

NEW PRODUCTS OF AVOCADO (*Persea americana* Mill): PASTE AND PIECES OBTAINED BY OSMOTIC DRYING.

M. Schwartz¹, J.A. Olaeta², P. Undurraga², M. Sepúlveda¹ and P. Tepper

¹Universidad de Chile. Facultad de Ciencias Agronómicas. Departamento de Agroindustria y Enología. Casilla 1004, Santiago, Chile. E-mail: mschwartz@uchile.cl

²Pontificia Universidad Católica de Valparaíso. Facultad de Agronomía. Casilla 4-D, Quillota, Chile. E-mail: jolaeta@ucv.cl

The phenomenon of mass transfer during the osmotic dehydration of avocado pear (*Persea americana* Mill) was studied in order to preserve this fruit, keeping its organoleptic characteristics. The process was carried out using 1-centimetre thick crescent-shaped pieces of avocado, and three osmotic solutions (in which pH was adjusted in 2): NaCl 20% w/v (T₁); maltodextrin (DE = 18-22) 60% (T₂) and the mixed solution NaCl 10%-maltodextrin (DE = 18-22) 50% (T₃). The pieces were completely immersed for six hours, at ambient temperature. The pieces were ground and vacuum-packed in polyethylene bags after osmotic dehydration. The weight loss (PP) was evaluated and reached 5.7, 17.5 and 30.3% in T₁, T₂ and T₃, respectively. The highest level of water loss (PA) occurred in T₃ (39.4%), meanwhile the PP level only reached 14.8 and 22.4% in T₁ and T₂, respectively. The soluble solids gained (SG) reached values of 8.5, 4.4 and 9.2% in T₁, T₂ and T₃, respectively. Water activity (a_w) decreased an initial value of 0.968 to 0.907, 0.965 and 0.910 with T₁, T₂ y T₃, respectively. In relation to color, the L* parameter decreased from 60.7 to 54.8, 57.3 and 50.9 in T₁, T₂ y T₃, respectively. The a* parameter increased (i.e. became less negative) in all the treatments. The b* parameter decreased in T₁ and T₃ but increased in T₂. The pieces and pulp exposed to air during 24 hours did not become darker, keeping the normal green color of the fruit.

Key words: Osmotic dehydration;
Avocado (*Persea americana* Mill) cv. Fuerte.

NUEVO PRODUCTO DE PALTA /AGUACATE (*Persea americana* Mill): PASTA Y TROZOS OBTENIDOS POR SECADO OSMÓTICO

M. Schwartz¹, J. Olaeta², P. Undurraga², M. Sepúlveda¹ y P. Tepper

¹Universidad de Chile. Facultad de Ciencias Agronómicas. Departamento de Agroindustria y Enología. Casilla 1004, Santiago, Chile. E-mail: mschwartz@uchile.cl

²Pontificia Universidad Católica de Valparaíso. Facultad de Agronomía. Casilla 4-D, Quillota, Chile. E-mail: jolaeta@ucv.cl

Con el fin de preservar la palta/aguacate (*Persea americana* Mill) manteniendo sus características organolépticas se estudió el fenómeno de transferencia de masa durante la deshidratación osmótica de esta fruta. El proceso se realizó con trozos de forma semilunar de un centímetro de espesor y tres soluciones osmóticas: NaCl 20% p/v (T₁); maltodextrina (DE = 18-22) 60% (T₂) y una solución mixta de NaCl 10%-maltodextrina (DE = 18-22) 50% (T₃). Los trozos se sumergieron completamente durante seis horas, a temperatura ambiente. Después de la deshidratación osmótica los trozos se trituraron y se envasaron al vacío en bolsas de polietileno. Se evaluó la pérdida de peso (PP) que alcanzó valores de 5,7; 17,5 y 30,3% para T₁, T₂ y T₃, respectivamente. La mayor pérdida

