Formulation and quality assessment of protein rich sesame *Chikki* - Indigenous energy bar

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■ **Abstract :** 'Brittle' is commonly known as *Chikki*-it's an indigenous sweet snack, mostly liked by all age groups, also possesses nutritional importance in it. In present study utilization of sesame (*Sesamum indicum)* is carried out in *Chikki* to evaluate the acceptance of consumers towards S_1 to S_4 samples *i.e.* S_1 as Raw sesame and Jaggery, S_2 as Roasted sesame and Jaggery, S_3 as Raw sesame and Sugar while S_4 as Roasted sesame and Sugar. Sample S_1, S_2, S_3 and S_4 were subjected to proximate analysis, Textural Analysis, organoleptic evaluation and statistical analysis (ANOVA). Results showed the more hardness in Roasted sesame and sugar sample (S_4) 201.70 MJ. Organoleptic properties revealed that raw sesame and sugar sample (S_4) is acceptable permutation of *Chikki* followed by roasted sesame and jaggery sample (S_2).

■ **Key words :** Sesame *Chikki*, ANOVA, Texture analysis

Sesame seeds are used extensively in India. In most parts of the country, sesame seeds assorted with jaggery, sugar, or palm sugar is prepared into *Ladoos* or brittles similar to peanut brittle and consumed as snacks. Sesame *Ladoos*, in jaggery, is made and eaten in various forms during the festival of Makar Sankranti in Maharashtra. Sesame seeds are an excellent source of copper, a very good source of manganese, and a good source of magnesium, calcium, phosphorus, iron, zinc, molybdenum, and selenium (Phillips *et al*., 2005). Jaggery contains protein, minerals, and vitamins and is a potent source of iron and copper in it (Manay and Swamy, 2001).

The World Health Organization defines malnutrition as deficiency, excess or imbalance in a person's intake of energy and/or nutrients. Almost 11% of the world's population is considered undernourished, they lack adequate nutrients needed to thrive (Schneyder, 2014) .Worldwide malnutrition is very dreadful issue, commonly observed in children due to protein- energy malnutrition. Nutrition supplements are a useful adjunct to increase protein, energy and nutrient intake.

Hence, in present research an attempt was put forward to give a tool for supplementation of protein to malnourished population.

■ METHODOLOGY

Sesame seeds, jaggery and sugar were procured from local market.

Preparation of *Chikki* :

Chikki was prepared by traditional method and the process was same for roasted and raw sesame. The sesame seeds were roasted to golden brown color in a

pan for 2-3 min. The roasted sesame was added to melted jaggery and sugar mixture with continuous stirring, respectively. The hot mass was then spread on greased surface and sheeted and cut into 1.5x 4cm (Chetana and Sunkireddy, 2011).

Process :

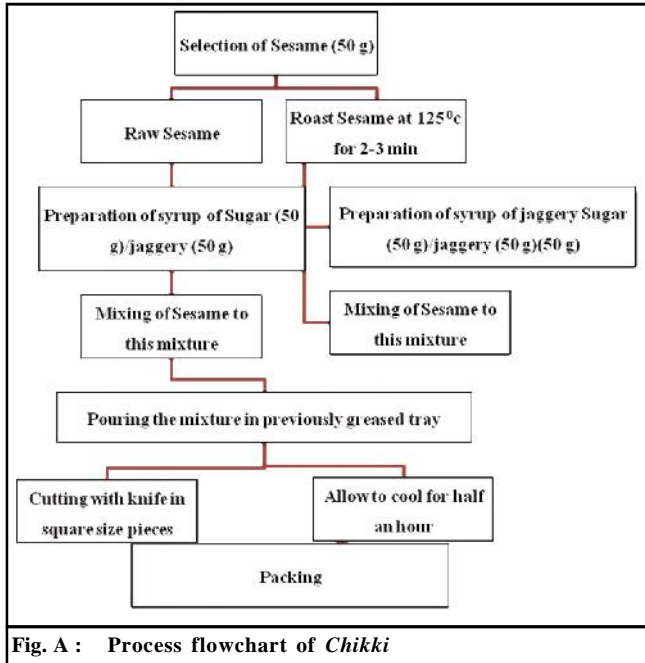Process of *Chikki* is given in form of flow chart (Fig. A.)

