Preparation and characterization of osmodehydrated fruits from lemon and date by-products

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Abstract:

In this study, an osmotic dehydration process (ODP) was established in order to formulate osmodehydrated fruits from Citrus and date by-products. ODP were conducted at 40 °C. This temperature was maintained using an oven, or a water bath with continuous stirring. The osmodehydration kinetic in a water bath showed a better mass transfer. Then, osmodehydrated fruit (ODF) preparations of about 40 °Brix were formulated using different isotonic solutions (sucrose, glucose/sucrose; glucose and date juice). All the formulated products showed better sensorial characteristics (lower acidity, higher sugar content..) than the untreated lemon by-product. Their attractive colour and their good densities allow them to be incorporated in some milk products. The isotonic solution composition influenced their physical characteristics. In fact, ODF prepared in glucose and glucose/sucrose solutions presented more opened structures and lower water holding capacities (WHC) than the others. These results support the valorization of citrus and date by-products as ODF that could be consumed or incorporated as an ingredient in food formulations.

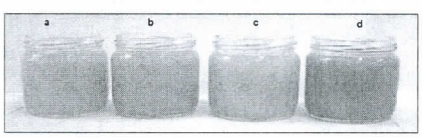
Introduction

In Tunisia, the production of citrus fruits was nearly 225000 tons in the 2002-2003 growing season. On the other hand, dates production was nearly 115000 tons in this season, with 72000 for the "Deglet Nour" variety.

Citrus juice industries generate a considerable quantity of by-products which are mainly constituted by peels (albedo and flavedo), seeds and fruit pulp remaining after juice extraction.

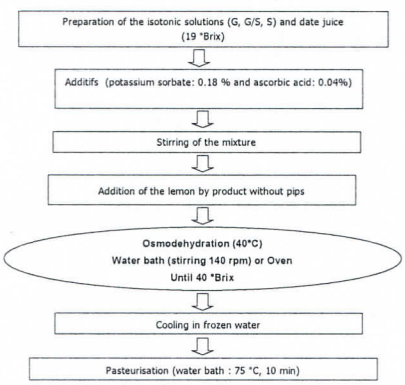
These by-products are generally thrown or in limited cases used in animal feed or as a fertilizer. Their rejection could give rise to serious environmental pollution. Also, a large quantity of dates (30000 tons/year) is lost for many reasons, during the picking or the storage. These dates by-products are generally discarded or partially integrated in animal feed. Citrus and dates by-products could be useful in the food industry, awing to their high content of many important natural compounds such as pectin, flavonoids, sugar and dietary fiber.

In this sense, wide prospects for osmotic dehydration (OD) in concentrated solutions have arisen as a pre-treatment in combined techniques. This process allows as to obtain fruit products with a good organoleptic and nutritional content. These fruit preparations could be used not only as finished products but also as ingredients for many foods such as ice-cream, confectionery and bakery products. The aim of this study was to use lemon by-products and dates by-products for the preparation of dehydrated fruits after treatment by DIS process. The most physical and chemical properties of lemon by-products as well as date fruit and juice were also evaluated.



a : sucrose; b: glucose/sucrose; c: glucose; d: date juice

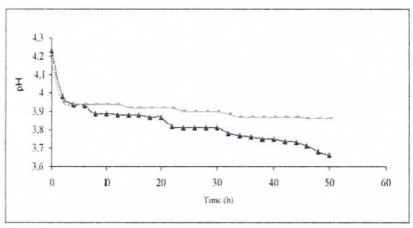
Osmodehydrated fruits preparation

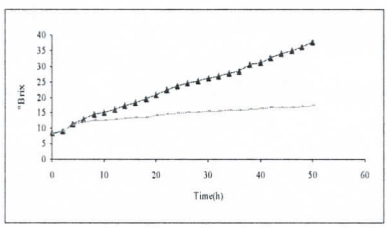


Physico-chemical properties of the by-products and the date juice (g/100g dry matter basis)

