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Effect of Forming Pressure on "Hardness" of Peda

Anilkumar R. Chaudhari[1*], Sunil Patel[2] and Vivek Koshta[3]

[1]Dairy Engineering Department, MIDFT, Mehsana, India
[2]Dairy Engineering Department, SMC College, Anand, India
[3]Dairy Engineering Department, MIDFT, Mehsana, India

**Corresponding author*

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A B S T R A C T

The rich tradition of indigenous dairy products in India, deeply intertwined with societal and cultural practices, faces challenges in the organized dairy sector. Hindrances include a lack of mechanized production, labor-intensive methods, absence of quality standards, and poor shelf life. However, the manufacturing of these products holds immense promise, presenting an opportunity to increase their value by 200%, compared to Western counterparts. Indigenous dairy consumption is anticipated to grow at over 20% annually, surpassing the 5 to 10% growth rates of Western dairy products. The renowned Khoa-*Peda*, a sweet from Mathura, exemplifies this potential. Made from Khoa, sugar, cardamom powder, and nuts, it boasts a long shelf life and diverse market variants. Efficient production processes and increased demand for indigenous dairy products could not only enhance economic value but also generate substantial employment opportunities, fostering a thriving industry.

Introduction

Since the beginning of time, when dairy animals were domesticated, Indigenous milk products have been an integral component of Indian population's sociocultural and daily routine. Whether it is a birth, an engagement, a wedding, a job, the opening of a new home, automobile, or business, a feast or festival, a social or religious occasion, or the fulfilment of any other noteworthy activity, it is always followed by the giving of sweets.

The fact that 50–55 percent of India's milk production is used to make these indigenous dairy products attests to their widespread appeal. These products are in greater demand than similar western products on the market (mainly – butter, cheese and milk powder).

The organized dairy sector was unable to produce these goods on a commercial scale because of the Indian dairy industry's shortcomings in the following areas:

i. lack of mechanized production lines for large-scale production;
ii. labour-intensive, energy-inefficient methods of production;
iii. lack of physico-chemical, microbiological, and textural standards for most of the products, which results in inconsistent product quality;

iv. poor shelf life due to lack of suitable storage, transportation and cold chain.

The manufacturing of these indigenous dairy products offers great promise and opportunity because they have the capacity to add a spectacular 200% to their worth compared to the western products' 50%. The consumption of indigenous dairy products is projected to increase annually at a rate of more than 20%, compared to the growth rates of western dairy products, which range from 5 to 10% (Bandopadhyay and Khamrui, 2007). Additionally, locally produced dairy products might create a lot of job opportunities (Parekh, 2013)

Typically, a glob of any doughy substance is what the word "*Peda*" refers to. *Khoa-Peda* is a sweet meat dish made from *Khoa* that is milk-based. The recipe is from the Uttar Pradesh town of Mathura. This delicious, mouth-watering treat has been linked to Mathura for a long time. The major component of the *Peda* recipe used by the confectioners in Mathura is *Khoa*. Other components that are added to *Peda* include sugar, cardamom powder, and nuts like pistachios and almonds. Traditionally, *Khoa-Peda* is made by combining it with sugar in a 3:1 (w/w) ratio.

On a slow, low fire, the *Khoa* sugar mixture is cooked until it becomes hard. Then, if necessary, nuts and flavourings are added after it has been taken off the heat. The long shelf life of *Khoa-Peda* is due to the drying out of moisture during the cooking process and the preservation action of sugar. The mixture is then rolled between the palms of the hands to create *Peda*s, using a small amount of ghee to prevent sticking. Light to dark brown in colour, spherical to disc-shaped and pressed at both ends, firm in texture, and weighing 10 to 25 grams, these are the characteristics of *Peda* (Aneja *et al.*, 2002; Banjare *et al.*, 2015)

In the Indian market, *Peda* is sold in a variety of forms. Plain *Peda*, kesar *Peda*, brown *Peda*, lal *Peda*, yellow *Peda*, malai *Peda*, white *Peda*, kheer *Peda*, mini *Peda*, elaichi *Peda*, etc. are a few of them. Some *Peda*s are well-known in their hometowns or places of origin, such as the Mathura *Peda* in the U.P., the Dharwad *Peda* in Karnataka, and the Rajkot *Peda* in Gujarat (Modha *et al.*, 2015; Londhe *et al.*, 2012). Processing *Khoa-Peda* entails two completely different types of procedures. Operations for making *Khoa*, combining sugar and other materials to create *Khoa-Peda* mass, which serves as a foundation for making *Khoa-Peda*, are included in the first category. The second category of operations entails converting the *Khoa-Peda* bulk into *Peda*s with a disc-like shape (Singh *et al.*, 2015; Singh *et al.*, 2018).