Fig. A : **Process flowchart of *Chikki***

Analysis of *Chikki* :

Moisture (Mettler Toledo HE53 Digital moisture analyzer), ash, protein, fat and dietary fibre were determined as per the AOAC (2012) method. Total carbohydrate = 100 – (fat + fibre + ash + protein). Energy (kcal) = $4.0 \times$ protein (g) + $4.0 \times$ carbohydrate (g) + $9.0 \times$ fat (g).

Color measurement :

The color of sample was measured in term of lightness (L) and color (+ a: red, -a: green, +b: yellow, -b: blue) using the Hunter Lab Color Measuring System.

Sensory analysis :

The sensory evaluation of freshly prepared sesame *Chikki* was carried out with the help of a 9 point Hedonic scale. The desirable characteristics of *Chikki* samples such as color, snap, hardness, crunchiness, sweetness, sesame flavour and the overall quality score were evaluated.

Texture analysis :

Chikki was analysed for its hardness by using Brookfield CT3 Texture analyzer, probe TA 9 needle, 1mm diameter, 43 mm length.

Statistical analyses :

Sensory data was analyzed by one way analysis of variance (ANOVA) at 5% level of significance. A value of $p < 0.05$ was considered statistically significant.

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Proximate analysis :

Table 1 shows the moisture content, fat, ash, and carbohydrate and energy values for formulations of *Chikki*. It was observed that moisture content of raw sesame *Chikki* having higher values compared to roasted *Chikki* samples. The roasting uses hot dry heat in which hot air covers food from all side and results in drying of surface. It is observed that there is no significant difference in protein content. Calorific value for all *Chikki*

Table 1 : Proximate analysis of *Chikki*						
Sample	Moisture %	Ash %	Fat %	Dietary fiber %	Protein %	Carbohydrate %	Energy (Kcal/100g)
S₁	1.40±0.01	6.80±0.00	20.76±0.02	10.60±0.05	15.67±0.06	46.17±0.01	434.20±0.02
S₂	1.34±0.02	4.00±0.03	19.95±0.02	10.30±0.06	15.33±0.01	50.42±0.00	442.55±0.07
S₃	1.25±0.00	3.04±0.02	20.36±0.00	10.53±0.01	16.08±0.06	49.03±0.03	446.11±0.00
S₄	0.65±0.04	2.00±0.00	19.68±0.01	10.68±0.00	16.12±0.07	50.84±0.05	451.08±0.06

Values are mean ± standard deviation of three independent determinations
S_1 = Raw sesame + Jaggery; S_2 = Roasted sesame + Jaggery; S_3 = Raw sesame + Sugar; S_4 = Roasted sesame + Sugar
Total carbohydrate = 100 – (fat + fibre + ash + protein)
Energy (kcal) = $4.0 \times$ protein (g) + $4.0 \times$ carbohydrate (g) + $9.0 \times$ fat (g)

have shown similarity but S_4 having highest value; 451.08Kcal.

Color analysis :

Fig. 1 shows that redness of samples S_2 and S_4 are more than S_1 and S_3, respectively. Roasting of sesame contributes dark colour to final product. Generally brown colour is outcome of Maillard reaction (Ng *et al.,* 2014). Sample S_2 is darker than S_4; which is due to replacement of jaggery with sugar. Jaggery also contributes its brown colour to product because of presence insoluble matter and hence less bright colour of product. Brightness (L) values shown decreasing trend as pre-treatment and sweetener used envelops the *Chikki*.
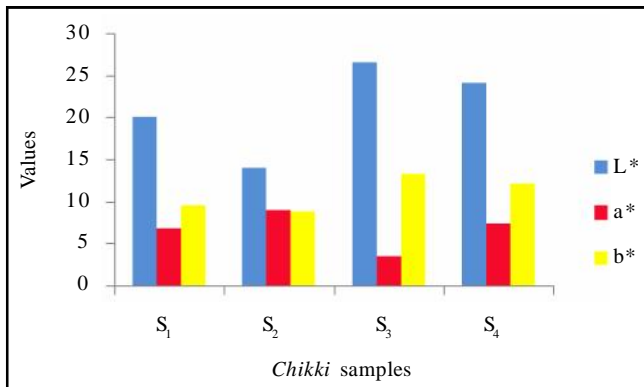

Fig. 1 : Color analysis of *Chikki*
L*: lightness/darkness; ±a*: red/blue; ±b*: yellow/ green. Values are mean ± standard deviation of three independent determinations

Fig. 2 : Photographs of *Chikki*
S_1 =Raw sesame + Jaggery; S_2 =Roasted sesame + Jaggery; S_3 = Raw sesame + Sugar; S_4 = Roasted sesame + Sugar

