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Development of Popped Sorghum Brittle Incorporated with Ragi Flour

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Abstract: Brittle is one of the most consuming Indian traditional sweet snacks. Brittle is basically is made of nuts, breakfast cereals and jaggery/sugar as a sweetener. The current study aim to make sorghum and ragi millet available to people as ready to eat sweet snack with the advantage of increased nutritional value. Sorghum is having the greater nutritional value as well as physico- chemical properties suitable for popping process. The objective is to developing a brittle by using a popped sorghum incorporated with ragi flour gives a greater value addition apart from the brittle that is previously available in the market. The brittle is formulated in three types of samples controle To, experimental T1 and T2. i.e. T0 (10:90), T1 (05:90:05) and T2 (09:86:05) %

(Keywords: Popped sorghum, Jaggery, Ragi Flour, Popping, Confectionary, Brittle**)**

I. INTRODUCTION

Confectionary has wide scope in research and development. It plays a very important role in developing an industrial market in food industry. It starts from formation of product from raw material of having great quality with lower cost of manufacturing. Another focus is on the great nutritional value along with food safety. In describing the scope of confectionary industries as India is larger consumer of traditional food including sweet snacks, among such products brittle is one of the most consuming Indian traditional sweet snack. Brittle is basically is made of nuts, oil seeds and jaggery/sugar as a sweetener. But in the modern time is also made up from pulses and breakfast cereals. As the millets is staple food in India with a greater nutritional value. It is important to make Sorghum and ragi millet available to people as ready to eat sweet snack with the advantage of increased nutritional value. Developing a brittle by using a popped sorghum incorporated with ragi flour gives a greater value addition apart from the brittle that is previously available in the market.

RTE snacks are widely manufactured in food industry due to their ease of consumption. After developing these snacks there will be fulfillment of consumer satisfaction to all the food dealings. Due to increment in the improvement in the traditional methods would promote to increment in production and improvement in quality of product. The quality and sensory parameters play as key factor on consumer acceptance point of view. The similarity in quality of product increases more attraction of wide range of people of different view towards the product.

In the part of these RTE snacks the puffed and popped RTE has great convenience to consumer according to quality point of view and product acceptability during this age of fast modern lifestyle, increased globalization are having health consciousness mandate to use RTE food products. Popped grains are healthy to consume as they are taken as whole grain fulfill the nutritional requirement of these growing fast lifestyle. The whole grain composed most of the nutrition as present in different layer of grain seed. They are rich in fibers phytochemicals and macro as well as micro nutrients they also content antioxidants which makes grains more beneficial towards the removal toxicants and radicals from body.

In all grains classification sorghum is rich in calcium that make bones strong, mussels build by proteins and iron helps to improve RBC's by increasing the ability to hold the oxygen. Vitamin B play role in production of antibodies and enhancing the nervous function. Niacin improves the flow rate of blood. Magnesium increases the calcium absorption in bones and regulates body temperature.

In the making of popped cereals first know about the popping. Popping is nothing but the expansion of endosperm by starch gelatinization when the grains come in contact with heat for short time period. During this process the vapours formed due to immediate heating, which cook the grain by breaking the alurone layer. The popping is affected by grain anatomy, chemical composition and physic-chemical properties. There are wide range of popping methods used. The traditional methods are by use of heat, sand, In hot oil, hot air popping. The modern techniques microwave and infrared popping. In these methods the sand popping is widely used and oldest method, in this technique sand is filled in hot kettle or pan heat upto 250°C. the grains mixed with hot sand. In hot oil method the temperature of oil is in between 200 to 220°C. Gun popping method is also used. In microwave and infrared popping the grains are exposed to high temperature produced by bumbardation of waves of different frequencies.

Sorghum is widely applied after the corn for making of popped grains. It having a 5th rank in global production. It having good nutritional values in n all the millests category. Due to all the unique characteristics of sorghum earn separate considerations for consumption. Now it is used in industrial field in production of biofuel/ biodiesel production.

