BEST: International Journal of Humanities, Arts, Medicine and Sciences (BEST: IJHAMS)
ISSN (P): 2348-0521, ISSN (E): 2454-4728
Vol. 5, Issue 12, Dec 2017, 89-92

OPTIMIZATION OF DIETARY FIBER EXTRACTION FROM DATE SEEDS

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ABSTRACT

The extraction conditions of dietary fiber from date seeds are optimized for the higher yield. The conditions like solvent to sample ratio, extraction and time temperature efficiency were studied. In the reference article, both the yield of dietary fiber and phenolics were increased by the acetone (50%) and water in the seed concentrate but here only the dietary fiber is studied. This work obtained the optimum condition of 1 hour C with a solvent to sample ratio of 60:1. In this work, the response surface methodology is used with three factors solvent to sample ratio, temperature (independent variables) to attain the dependent variable yield percentage (dietary fiber). Based on this study, we believe date seeds concentrates could potentially be an inexpensive source of natural dietary fiber and possibly used as a functional food ingredient.

KEYWORDS: Phenolics, Date Seeds, Dietary Fiber, Solvents & Ratio

INTRODUCTION

Dates are widely cultivated in the Middle Eastern countries. Usually the date seeds are considered to be a waste product in many dates processing plants producing pitted dates, date syrup and date confectionery. The wasted date seeds are used mainly for animal feeds like cattle, sheep, and camel and poultry industries. The annual production of dates ranges around 6227,650 of metric tons (as per the statistical data on March 2017) in which the seeds weight ranges from 380 to 1245 of metric tons. The wasted date seeds possess higher value of nutritional properties.

The date seeds are a good source of potassium. It also contains 3.1–7.1% moisture, 2.3– 6.4% protein, 5.0–13.2 fat, 0.9–1.8% ash and 22.5–80.2% dietary fiber. Higher levels of phenolics (3102–4430 mg Gallic acid equivalents/100 g); antioxidants (580–929µm trolox equivalents/g) and dietary fiber (78–80 g/100 g; Al-Farsi et al., 2007) are present in the date seeds. Dietary fiber has important therapeutic implications for certain conditions such as diabetes, hyper lipidemia, and obesity and may exhibit a protective effect against hypertension, coronary heart disease (CHD), cholesterol, colorectal and prostate cancers, and intestinal disorders (Johnson &Southgate, 1994; Kritchevsky, 1988; Tariq et al., 2000). Solvent choice, solvent to sample ratio, contact time and temperature may significantly influence the extraction efficacy.

MATERIALS AND METHODOLOGY

Seed Extraction

The date seeds of Mabseeli were in oven C and then grounded to 1.5mm in a hammer mill. Then, they are extracted at a constant stirring rate of 120 rpm using a magnetic stirrer plate. The solvents, water and acetone (50%) were used for the optimization of seed extractions (Khokhar & Magnusdottir, 2002; Tabart et al., 2007).

The centrifugation (1000 rpm / 10 minutes) and filtration (Whatman no.4 filter paper) process were used, to separate the solid rotary evaporator under vacuum conditions. After selecting the optimum condition for extraction, seven

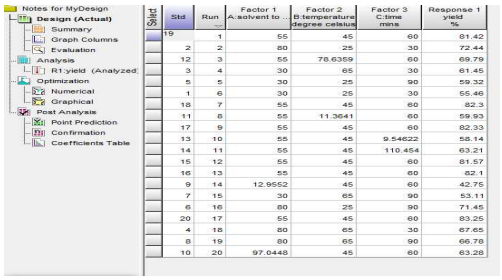
solvents (water, ethanol, methanol, acetone, 50% ethanol, 50% methanol and 50% acetone) were used to identify the proper solvent for extraction. Then the dietary fiber con

Dietary Fiber

Dietary fiber content was determined by enzymatic gravimetric method (AOAC, 1995). The triplicate samples were gelatinized with heat stable α-amylase, and then digested enzymatically with protease and amyloglucosidase, to remove the protein and starch from the date seeds powder. Total dietary fibers were calculated as the sum of soluble dietary fiber and insoluble dietary fiber (after correcting for ash and undigested protein).

