods.

Traditional wet osmotic dehydration has however some disadvantages related with the handling of big volumes of osmotic solutions. The dry osmotic dehydration might be an alternative since the volume of solution generated is considerably lower than the volume managed in the wet method and it is more concentrated in aromatic compounds, soluble vitamins and minerals as it comes from the product itself.

The aim of this study was to compare the two different methods, wet and dry osmotic dehydration, as a step to produce a 30 Brix spread kiwi product formulated with two different sugars, sucrose and isomaltulose. Physicochemical parameters as well as colour and texture analyses were performed.

The results showed that there was not a clear behaviour of the samples in colour terms, although less L* values were obtained for all the products compared with fresh one. On the other hand, the use of different sugars did not show significant differences either in colour terms or texture parameters. Therefore, isomaltulose can be used as an ingredient to replace sucrose in the manufacturing of this kind of products. Furthermore, since isomaltulose has less sweetener power than sucrose, the obtained product is closer in taste to fresh fruit than the product processed with sucrose.

Keywords: Kiwi; Healthy fruit product; Isomaltulose; Diabetes.

INTRODUCTION
Nowadays consumers demand products with good taste and flavour but moreover, they require this foods to be healthier and with good nutritional and functional value. More and more the improvement of organoleptic quality and other nutritive aspects is being necessary. Besides this aspects, sometimes it is also required that this foods would not produce undesirable effects, related for example with sugar consumption, as caries and diabetes. Therefore the development of new products which satisfy consumer expectations is becoming a priority goal of food industry.

From this point of view, the development of a fruit spread would be interesting since they present some characteristics similar to fresh fruit but on the other hand they are more stable than the fresh ones as the aw of the product is reduced by water removing and sugar addition. Moreover when sucrose is replaced by a healthier sugar like isomaltulose this product would have an added value for specific groups of population as children or old people, since this sugar has a low glycemic index and does not provokes caries.

On the other hand, wet osmotic dehydration (WOD) is a usually extended technique for the processing of fruits and vegetables, due to the high quality of the products obtained as compared with other drying methods. In this method, the food is immersed in a concentrated solution generating a difference in osmotic pressure between the food and the surrounding solution. This phenomenon transfers water from the product to the osmotic solution while osmotic solutes are transported from the solution into the product. However, this method presents some disadvantages related with the preparation and handling of big volumes of osmotic
solutions, the high water consumption and the losses of nutritional soluble compounds in the osmotic solution.

The dry osmotic dehydration might be an option to elaborate this kind of products as the volume of solution generated is considerably lower than the volume managed in the wet method and it is more concentrated in aromatic compounds, soluble vitamins and minerals as it comes from the product itself.

The aim of this work was to analyze and compare the physicochemical aspects of an isomaltulose kiwi spread fruit made by means of dry osmotic dehydration.

MATERIALS & METHODS

Kiwis (*Actinidia deliciosa*), acquired in a local supermarket were handy selected to avoid physical damage. Samples were peeled, cut in 1 cm³ cubes and sink in chloride water.

**Equilibrium stage:** two different osmotic dehydration methods were used, Wet Osmotic Dehydration (WOD), in which the fruit was immersed in a hypertonic osmotic solution (40 Brix) and Dry Osmotic Dehydration (DOD), in which the osmotic agent was placed directly on the fruit like in meat or fish salting process. The equilibrium concentration achieved in this stage was 30 Brix. The ratio fruit:sugar or fruit:solution was calculated by mass balances. Sucrose or Isomaltulose were used as osmotic agents. The work temperature was 25 ºC.

**Product formulation:** the ingredients in the spread formulations were dehydrated kiwi, osmotic solution, apple pectin (1, 1.5, 2 %) as a jelling agent and potassium sorbate (500 ppm) as a preservative. The different obtained kiwi spread products obtained can be seen on table 1. According to the different proportions of dehydrated kiwi:osmotic solution and depending on the dehydration methods, three kinds of process were selected.

- WOD: 70 % dehydrated fruit and 30 % osmotic final solution.
- DOD1: 100 % dehydrated fruit and 100 % generated osmotic solution
- DOD2: 70 % dehydrated fruit and 30 % generated osmotic solution.