Lets come towards the popped grains, the popping increase nutritional digestibility when compared with raw all semi processed sorghum and sorghum products. The health benefits of popped sorghum considered it as healthy snack for consumption. The sorghum

extracts compounds have no impact on social diseases. The greater nutritional and physico-chemical properties of sorghum make it suitable for popping process. The physical parameter effect such as hardness or vitreousness on the quality of sorghum food products have been well described. The higher content of carbohydrates are considered for making thick snack prodigies. The starch content ranges from 64 to 70% ,protein 9 to 13%, fat 1.9 to 3.8%.The nutritional availabilities is increased by popping process as contain Moisture (% db) 14.12 to 15, Protein (%) 11.38 to 12, Fat (%) 3.01 to 4, Crude fibre (%) 1.38 to 2, Ash (%) 1.44 to 2, Total carbohydrate (%) 68.85 to 70.

Ragi is kind of millet consumed some part of India. It comes under staple food category. It is rich source of minerals, dietary fibers and essential amino acids. It also have phenolic compounds having antioxidantal characteristics. Finger millets widely used in traditional foods making process in beer substitution. It is rich in Iodine content among grain cereals. Due to presence of resistant starch and slow digestibility according to way of consumption of processed foods. Ragi is used as good source for preparation of food for all edge groups as well as patients. The heaviness of fibers and slow rate of digestion makes consumer fulfill of satisfaction to hunger and make energetic. Low calorie prevent from extra calorie consumption. The fewer component of food may lead to some chronic as well as cardiovascular disease according to scientific proof. Finger millet is important source of food in Africa and Asia. It is having size from 1 to 2 nm and pronounced differently in different regions as birds food, African millet. Ragi is powerhouse of nutrients add a value to gluten free diet. According to NIN 2017 report ragi contain Ragi Moisture % 10.89 Protein % 7.16 Fat %1.92 Ash % 2.04 Carbohydrate % 66.82 Iron (mg) 4.6. Ragi flour is a major product consumed across the India and Asia. Milling increases the digestibility of grains, ragi flour is rich in dietary fibers, protein and minerals content.

Jaggery a traditional natural sweetener and part of diet in rural part of country. It is having sweet taste and made up from sugar cane, palm juice and date sap. It contains minerals from 0.6 to 1.0 gm, 11g iron, 0.4g calcium and 0.045g magnesium and phosphorous, 10 to 15 reducing sugar, 0.25g protein and 0.05g fat per 100g of jaggery rich in magnesium, potassium and iron content. It is also used as preventing agent in smocking industry. Purified blood and bile disorders. Jaggery is traditional sweetener used in ancient to modern edge in Indian sweets as well as sweet snack. Jaggery is made up by concentrating the sugarcane juice, Tadi juice. Apart from crystal sugar jaggery is rich source of iron, minerals and carbohydrates. According to NIN2017 report jaggerycontainConstituents,Moisture%3.9,Protein%1.82 ,Fat%0.16,Ash % 1.92,Carbohydrate %84.87 Iron (mg) 4.63.

II. JUSTIFICATION

Due to consciousness towards the health of consumers it is very necessary that to prepare a healthy, allergen and sugar free diet for the diabetic patients and glutein intolerants. In such category of foods sweet snacks such as popped sorghum brittle provide a great value addition in nutritional point of view.

III. RESEARCH METHODOLOGY

The methodology applied to study Development of popped sorghum brittle incorporated with ragi flour is presented under the following contents:

3.1 Materials

RAW MATERIALS

In preparation of brittle raw materials i.e. sorghum, jiggery and ragi flour are selected from the local market. The selected ingredients are clean good to use condition.

INGREDIENTS

Good quality popped sorghum, jageery and ragi flour was procured of for the study.

CHEMICAL

In all of the chemical compounds utilization for research were of analytical grade and have been acquired from food technology laboratory of Department of Food Technology.

PROCESSING AND ANALYTICAL EQUIPMENT'S

Domestic mixer, autoclave, hot air oven, laminar air flow, vertical incubator, refrigerator, muffle furnace, micro kjeldahl apparatus, soxhlet apparatus, etc.

PACKAGING MATERIAL

Food grade high density polyethylene bags are used for packaging of brittle.

The methodology applied to study Development of popped sorghum brittle incorporated with ragi flour is presented under the following contents:

3.2 PREPARATION OF BRITTLE

3.2.1 Preparation of Controle Sample To

The controle sample is prepared from Popped sorghum and jaggery in proportion (10:90) of 10g popped sorghum and 100g jaggery.