OPTIMIZATION METHOD

The reference article did the statistics using the Microsoft Excel Statistical Data Analysis (t-test: two-sample equal variance, using two-tailed distribution). In this report, the Response surface methodology of central composite was used for the optimization. In which the time (30, 60, 90 minutes) were used with 20 runs for obtaining the better extraction efficiency as shown in fig 1.



Std	Run	Factor 1 A:solvent to ...	Factor 2 B:temperature degree celsius	Factor 3 C:time mins	Response 1 yield %
19	1	55	45	60	81.42
2	2	80	25	30	72.44
12	3	55	78.6359	60	69.79
3	4	30	65	30	61.45
5	5	30	25	90	59.32
1	6	30	25	30	55.46
18	7	55	45	60	82.3
11	8	55	11.3641	60	59.93
17	9	55	45	60	82.33
13	10	55	45	9.54622	58.14
14	11	55	45	110.454	63.21
15	12	55	45	60	81.57
16	13	55	45	60	82.1
9	14	12.9552	45	60	42.75
7	15	30	65	90	53.11
6	16	80	25	90	71.45
20	17	55	45	60	83.25
4	18	80	65	30	67.65
8	19	80	65	90	66.78
10	20	97.0448	45	60	63.28

Figure 1

RESULTS

Response Surface Methodology (RSM)

Here RSM of composite method was used with dependent variable: solvent to sample ratio (30:1, 55:1, and 80:1), temperature (25, 45, and 65 C), time (30, 60, 90 minutes), and independent variable: yield% (dietary fiber) and the design model used were quadratic as shown in the fig 2, 3.

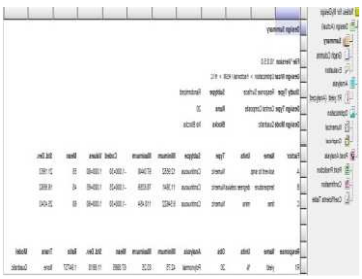


Figure 2

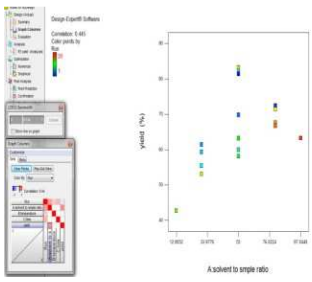


Figure 3

The response, yield % (dietary fiber) obtained ranges from minimum value of 42.75 to the maximum value of 82.33 from the solvent to sample ratio (30:1, 55:1, 80:1) as shown in the fig 3. It shows the relationship between solvent to sample ratio and yield (%). The ANOVA for Response Surface Quadratic model shows that the F-value of 14.35 implies the model is significant. There is only a 0.01% chance that the lack of fit F-value this large could occur due to noise fig 4.

Figure 4

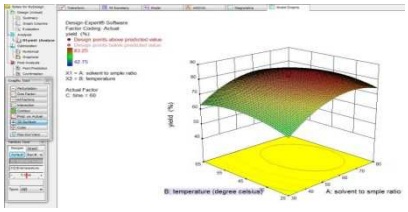


Figure 5

The equation obtained in coded terms is,

Yield = 82.84 +2.22*A -0.29* B +2.61*C -0.16* AB -2.01* AC -2.34* BC -13.49* A^2 -2.27* B^2- 5.03* C^2.

Where,

A - Solvent to sample ratio, B- temperature, C - time.

The overall optimized factors value obtained were solvent to sample ratio– 66:1,

◦ Number of extractions: 2 and yield: 80.95% using Response Surface Methodology (central composite).

DISCUSSIONS

The solvent acetone (50%) and water extraction increased the total dietary fiber as well as its insoluble fiber in the date seeds powder. The difference in dietary fiber could be related to the stage of maturation, and varieties. The recovery attains the maximum value of 80.95%, when the creased by further increasing as shown in the fig.no:5.

CONCLUSIONS

The overall optimized values obtained were solvent to sample ratio– 66:1, temperature: 62 minutes yield: 80.95% from the Response Surface Methodology of central composite. But in the reference article they used t- test and the optimized value obtained were solvent to sample ratio- 60:1, temperature: 45 ◦, time: 60 minutes, number of extractions: 2 yields were 81.5%. So, the t-test methodology gives the higher value of recovery (%) than the Response Surface Methodology.

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