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IMPROVED EXTRACTION OF KOKUM FRUIT PULP BY OPTIMIZING PROCESS PARAMETERS USING RESPONSE SURFACE METHODOLOGY (RSM) TOOL

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ABSTRACT

To obtain a suitable smooth kokum pulp depending on water temperature and soaking time, response surface methodology (RSM) optimal is used. Garcinia indica has many benefits and it's grown all over India. In the present study, rise in the water temperature and soaking time led to increase in the overall pulp recovery and HCA content**.** Using water extraction method, the kokum pulp was extracted at different temperature (15-31°C) and time (15-40 min.). Optimum conditions for smooth kokum pulp were temperature of water 30.07°C and 40 min soaking time, It's represented in the form of surface and contour plots.

KEYWORDS: RSM (optimal), Pulp recovery, Hydroxy citric acid, Kokum, Optimization & Central Compound Rotatable Design

INTRODUCTION

The botanical name of kokum is Kokum, a used as an acidulant for preparing curries mainly by the people living in Maharashtra, coastal Karnataka and Goa. During summer, the drink of ripe rinds is used as a cooling drink by blending with sugar and cardamom. Kokum Kadi or birinda solkhadi are the special dishes of Goans. It is served usually with rice or can be used as an after meal digestive drink. Un-pleasant smell of mackerel and sardines is removed by addition of kokum. Also, it is used to develop the taste of coconut based curries. Pickle and chutneys can be prepared from Kokum. Birindi saar and kokum kadi helps to solve gastric problems. The composition of rind is, it has tannin 1.7%, Total sugars 4.1%, pectin 0.9%, Fat 1.4%, protein 1%, moisture is 80.0g per 100g. The kokum leaves and rinds have HCA (Hydroxycitric acid) as a major organic acid. Seed is stearic, oleic rich. Kokum has many health benefits and has a major role in Ayurvedic system of medicine. It's used to treat obesity and studies have shown that hydroxycitric acid has anti-obesity effects. (Arseculeratne, S. N., Gunatilaka, A. A. L., & Panabokke, R. G, 1981). Number of studies has shown that Hydroxycitric acid even at high dosage of 5 g/kg b. wt. dostemic toxicity. When extrapolated to human dose, 5 g/kg b. wt. amounts to about 350 g. It is nearly 233 times more than the recommended dose of 1.5 g/ day (Jena et al., 2002). Kokum pulp was extracted from dried rinds by using Cold Water extraction. HCA (Hydroxycitric acid) content was maximized by this method. Underutilized fruit kokum can be preserved by making pulp to use it during off-seasons. In the present study to obtain maximum pulp and HCA content from kokum dried rind RSM tool is used by optimizing processing conditions like extraction temperature and time.

LITERATURE REVIEW

Methodology

Collection of Fruits: Kokum rinds which are black red in color were purchased from a retail shop in kannan store, Alandurai.

Extraction of Kokum Pulp: The dry kokum rinds were cleaned in normal water to remove excess salt. For each treatment, 100 gm of sample was used. Equivalent quantity (100ml) of water was added to the cleaned rinds. The washed rinds were drenched in water at different temperature for a variety of periods of time (Table 1). The kokum pulp was extracted by crushing into the mixer operated at 3000 rpm for 10 min at room temperature (28-32 °C). To obtain smooth pulp, the kokum pulp was strained through stainless steel sieve which is having 30 mesh. Further the kokum pulp is pasteurized for 10 mins at 60°C and then it is packed in the aluminium cover.

Grinding Device: The laboratory scale mixer was used. In the jar 1.8 mm thick stainless steel grinding blade was used to grind the materials. Grinding blades consist of three cutting edges.

Extraction Trials: Central composite Rotable Design was used to determine the effect of water temperature on the pulp recovery (PR), Hydroxy Citric Acid content (HCA) based on soaking and soaking time. An extraction treatment is shown in table 2.

Determination of Pulp Recovery

Weight of the smooth pulp divided by weight of whole rinds is used to calculate percentage of pulp recovery (% w/w) according to (Mamiro peter, Fweja Leonard; 2005)

HCA Determination

Ti-ration method with 0.1N NaOH was used for HCA content determination. It is indicated by the formation of hydroxyl citrate with the end point having black color (G. K. Jayaprakasha, K. K. Sakariah; 2002).

Table 1: Effect of Process Variables on PR. and HCA of Extracted Kokum Pulp

Run	Factor 1 A:Temperature degree celsius	Factor 2 B:soaking time min	Response 1 pulp recovery PERCENTAGE	Response 2 HCA g/100kg
1	24.0605	29.2577	87.71	12.6
2	25.3331	17.067	94.73	15.2
3	28.3025	23.727	80.7	11.69
4	22.5758	40	94.73	15.18
5	30.07	15.86	91.22	13.22
6	20.5962	15.86	80.7	11.76
7	30.07	31.551	91.22	13.22
8	24.0605	29.2577	80.7	11.76
9	15.93	22.6192	75.43	10.13
10	20.5962	15.86	66.66	8.91
11	22.5758	40	80.7	11.76
12	30.07	40	91.22	13.22
13	15.93	40	30	75.43
14	18.5459	31.1889	66.66	8.91
15	24.0605	29.2577	70.17	9.81
16	15.93	22.6192	75.43	10.13

X represents the coded level of variables; X represents the actual level of variables.