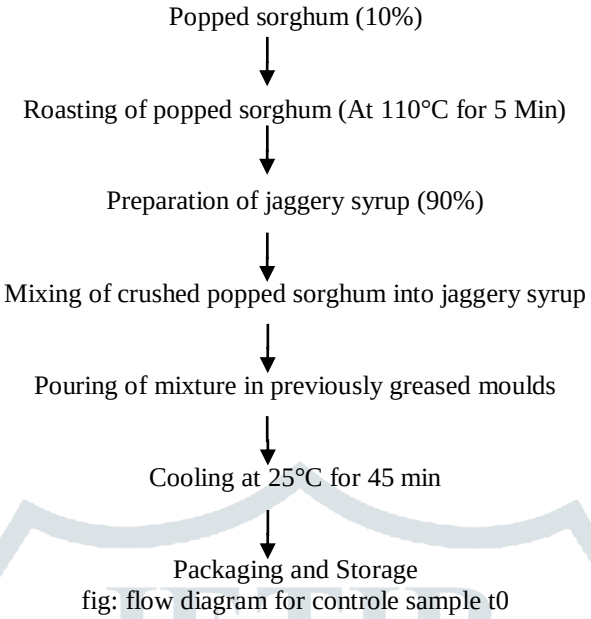

fig: flow diagram for controle sample t0

3.2.2 PREPARATION OF EXPERIMENTAL SAMPLE T1 AND T2

The experimental sample T1 is prepared from Popped sorghum, jaggery and ragi flour in proportion (05:90:05) i.e. 5g popped sorghum, 100g jaggery and 5g ragi flour. And the experimental sample T2 is prepared from Popped sorghum, jaggery and ragi flour in proportion (09:86:05) i.e. 10g popped sorghum, 100g jaggery and 5g ragi flour.

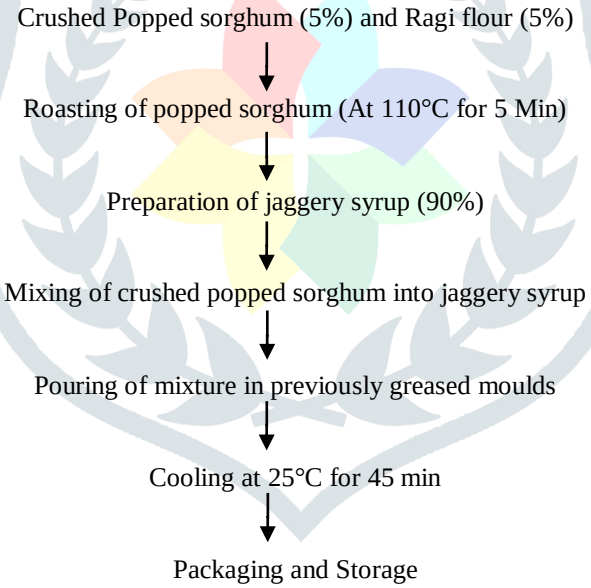

fig: flow diagram for experimental sample t1

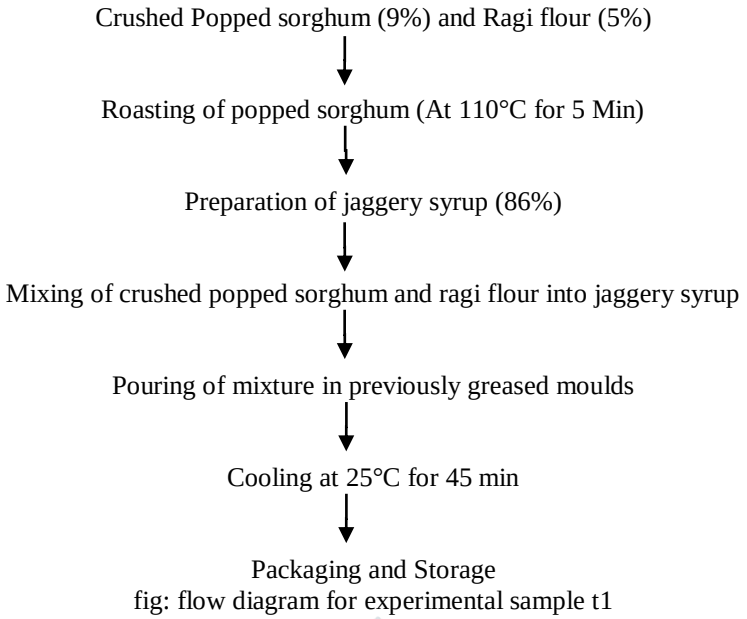

fig: flow diagram for experimental sample t1

(Shanker Suwan Singh Assistant Professor, Food Technology, Warner College of Dairy, Technology, SHUATS, Naini, Allahabad, Uttar Pradesh, India)