Component	Lemon by-products	Date by-products	Date juice
Dry matter (%)	15.87	65.78	17.17
Ash	2.57	2.27	2.40
pH	3.14	5.11	5.62
Acidity (Meq/100 g)	38.71	6.93	1.20
Protein	7.88	2.84	1.79
Total sugars	13.77	87.71	85.58
Pectin	21.56	2.27	0.53
Total soluble solids (°Brix)	7.38	-	19
a_w	0.980	-	0.957

Kinetic of ODP in drying oven / water bath

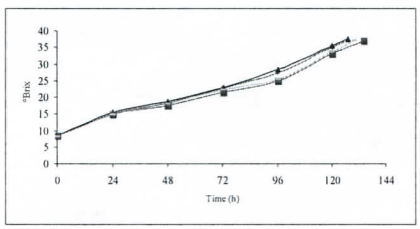




(▲ water bath ; ▫ drying oven)

Better mass transfer in the water bath

Study of the ODP at a water bath



(◆ date juice ■ sucrose — glucose/sucrose ▲ glucose)

Molecular size of the sugars ⇗ ODP speed ⇘

Physico-chemical properties of the osmodehydrated fruits (g/100g dry matter basis)

Component	Isotonic solution			
	Date juice	Sucrose	Glucose/ sucrose	Glucose
Dry matter (%)	41.99	44.05	41.58	44.73
Ash	3.04	1.39	1.33	1.30
pH	3.57	3.26	3.15	3.07
Acidity (Meq/100g)	17.32	14.40	15.20	15.44
Proteins	8.75	6.85	6.86	6.55
Total sugars	78.56	81.06	82.64	82.69
Total soluble solids	40.14	40.36	40.17	40.68
a_w	0.919	0.932	0.925	0.904
WHC (%)	67.55	68.74	40.39	54.58
Density	1.190	1.220	1.230	1.230

• Total sugars ⇗ ; Acidity ⇘ : Better sensorial properties

• Similar characteristics for date juice : good substitute of isotonic sugar solutions

•Good densities : incorporation in some milk products

Colour study of osmodehydrated fruits

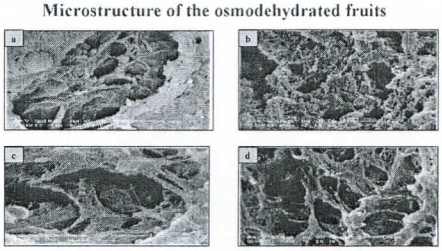
CieLab coordinate	Isotonic solution			
	Date juice	Sucrose	Glucose/sucrose	Glucose
L^*	21.95	25.04	25.41	36.94
a^*	3.35	3.11	2.20	1.91
b^*	4.16	6.15	7.09	16.47

• ODF prepared in sugar solutions : yellowish brown colours ⇨ enzymatic or non enzymatic browning

• Samples prepared in sucrose more brownish (Lower L^*, higher a^*) ⇨ longer time of ODP

• ODF prepared in date juice : darker colour

Microstructure of the osmodehydrated fruits



a: date juice ; b: sucrose ; c: glucose/sucrose ; d: glucose

• Apparent network : gel formation (extracted pectin)

• Samples prepared in glucose and glucose/sucrose : more open structure ⇨ lower viscosity and WHC

Conclusion

Lemon and date by-products were good food matrices for the preparation of ODF preparations using ODP.

Results showed a better mass transfer when the ODP was performed in the water bath at 40 °C. Physico-chemical analysis indicated that the ODP has been described as a suitable method for preserving fruit quality and developing new food ingredients. The nature of the solutes used for the dehydration solution (sucrose, glucose/sucrose, glucose and date juice) influenced the kinetic of the ODP as well as the properties of the final products. Juice from date by-products was found to be a good substitute of isotonic sugar solutions.