<table>
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<th>Table 1. Experimental design of the different kiwi spread products.</th>
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**Physicochemical analysis:** Measurements were carried out by triplicate. Moisture content was determined gravimetrically by drying to constant weight in a vacuum oven at 60 ºC (method 20.103 AOAC, 1980). Soluble solids content (Brix) was measured in samples, previously homogenized, with a refractometer at 20 ºC (ATAGO 3 T). Water activity (*a*<sub>w</sub>) was determined with a dew point hygrometer (FA-st lab, GBX). pH was determined by a pH-meter (SevenEasy, Mettler Toledo).

**Colour measurements:** Instrumental measurements of colour were conducted at room temperature in a Minolta spectrophotometer (model CM-3600d) by placing the kiwi spread in a 20 mm thick and transparent plastic cell and by using a black plate as the background to standardize the measurements. Visible absorption
spectrum was recorded between 380 and 770 nm by reflectance to obtain tristimulus values of CIEL*a*b*, using illuminant D65 and standard observer (10° visual field) as references.

**Texture determinations:** Objective determinations of strength and consistence were under the back-extrusion test using a texturometer TA/XT/PLUS Texture Analyzer and the accessory Back extrusion cell with 35 cm ring [1, 2].

The back-extrusion test consisted on making a circular base embolus of 35 mm of diameter, go through the sample contained in a glass cylindrical vessel, at a constant speed of 1 mm·s⁻¹. For all the assays the embolus covered the same distance until the bottom of the vessel and the amount of sample was the same.

**RESULTS & DISCUSSION**

After the formulation of the different kiwi spreads they were storage during 24 hours at room temperature to allow the gel formation. Then analysis of moisture (x%), soluble solids content (xss), and water activity (aw), pH as well as colour and texture determination were performed.

The obtained products showed a similar composition in terms of moisture and soluble solids content which could be expected as the ratio was calculated to reach a final concentration of 30 Brix. The solid soluble content of the final spread-products was 0.291 (± 0.03) and the moisture of 0.69 (± 0.02). On the other hand, aw showed values of 0.964 (± 0.006). Finally the final pH value for the formulated products was around 3.37 (± 0.07). Therefore no differences depending on the different sugars, dehydration methods or pectin percentages were found in terms of physicochemical parameters on the final products. These results are contrary to those obtained for the same kind of spreads elaborated with strawberry where the isomaltulose spreads showed a higher aw compared with the sucrose ones [3].

**Colour analysis:** Figure 1 shows the colorimetric coordinates (L*, a*, b*) of the different kiwi spread as well as the coordinates of fresh kiwi.

![Figure 1. Colour coordinates of the samples in the chromatic planes b*-a* and L*-a*](image)

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**Figure 1.** Colour coordinates of the samples in the chromatic planes b*-a* and L*-a*.
As can be seen on Figure 1, all the samples were very similar to the fresh one and there was not a clear tendency in the colour coordinates (L*, a*, b*) of samples depending on osmotic dehydration method, kind of osmotic agent or pectin percentage; similar results have been reported in tomato spreads of 50 Brix [4], while colour differences have been notice in other spread-products such as in strawberry ones depending of osmotic agent [3]. This fact could be related to the high stability of kiwi pigments and lower degree of interaction within the system components compared to those present in strawberries.

**Texture analysis:** Figure 2 shows the consistency and cohesiveness of the different samples obtained after back extrusion test. It can be seen that no differences in texture parameters were found between the different products as a consequence of the different sugars used in their formulations. On the other hand, spread-products with different consistency and cohesiveness characteristics could be obtained depending on osmotic dehydration method and pectin percentage used.

**CONCLUSION**

This work confirmed the viability of DOD and the use of new sugars (ex, Isomaltulose) as an alternative to obtain tomato spreads with colour and texture comparable to those elaborated by WOD with sucrose. The final product obtained by DOD is additionally richer in aromatic compounds, soluble vitamins and minerals from fresh fruit since effluents are not generated, getting to increase the process yield. Furthermore, as isomaltulose has less sweetener power than sucrose, the obtained product is closer in taste to fresh fruit than the product processed with sucrose.

**REFERENCES**