3.3ANALYSIS OF RAW MATERIAL AND PREPARED BRITTLE

Nutritional evaluation of raw material and prepared brittles were analyzed, proximate composition of raw materials as nutritional parameters such as moisture, energy, carbohydrate, protein, fat, and Iron, using A.O.A.C 1995 process protocols.

MOISTURE

The 5 gm are gauged and dried in an oven at 110°C for 4 hours. Then place in a desiccator to cool. In the wake of cooling, it was weighted until the persistent loads were consistent. The subsequent weight reduction was determined as a level of dampness content (A.O.A.C. 1990).

FAT

The rough fat was assessed by utilizing soxhlet method. The stove dried example was place into extraction chamber and afterward oil ether was filled it. After that extraction was completed on warming mental at 60°C to 80°C. The extraction was proceeded till the fruition of 6-10 cycles. At that point additional ether was recouped in condenser and after that remained ether has vanished and carafe was cooled by keeping in desiccators.

PROTIEN

5-gram sample was taken in Kjeldhal's digestion flask. Then add 25 ml conc. H_2SO_4 9.80 gm potassium sulfate and 0.20 gm cupric sulfate and kept it in digestion room on heating mental at 80°C TO 90°C for 90 min. When the content become clear then cooled it and add 250 ml distilled water. Then add slowly 100 ml of 40% NaOH to flask, so as to form a distinct layer at bottom. A 50 ml from aliquot of 0.1 H_2SO_4 was used as collector. The condensed fumes collected in 0.1 H_2SO_4 solution, when about 200 ml of distillate was collected the tube was disconnected. The distillated was titrated with 0.1N NaOH with methyl red indicator and titrates until color changes from red to yellow. A blank was run at the same time. The % nitrogen in the example was determined by utilizing following equation (A.O.A.C. 1965)

FIBRES

The analysis of crude fibre method is followed by (A.O.A.C. 2000)

Carbohydrates

Carbohydrate content was calculated by using following formula (Ranganna, 1986).

% Carbohydrate =100 - (% Moisture + % Fibers + % Fat + % Protein+%Minerals)

MINERALS

Gauge 10 gm of all around blended example in a tared silica dish and warmth over a low Bunsen flame to dissipate a great part of the regular substance. Move the silica plate to the suppress heater at a temperature of around 300°C until the coal has quit consuming and increment the temperature to 429°C for an hour and a half. At that point place it in a desiccator to cool. At that point include 5 ml of concentrated HNO and 5 ml of water and warmth for 2-3 minutes over low warmth to break the dissolvable salts. At that point channel through whatman 1 of every a 25 ml volumetric jar. What's more, load up with water freely (Goyal *et al.*, 2009).

TEXTURE ANALYSIS

The brittle texture analysis done by with help of Texture analyzer (Model TA- XT2i. p), (Stable Micro Systems, Godalming, UK), Measurement were conducted using a 50 kg load cells and cylindrical aluminum probe 36 mm diameter. Max. 25% energy in

the form of force required to compress the brittle had been recorded. The determination of Hardness, springiness of brittle was analyzed.

Technical specification

Test speed: 0.01 - 40mm/s
Force capacity: 50Kg.f (500N)
Load cells: 0.5, 5, 30, 50Kg.f
Distance resolution: 0.001mm

SENSORY EVALUATION

All control sample and experiemental sample product tests were evaluated for their tactile attributes to be body and texture, color and appearance, taste and flavor, mouth feel and over all acceptability by a prepared boards involving 10 authorities from employees and post graduate understudies of the division. The specialist record their rating on 9 point hedonic scale (9 and 1 points shows like extremely and dislike extremely) (Ranganna, 1986).