de agua (PA) se logró con el T₃ (39,4%) ($P \leq 0,05$), en tanto que con T₁ y T₂ sólo se logró una PA de 14,8 y 22,4%, respectivamente. Los sólidos solubles ganados (SG) llegaron a 8,5; 4,4 y 9,2% para T₁, T₂ y T₃, respectivamente. La actividad de agua (a_w) disminuyó desde un valor inicial de 0,968 hasta 0,907, 0,965 y 0,910 con T₁, T₂ y T₃, respectivamente. En color, el parámetro L* disminuyó desde 60,7 hasta 54,8; 57,3 y 50,9 con T₁, T₂ y T₃, respectivamente; el parámetro a* aumentó (se hizo menos negativo) con todos los tratamientos y b* disminuyó con T₁ y T₃ y aumentó con T₂. Los trozos y la pulpa expuestos al aire durante 24 horas no se oscurecieron permaneciendo el color verde típico de la fruta.

Palabras claves: Deshidratación osmótica ;
Palta/aguacate (*Persea americana Mill*) cv Fuerte

1. Introduction

Avocado is a fruit very appreciated by its organoleptic and nutritious qualities, but highly percedera reason why it requires of a suitable handling of cold for his conservation postharvests. (FAO, 1990). The processing of this fruit presents/displays certain obstacles like the enzymatic pardeamiento, the microbiological deterioration and the generation of scents and strange flavors as resulting from the application of heat treatments, factors that limit the conservation of avocado by means of the application of traditional methods that have been applied to other fruits.

The water removal from food pieces is made with the purpose of diminishing its water activity and thus to inhibit the microbial development and reactions of deterioration. One of the most efficient forms to remove water of foods is through the osmosis, since it does not have to undergo a change of state (Bolin et al, 1983; Schwartz, 1994).

Of general terms, the osmotic dehydration (DO) consists of submerging food pieces in a hypertonic solution, originating two main flows: an exit of water from the food towards the solution and an entrance of solutes from the solution towards the food. Both flows are affected by factors such as the temperature of work, the concentration of the solution, the type of solute used and the own characteristics of the food. The idea is to diminish the activity of solutes water being eliminated water and/or entering the food, of such form that is reduced the water available, necessary for the development of metabolic functions and the growth of microorganisms (Farkas and Lazar, 1969).

In the specific case of avocado, the DO as opposed to presents several advantages the traditional dehydration. Because it is possible to be made to room temperature, neither the flavor nor the color suffer thermal damage, which would allow to diminish or to eliminate the use of reducing agents like sulphite anhydride(SO₂). On the other hand, the fact that the loss of water does not happen due to a change of phase (liquid-steam) in combination with the soluble solid gain allows to conserve in suitable form the structure and therefore to improve the final texture. In addition the potential contribution of incorporated solids is due to consider, to the flavor and/or nutritional value of the food (Beristain et al, 1990; Schwartz, 1993).

The primary target of this work is to study the phenomenon of transference of mass during the osmotic dehydration of avocado cv Fort being used two osmotic agents.

2. Material and Methods

2.1 Materials

Avocado cv Fort was used with resistance to the pressure between 1.61 and 2.02 K. These were submerged in three solutions: NaCl 20% p/v (aw: 0,84); maltodextrin 60% (aw: 0,92) and one mix NaCl and maltodextrin to 10 and 50% (aw: 0,81), respectively.

The fruit washed with chlorinated water (20 ppm of free chlorine) was cut in semimoons of 1 cm of thickness. The DO was made during six hours, having submerged the pieces in the hypertonic solutions to room temperature (18-22° C). After dehydration, the fruit was let slip and a part was crushed. The pieces and the pulp were packaged to the emptiness in polyethylene bags.

Analytical techniques.

Color of the pulp (L* parameters, a* and b* with a colorimeter Minolta CR-200 b). Water activity (aw; with a measurer aw - Wert/Messer marks Lufft). Soluble solids (SS) (by sample dilution; a manual refractometer of optical Kyowa Co., Ltd. was used, model H-1A.) residual Humidity (dried in stove to 105 during 24 hours). Loss of water (PA): one calculated, for hourly with

$$PA = (H * M) - (H_1 * M_1) / M, \text{ where}$$

M: Initial weight of the fruit (g); M1: Weight of the fruit, after osmosis (g)

H: Initial humidity of the fruit (%); H1: Humidity of the raw fruit (%).

