

Optimization of the production of date palm juice from "Mech Degla" variety (harvesting season 2019) by "microwave heating" method, applying "Box Behnken" statistical plan

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Introduction

Algeria is a major producer of dates. It is ranked 5th in production volume after Egypt, Iran, Saudi Arabia and the United Arab Emirates (18.4 million palm trees in 2013). The date palm fruit, being very rich in sugars, its pulp is perfectly suited to extract a sweet juice, thus, there is in the Saharan regions of Algeria, a traditional know-how in the transformation of dates into various food products (vinegar, jam, juice, ...).

Date palm juice produced on a traditional scale (direct heat) is characterized by its unwanted dark color, its high turbidity and its undesirable caramelized taste: the use of direct heat for concentration increases the level of HMF toxic products of caramelization due to thermal degradation of sugars.

Objectif

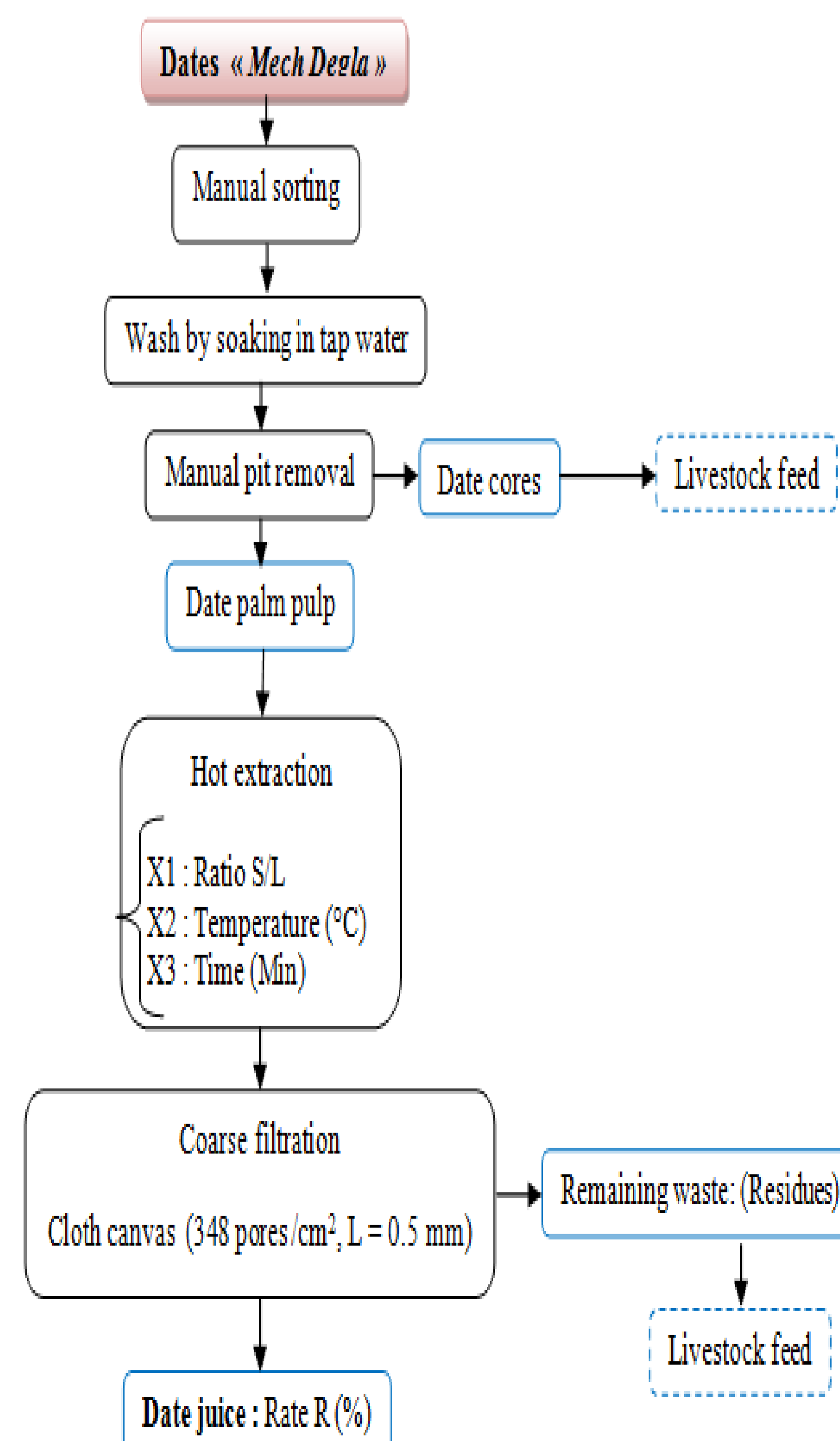
The present work aims to improve the manufacturing process of a date by-product "date palm juice" from a date variety of low market value but high nutritional value : "Mech degla" (harvesting season 2019), by applying new techniques in the extraction process other than that carried out on fire burner: microwave heating

Materiels and methods

The date juice extraction procedure has been optimized using "Box Behnken" plan to find the best experimental conditions for three independent factors (X1: ratio Solid/Liquid, X2: Power level (Watt), X3: Time (Sec)) affecting the response the rate of extraction "R"(%), the field of study for each factor was adjusted after preliminary plans.