MICROBIOLOGICAL ANALYSIS

TOTAL PLATE COUNT

The stored samples have been evaluated for microbial quality through determining the (TPC) usage of SPM. Curd samples had been taken aseptically and homogenize in 225 ml sterile water solution in a blender for about 2 minute and serial dilutions were made. PCA was suspending 23.5 grams in 1000 ml distilled water. One milliliter of every dilution become pour plated on PCA in sterile petri plates and incubates for 72 hours at 30-32°C. Finally of the incubation period the petriplate were eliminated for counting the developed colonies in cfu/gm. CFU were counted usage a colony counter.

YEAST & MOLD COUNT

The RBCA medium to decide the yeast and shape include in the frozen samples. The 32.2 gm of RBCA was moved to 1000 ml of sterile water and bubbled to break up all media. At that point, the medium was cleaned at 121°C for 15 minutes and afterward permitted to cool. Thusly, the medium was moved sterile petri dishes, and after that an example was filled it. Plates were set in a hatchery at 25°C for 120 hours and perception was accounted for in CFU/g.of.

TOTAL COLIFORM COUNT

The Violet red bile agar(VRBA) medium to decide the yeast and shape include in the frozen samples. The 39.5 gm of VBRA was moved to 1000 ml of sterile water and bubbled to break up all media. Heat in boling water bath and agitate frequently until completely dissolve,do not boil more than 2 min, do not autoclave. Thusly, the medium was moved sterile petri dishes, and after that an example was filled it. Plates were set in a hatchery at 38°C for 24 hours and perception was accounted for in CFU/g.

(Lab manual 14 FSSAI manual of methods of analysis of foods for microbial tests.)

IV. RESULTS AND DISCUSSION

The values collected of different parameters were arranged in table form. analyzed calibrated and calculated. The different values observed have been analyzed calibrated and calculated according to different experiments.

ANALYSIS OF RAW MATERIAL

table: data for different parameter of raw material

Sr.	Parameter	Popped Sorghum	Ragi Flour	Jaggery
1.	Moisture%	02.43	05.67	01.97
2.	Total Minerals%	00.67	02.06	00.18
3.	Crude Protein%	07.61	07.57	00.15
4.	Crude Fat%	00.50	00.94	00.10
5.	Crude Fiber%	01.60	00.77	00.00
6.	Carbohydrate%	87.19	82.99	97.60
7.	Energy Kcal/100g	383.70	370.70	391.90

The nutritional values estimated of raw materials varries different from standards values due to significance difference in variety, processing techniques and post harvest handling of material.

OPTIMIZATION OF BRITTLE VARYING POPPED SORGHUM

table: optimization of brittle varying popped sorghum

SampleCode	Popped Sorghum (%)	Jaggery (%)	Ragi Flour (%)
T0	10	90	--
T1	5	90	5
T2	9	86	4

FORMULATION OF RAW MATERIAL IN BRITTLE

table: formulation of raw material in brittle:

Sr.No.	SampleNo.	Popped Sorghum (gm)	Jaggery (gm)	Ragi Flour (gm)
1	T0	10	100	-
2	T1	05	100	5
3	T2	10	100	5

ANALYSIS OF FINAL PRODUCT:

The analysis of final product is carried out of different formulation with the duration of 30 days for 60days.

DATA FOR DIFFERENT NUTRITIONAL PARAMETER OF BRITTLE

table: data for different nutritional parameter of brittle- 1st day

Sr.	**Parameter**	**T0**	**T1**	**T2**
1	Moisture%	5.1	5.8	5.4
2	Total Minerals%	2.1	2.0	2.2
3	Crude Protein%	13.1	12.7	13.9
4	Crude Fat%	1.58	1.36	1.63
5	Crude Fiber%	1.9	1.7	2.0
6	Carbohydrate%	96.35	95.5	97.58
7	Energy Kcal/100g	396.71	395.5	397.81

table: data for different nutritional parameter of brittle- 30th day

Sr.	Parameter	T0	T1	T2
1	Moisture%	4.6	5.1	4.5
2	Total Minerals%	1.8	1.7	1.9
3	Crude Protein%	10.9	10.2	11.8
4	Crude Fat%	1.33	1.2	1.45
5	Crude Fiber%	1.67	1.52	1.82
6	Carbohydrate%	94.47	92.2	94.79
7	Energy Kcal/100g	388.64	387.26	391.25

table: data for different nutritional parameter of brittle- 60th day

Sr.	Parameter	T0	T1	T2
1	Moisture%	3.93	4.70	3.75
2	Total Minerals%	1.72	1.61	1.84
3	Crude Protein%	8.87	9.2	9.54
4	Crude Fat%	1.31	1.04	1.21
5	Crude Fiber%	1.42	1.27	1.59
6	Carbohydrate%	94.47	92.2	94.79
7	Energy Kcal/100g	384.78	383.39	386.87