To shape the *Khoa* bulk into *Peda*s, a designed mechanical forming setup was employed. In the current study, the effects of only forming/shaping pressure on the rheological property (hardness) of *Peda*s produced with it were examined.

Materials and Methods

Preparation of *Peda*

The Sahyog plant supplied the *Peda* for this experiment as Market Sample. Another sample of *Khoa* is prepared at Dairy Technology Department with standard as mentioned in E-course of ICAR. Each trial required only 100g of *Khoa*. The rough composition of *Peda* was as below:

Mechanized Forming Assembly

As shown in Fig. 1 and Pic 1. A pneumatic piston valve operates with helps of air regulator is actuated with help of On-Off air switch. The *Peda* molder is pre-filled with around 20 grams of *Khoa* as placed between end plate and pneumatic piston valve.

Compressed air is supplied by air compressor at Student Training Dairy at MIDFT, Dudhsagar Dairy. When air switch is “On”, the air actuates the piston and press the molder. The *Khoa* filled molder compress the *Khoa* and form a *Peda*. End Plate will restrict the movement of molder further and helps molder to form *Peda*. Different values of pressure (0.01, 0.5, 1.75, 3.0, 3.5 kg/cm^2) achieved by setting Air Regulator on desirable pressure. In,

Hardness analysis of *Peda*

Market Sample and samples prepared at Dairy Technology Lab ware subjected to harness analysis using Cone-Penetrometer at PG Lab, MIDFT at 20 C.

Statistical analysis

Design Expert 13 was used to design Response Surface Methodology for Pressure and temperature (Fixed 20 C) as parameter and Harness as Response.

Results and Discussion

The thirteen number of trials were taken having 3 *Peda*s in each trial. The trial runs and values of parameters and response are presented in Table -1.

Effect on Hardness

To calculate the hardness from Cone penetrometer's value following equation were used.

$$H = \frac{(G*10^{-3})}{[h\pi\,(\tan\alpha/\cos\alpha)\,(h+2r/\tan\alpha) + \pi r^2]*10^{-4}}$$

Where,

'h' = depth of cone penetration in the curd in 0.1 mm

α = Half cone angle

r = radius of cone in0.1 mm

G = weight of cone assembly in grams.

A Design expert software used to analyse how pressure affects the hardness of a product. These findings showed that pressure had no significant effect on the rheological characteristic - hardness of the final product.

Table.1 Market Sample analysis report

Fat	Moisture	Sugar	Protein	Lactose
Market Sample				
19%	15%	30-31%	19-20%	16%
Prepared at Dairy Technology Lab				
20%	14.5%	30%	19%	16.5%

Table.2 RSM Design and hardness

		Factor 1	**Factor 2**	**Response 1**
Std	Run	A:Pressure	B:Temp	Hardness
		kg/ cm²	C	Kg/cm²
9	1	1.75	20	0.85
5	2	0.50	20	0.86
4	3	3.00	20	0.88
6	4	3.50	20	0.88
10	5	1.75	20	0.86
1	6	0.5	20	0.85
2	7	3.00	20	0.88
7	8	1.75	20	0.87
8	9	1.75	20	0.86
13	10	1.75	20	0.85
11	11	1.75	20	0.86
3	12	0.50	20	0.86
12	13	1.75	20	0.85