Box Behnken plan is done using MINITAB software, version 17.1.0

1. Date juice making diagram



2. Calculation of yield R (%)

$$R (\%) = \frac{\text{TSS jus} (\%) * 100}{\text{TSS pulpe} (\%)}$$

Results / Discussion

1. Experimentation matrix

Run	Ratio S/L	Power level (Watt)	Time (Sec)
1	-1	+1	0
2	-1	-1	0
3	0	0	0
4	0	+1	+1
5	0	-1	-1
6	0	-1	+1
7	-1	0	-1
8	-1	0	+1
9	+1	0	+1
10	+1	+1	0
11	+1	0	-1
12	0	0	0
13	0	+1	-1
14	0	0	0
15	+1	-1	0

Run	Ratio S/L	Power level (Watt)	Time (Sec)
1	0.1666	640	230
2	0.1666	480	230
3	0.2083	560	230
4	0.2083	640	260
5	0.2083	480	200
6	0.2083	480	260
7	0.1666	560	200
8	0.1666	560	260
9	0.2500	560	260
10	0.2500	640	230
11	0.2500	560	200
12	0.2083	560	230
13	0.2083	640	200
14	0.2083	560	230
15	0.2500	480	230

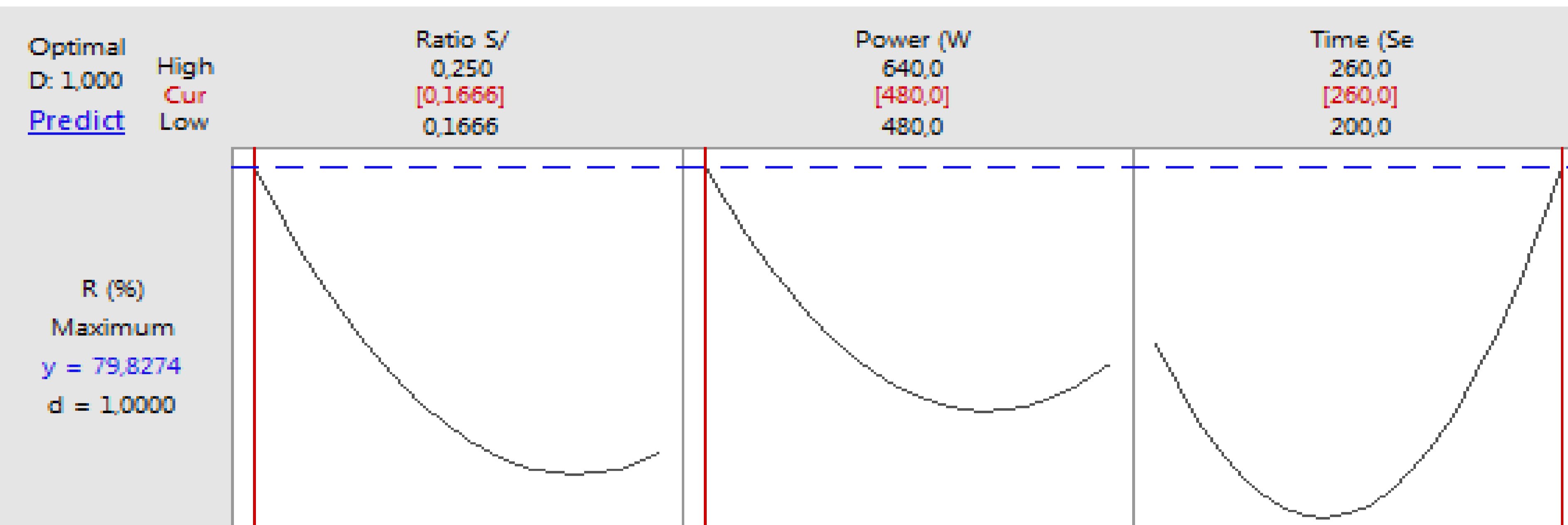
2. Regression Equation in Uncoded Units

$$R (\%) = 1206 - 1792 \text{ Ratio S/L} - 1,135 \text{ Power (Watt)} - 5,69 \text{ Time (Sec)} + 3239 \text{ Ratio S/L} * \text{Ratio S/L} + 0,000918 \text{ Power (Watt)} * \text{Power (Watt)} + 0,01303 \text{ Time (Sec)} * \text{Time (Sec)} + 0,728 \text{ Ratio S/L} * \text{Power (Watt)} - 0,25 \text{ Ratio S/L} * \text{Time (Sec)} - 0,000271 \text{ Power (Watt)} * \text{Time (Sec)}$$

3. Maximum yield and optimal extraction conditions

R (%)	Ratio S/L	Power level (Watt)	Time (Sec)	Composite Desirability	95% CI	95% PI
79,8274	0,1666	480	260	1	(70,23; 89,42)	(62,80; 96,86)

4. Optimization Plot



Conclusion

The aim of the development of date transformation sector is:

1. Promote the national potential of date varieties of low market value for the diversification of the use of dates in the food industry and the safeguarding of traditional knowledge and skills as a national cultural heritage.
2. Create added value for Algerian dates of low market value.
3. Standardize products made from dates (example: rob, flour, etc.)
4. Encourage the creation of SMEs (Small and Medium Enterprises) in the industrialization of these products to improve the socio-economic conditions of rural families. (BELGUEDJ,2015)

Bibliographic references

ITDAS (Technical Institute for Development of Saharan Agronomy, Algeria, 2014 (b): Five-year plan 2015-2019, Date sector

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