After 60 days of observation it was found that There was significant difference in nutrient content, of different samples during different time interval due to the raw material used and processing treatment combination. The nutritional value of sample T2 is higher as compared to other two. The difference in nutritional values were due to the difference in physic-chemical content of Popped sorghum, jaggery and ragi flour were used in different proportions in different experiments.

SENSORY EVALUATION OF POPPED SORGHUM BRITTLE DURING STORAGE

Sensory evaluation of popped sorghum brittle was done for the attributes namely color, texture, taste/mouth feel, appearance and overall acceptability of the popped sorghum brittle. Evaluation was done on the basis of 9 point hedonic scale. Popped sorghum along with jaggery was used as a control sample for sensory evaluation. The sensory evaluation of during storage was done for over 60 day's at room temperature.

table: data for sensory analysis of brittle

Sample	Days	Color	Flavour	Appearance	Texture	Taste	Overall Acceptability
T0	1	9	8	8	7	8	8
	30	8.7	7.8	7.6	6.9	7.7	7.74
	60	7	7	7	6	7	6.8
T1	1	8	7	8	7	7	7.4
	30	7	6	7	6	6	6.4
	60	6	5	6	5	5	5.4
T2	1	9	9	9	8	9	8.8
	30	8	8	8	7	8	7.8
	60	8	7	7	6	7	7

After the 60 days of sensory analysis and the sample T2 found more acceptable as per consumer point of view than other treatments due to the difference in raw material used as well as processing techniques