Gained soluble solids (SG): They calculated in hourly with:

$$SG = (M1 * S1) - (M * S) / M, \text{ where}$$

M: Initial weight of the fresh fruit (g); M1: Weight of fruit, after osmosis (g)

S: Initial SS of the fruit (°Brix); S1: SS of the raw fruit.

2.3 Experimental design and statistical analysis: in this study three treatments were made: T1: NaCl 20%; T2: maltodextrin 60%; T3: mixture of NaCl to 10% and maltodextrin 50%. For the analysis of the treatments, a randomized design with six repetitions by treatment was used completely. The results were analyzed by ANDEVA and in case of existing statistically significant difference the test of multiple comparison of Duncan was used.

3. Results and Discussion

In table 1 the used raw material is characterized

Table 1. Physical and chemical characteristics of avocado cv Fort.

Humidity	S. solids	Aw	Color		
(%)	(°Brix)		L*	a*	b*
80,7	4,7	0,968	60,7	-12,5	31,2

Humidity content. The synergic effect is well-known that is between the NaCl and the maltodextrin (Figure 1), because for a same total concentration of solutes, the mixture was significantly more effective, obtaining avocado with a value average of 59.23% of humidity, in comparison to 69.84%, that it generates the treatment of single maltodextrin. Unlike which they established Hawkes and Flink (1978) for the apple, the NaCl did not turn out to be a good osmotic agent for avocado. This, without considering the disagreeable taste salty that gave to him.

Soluble solid content. A clear difference in the amount of solute was appraised that penetrates to the food and this is explained by the different composition from each solution. After four hours of dehydration a significant difference between all the treatments was observed (Figure 2).

Polisacaridos that constitutes the maltodextrin cannot penetrate cellular membranes due to their great size, reason why the increase in the content of disacaridos SS must to the monkey and that composes it. This explains the smaller increase in the SS content of T2 in relation to the other treatments that use solutes of smaller mass to molar, reaching in average the 10.78° Brix after six hours. Had not only his low molecular weight, but that to a the size of the ions Na⁺ and Cl⁻ the NaCl penetrated, increasing its content in SS until 14.6, in average.

The increase in T3 had to the incorporation of NaCl and sugar molecules, of low molecular weight, that penetrated to avocado.

Loss of weight. The effectiveness of the NaCl in the initial speed of loss of weight stands out since with a total concentration of 20% it produced a PP that almost doubled the value obtained with a 60% of maltodextrin.

Again the sinergic effect of the mixture of solutes is appraised. For a same total solid content (60%), the mixture generated a PP greater than the pure solution. The final values in average are: 5,73; 17,49 and 30.25%, for T1, T2 and T3, respectively.

Loss of water (PA). Although the NaCl generated a great loss of initial water, the final result was low, arriving at a total of 14.84%, after six hours. This opposes with conclusions of Hawkes and Flink (1978), who determined that a solution of NaCl to 25% is far the best osmotic agent, for other fruits (Figure 3).

The greater PA obtained with the mixture of NaCl and maltodextrin, reaching after six hours a 39.39%. The single maltodextrin, with the same total solid concentration, only obtained an equal PA to 22.35%.

Gained soluble solids. The maltodextrin has a low percentage of small molecules, reason why it did not produce a great soluble solid gain, arriving finally at a 4.35% (Figure 4).

Due to the low size of ions of the NaCl, the SS gain was significant, as much for the solution of pure NaCl as for the mixture. These two treatments had similar gains throughout the process, with final values of 8.54 and 9.19% for NaCl and the mixture, respectively.