Figure.1 Schematic Diagram of Molding Assembly

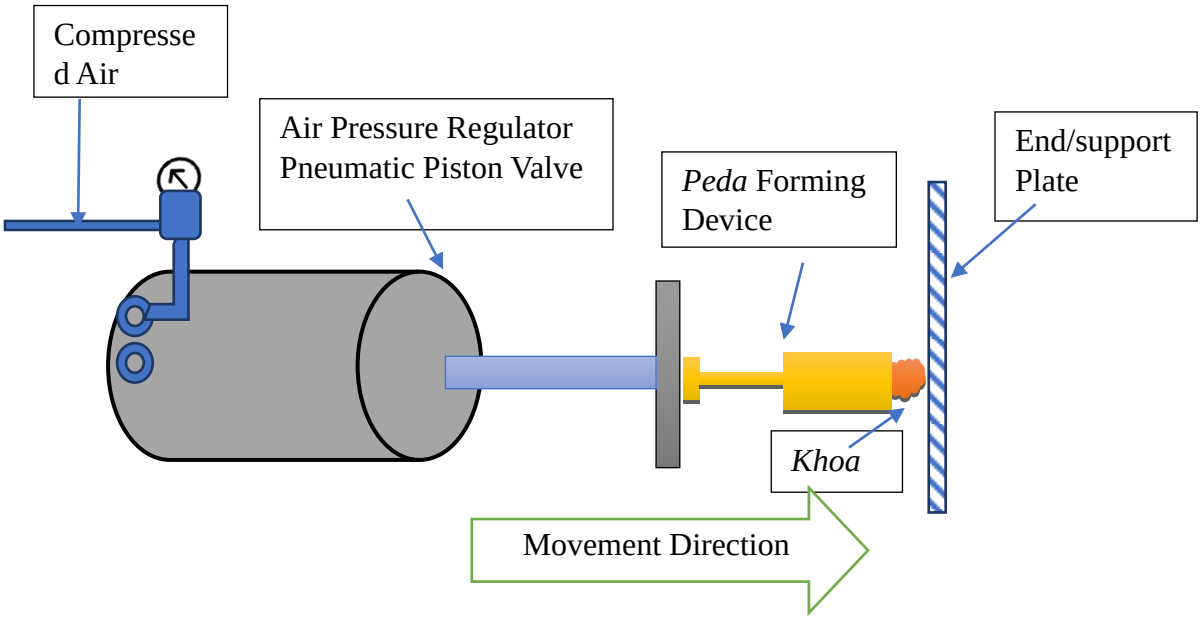
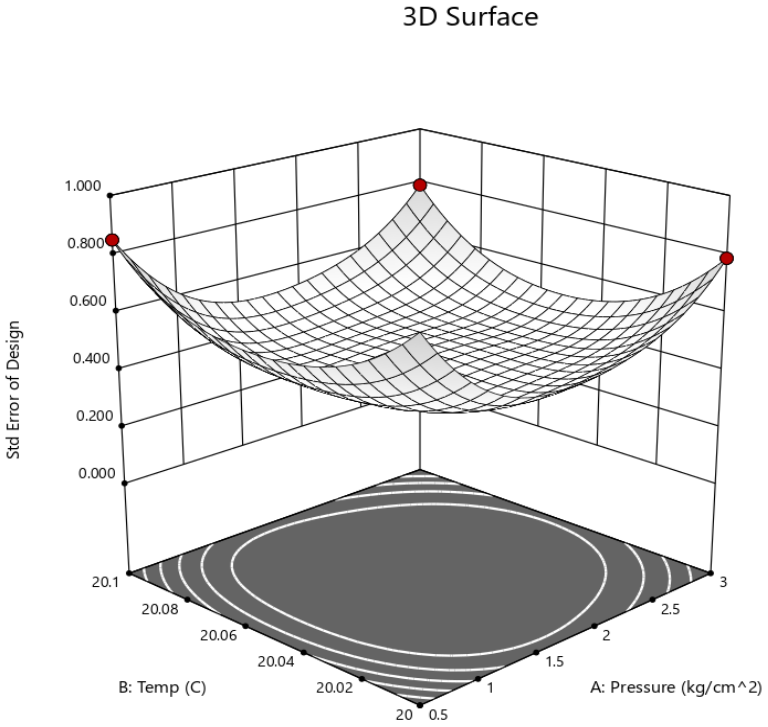


Figure.2 Photo to Actual Assembly

Figure.3 From 3D graph, plotted against pressure and temperature to Standard Error of Design, Pressure 1.5 kg/cm^2 shows lowest error.



Author Contribution

Anilkumar R. Chaudhari: Investigation, formal analysis, writing—original draft. Sunil Patel: Validation, methodology, writing—reviewing. Vivek Kostha:—Formal analysis, writing—review and editing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval: Not applicable.

Consent to Participate: Not applicable.

Consent to Publish: Not applicable.

Conflict of Interest: The authors declare no competing interests.

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