Sensory evaluation of *Chikki* :

Market conditions are highly based upon the factor taste. Taste is a basic quality parameter which directly sways approval of product. It was found that *Chikki* made by formulation S_4 had overall quality score 7.7 which is higher as compared to others (Table 2). Based
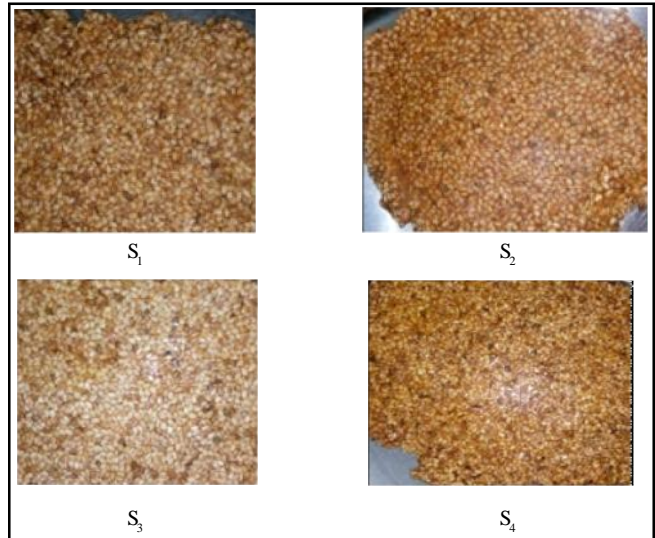
on the above results it can be concluded that S_4 was the most acceptable *Chikki*. The data was analyzed for ANOVA. The analysis of variance (ANOVA) revealed that there was non-significant variation among the values of various sensory parameters. The values for Fcal was
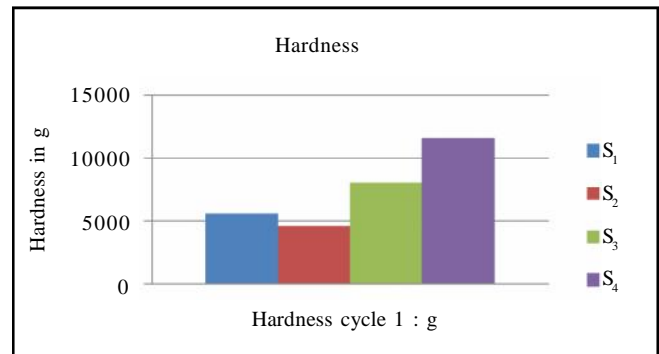

Fig. 3 : Graphical representation of Hardness of samples

Table 2 : Sensory evaluation of *Chikki*				
Parameter	S_1	S_2	S_3	S_4
Colour	6.8±0.00	7.5±0.01	7.0±0.02	8.0±0.05
Snap	7.0±0.02	8.0±0.03	7.2±0.01	7.5±0.03
Hardness	6.5±0.01	7.5±0.00	7.3±0.00	7.6±0.04
Crunchiness	6.0±0.00	7.0±0.00	7.2±0.03	7.5±0.05
Appearance	6.5±0.04	7.9±0.01	6.8±0.05	7.2±0.04
Mouth feel	6.0±0.05	8.1±0.02	6.5±0.07	7.8±0.00
Overall acceptance	6.4±0.05	7.6±0.01	7.0±0.00	7.7±0.00

Values are mean ± standard deviation of three independent determinations
S_1 =Raw sesame + Jaggery; S_2 =Roasted sesame + Jaggery; S_3 = Raw sesame + Sugar; S_4 = Roasted sesame + Sugar

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found to be 21.14 hence, it is concluded that data supports alternative hypothesis (p<0.01).

Textural analysis :

Fig. 4 indicates the data of texture analysis of *Chikki*. The samples were analyzed for hardness property. It was observed that S_4 have high value of hardness as compared to other sample. This may be a result of roasting treatment and sugar syrup combination. Sugar syrup having low viscosity and showing less tendency to deposit crystal.

Conclusion :

In a present study it is revealed that the roasted sesame and sugar *Chikki* was found to be most acceptable. Sugar imparts hardness to brittle as compared to jiggery. Sesame being highly nutritious as it posses good fatty acid as well as protein profile, its *Chikki* has potential to battle against malnutrition in case of affected children through various supplementary feeding programmers.. Sesame brittle made of either jaggery or sugar both are having own importance nutritionally as well as therapeutically.

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