Color. The L^* parameter measures the luminosity or brightness and varies between 0 (black) and 100 (white); the parameter a^* measures the intensity of the red one (when he is positive) and of green (when he is negative) and the parameter b^* measures the intensity of the blue yellow respectively and (when he is positive or negative,). Significant differences in all the treatments were observed, between initial and final the L^* parameter. A diminution of the L^* value took place, from 60,5; 61,8 and 59.8 up to 54,8; 57,3 and 50.9 (for T1, T2 and T3, respectively). This was translated in an intensification of the green color of the pulp of avocado. The treatment that eliminates more water, has final a L^* minor, being this significant different from the one from the other two treatments.

Water activity. The treatment with maltodextrin was the one that less diminished the A_w of avocado(0.965 end), and in addition, it was different in significant form of the other two. The diminution of A_w in T3 (0.91 end) had in important form to PA, whereas the NaCl had a greater effect through its incorporation (solid gain), arriving at 0.907 after six hours of treatment.

4. Conclusions

1. As much the exposed paste as the pulp to the air was not darkened passed 24 hours.
2. - The greater loss of water is associate with the treatment that uses a maltodextrin mixture 50%-NaCl 10%, which simultaneously produces an important diminution of A_w . On the other hand, the smaller loss of water happens with the treatment of NaCl 20%, being the single maltodextrin the one that produces an intermediate loss of water.

3. - The entrance of NaCl to the avocado dehydrated with the mixed solution, distributes a fort to him salty taste, which could be corrected using a smaller concentration of salt or could be used like extensor of fresh pulp of avocado. On the other hand, the treatment with single maltodextrin does not present/display east problem, but the loss of water is smaller and a_w practically stays. The great amount of NaCl that enters the avocado when using the solution of NaCl 20%, together with the low loss of water suggests this treatment is not adapted.

4 - The diminution of water activity increases the persistence of chemical agents and enzymatic of the avocado pulp

Gratefulness

This work forms of the project industrial Transformation of avocado, financed by the Foundation of Agrarian Innovation of the Ministry of Agriculture of Chile. The authors express their recognition by the offered support.

5. References

- Beristain, C.I., Azuara, E., Cortés, R., García, H.S. 1990. Mass transfer during osmotic dehydration of pineapple rings. *International Journal of Food Science and Technology*. 25: 576-582.
- Bolin, H.R.; Huxsoll, C.C.; Jackson, R.; K.C.N.G. 1983. Effect of osmotic agents and concentration on fruit quality. *Journal of Food Science*. 48: 202-205.
- FAO. 1990. III Reunión técnica de la red latinoamericana de agroindustria de frutas tropicales. *Federación Nacional de Cafeteros de Colombia*. 107-122.
- Farkas, D.F., Lazar, M.E. 1969. Osmotic dehydration of apple pieces: effect of temperature and syrup concentration on rates. *Food Technology*. 23: 688-690.
- Hawkes, J., Flink, J.M. 1978. Osmotic concentration of fruit slices prior to freeze dehydration. *Journal of Food Processing and Preservation*. 2: 265-284.
- Schwartz, M. 1993. Conservación de frutas por métodos combinados: una alternativa de interés para los productores y la agroindustria. *Simiente*. 63 (4): 212-213.
- Schwartz, M. 1994. La deshidratación osmótica como técnica de preconservación de frutas y hortalizas. *Aconex*. 44 (2): 10-13.
- Schwartz, M.; Sepúlveda, M.; Vilanueva, L. 1994a. Deshidratación osmótica de manzana (cv Granny Smith) con jarabe de maíz. *Libro resumen VIII Seminario Latinoamericano y del Caribe de Ciencia y Tecnología de Alimentos*. Uruguay. p. 54.
- Schwartz, M.; Silva, C.; Vergara, P. 1994b. Osmotic dehydration of Granny Smith apples using apple juice and hot air. *Proc. of International Symposium on the Properties of Water*. p. 84
- Schwartz, M.; Villanueva, L.; Sepúlveda, M. 1994c. Calidad organoléptica de la banana osmodeshidratada (var Cavendish) durante el almacenamiento. *X Congreso Latinoamericano de Nutrición*. Venezuela. p. 41-42.