Experimental Design and Statistical Analysis

A number of experimental parameters were chosen based on earlier treatments. Water Temperature (15-31°C) and Soaking time (15-40 min) were the self-determining variables. Effect on quality of pulp recovery and HCA by water temperature, soaking time were known by RSM (optimal).

RESULTS AND DISCUSSIONS

Pulp Recovery

Pulp recovery=78.48+14.94 A-3.88 B

Y=pulp recovery, A=temperature, B=soaking time

The quadratic terms advised that extreme raise of these variables resulted in reduction of PR. Above equation describes the effect of significant process variables on pulp recovery of the produced pulp

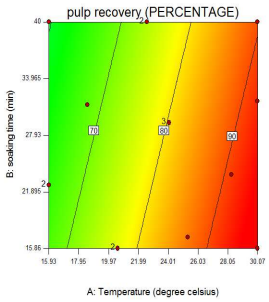


Figure a: Contour Plots

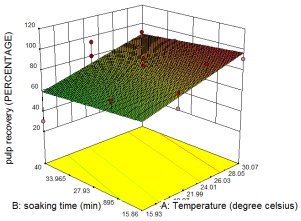


Figure b: 3-D Response Surface Plots

Above fig shows the effect of soaking time and water temperature on pulp recovery

Maximum pulp recovery was 94.73% at optimum condition of temperature 30.07 ^{0}c and soaking time 40 min, respectively.

HCA Content

HCA=+3.08+26.73*A+21.73*B-12.62*AB+14.24*A^2+13.05*B^2+14.36*A^2B-10.69* AB^2-34.63* A^3-23.32* B^3

Y=pulp recovery, A=temperature, B=soaking time

Above equation illustrate the effect of considerable process variables on recovery of HCA content.

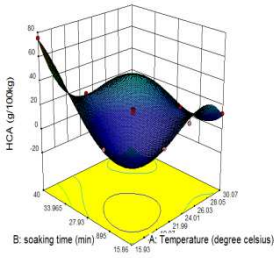


Figure c: 3-D Surface Response Plot

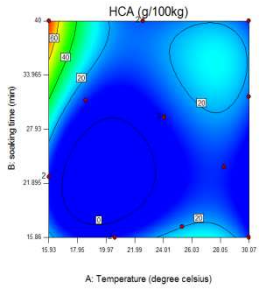


Figure d: Contour Plot

Maximum HCA content obtained was 75.43 g/100 kg at optimum condition of temperature 30.07 ^{0}c and soaking time 40 min, respectively.

Optimization

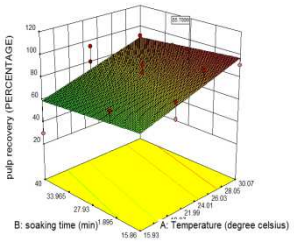


Figure e: Pulp Recovery

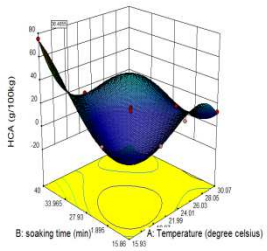
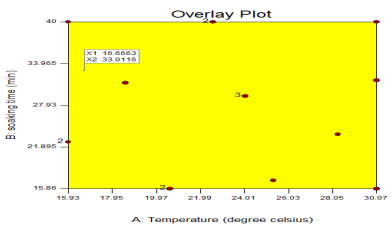


Figure f: HCA Content Numerical

Numerical optimization 3D optimization 3D surface

Surface response plot response plot

Up to a certain level the Overall Pulp recovery and HCA content increases with higher temperature and longer extraction time. Superimposing surface methodology was applied to response variables in graphical optimization overlay plot to find optimum combination of soaking time and water temperature to obtain smooth pulp.. The optimum was obtained at 30.07°C for 40 min which gave Pulp Recovery (94.73%), HCA content (75.43g/100g).



CONCLUSIONS

Soaking is an important process in the fruit pulp recovery, was optimized in order to get maximum PR and HCA content. Different combination of time and temperature showed that these variables are related to the PR and HCA content of smooth pulp.

Soaking, which is the main process in extraction of fruit pulp, was optimized with maximum PR and HCA content, so that the smooth pulp obtained having more yield along with more HCA content. The different extraction time and temperature for extraction of kokum pulp showed that all these variables markedly affect the PR and the HCA content of the smooth kokum pulp. The optimum was obtained at 30.07°C for 40 min which gave Pulp Recovery (94.73%), HCA content (75.43g/100g).

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