Texture analysis

table: data for texture analysis of brittle- 1st day

Samples	Texture	Hardness Kg.cm
T0	Hard	12
T1	Hard	11.5
T2	Crispy	10.5

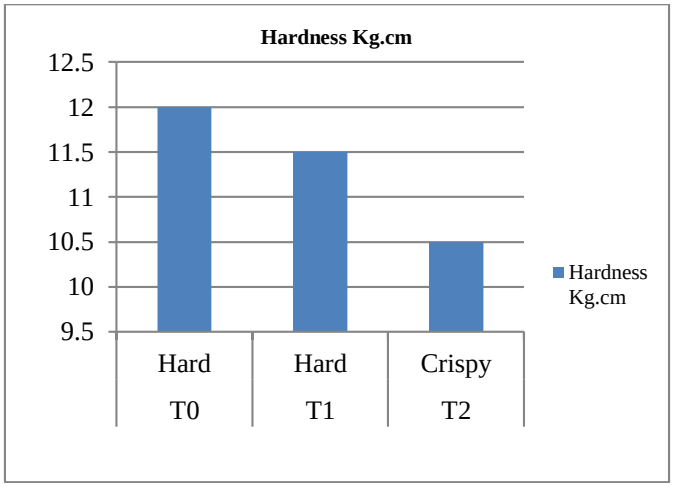

fig:- texture analysis- 1st data

table: Data for texture analysis of Brittle- 30th Day

Samples	Texture	Hardness Kg.cm
T0	Hard	11.3
T1	Soft	9.8
T2	Crispy	10.1

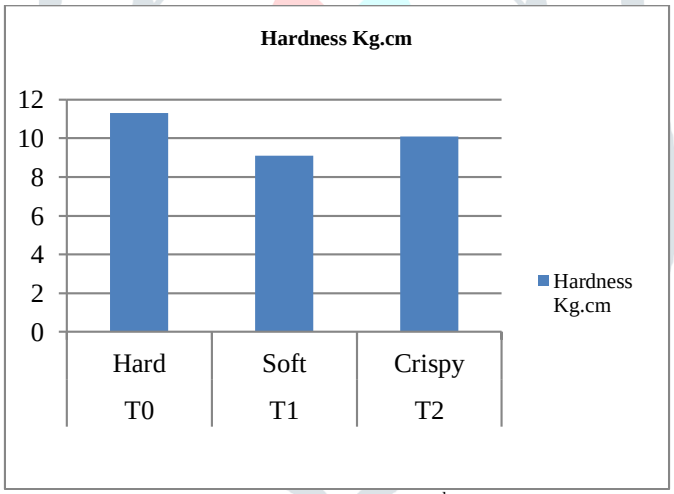

fig:- texture analysis- 30th day

table: data for texture analysis of brittle- 60th day

Samples	Texture	Hardness Kg.cm
T0	Soft	9.9
T1	Soft	9.7
T2	Crispy	10

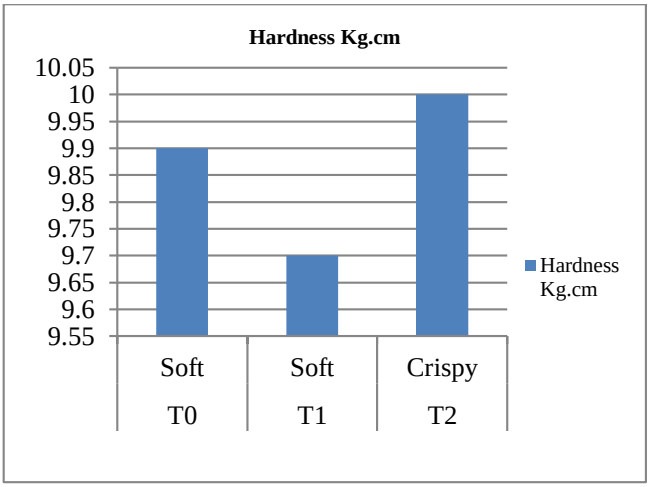

fig:- texture analysis- 60th day

After the 60days of observation it was found that the texture analysis the sample T2 found more acceptable as per consumer point of view than other treatments due to the difference in raw material used as well as processing techniques.

MICROBIAL ANALYSIS

Tpc (cfu /g) of final product

Changes in the TPC of sample are presented in Table 5.4.4.1 plate count of control sample & experimental sample was carried out at time interval of 30 days. At zero days there was zero count in healthy samples were freshly prepared in clean environment. In plate count of control sample T0 was within the limit up to 30 days but at 60th day the TPC was found to be 22 $x10^4$ which was above the acceptable limit. Hence we concluded that control sample has a shelf life of 30 days.

TPC of sample T1 was within the limit up to 30days butat 60th day TPC was more than that of acceptable limit &hence it was concluded that final sample has a shelf life of 30 days. The main reason for the spoilage of brittle was it is a good source of carbohydrates. Due to jaggery syrup the plate count may reduced. TPC (Cfu /g) of confectionary more than 3.0 $x10^4$ Cfu/ml then the confectionary is reported as unsafe according to food safety standards (2011).

TPC of sample T2 was within the limit up to 30days and also at 60th day TPC was within acceptable limit &hence it was concluded that final sample has a shelf life of 60 days at room temp.

table: tpc cfu/g of final product

Days	Sample T0	Sample T1	Sample T2
0	0	0	0
30	32 X 10^3	44 X 10^2	20 X 10^2
60	22 x 10^4	6.8X10^4	16X 10^3

Total Fungal Count (cfn/g) of Final product:

The Total Fungal Count is as presented in Table 5.4.4.2.Total Fungal Count of control sample & experiemental samples were carried out at regular intervals of 30 days. Initially at zero days there was count is negligible as samples were freshly prepared.

Total Fungal Count of the control sample T0 was within the limit up to 30thday but at 60thday the count was found to be 32 $x10^4$which was above the acceptable limit. Hence we conclude that control sample has a shelflife of 30 days.

The count of sample T1 was within the limit up to 30thday but at 60thday count was more than acceptable limit and hence conclude that healthy coconut balls has a shelf life of 30 days. Total Fungal Count (cfu/g) of confectionary products more than 5.6 $x10^3$/g (cfu/g) is reported as food safety standards (2011).

Total Fungal Count sample T2 was within the limit up to 30days and also at 60th day TPC was within acceptable limit &hence it was concluded that final sample has a shelf life of 60 days at room temp.

table: 5.4.4.2 total fungal count (cfn/g) of final product:

Days	Sample T0	Sample T1	Sample T2
0	0	0	0
30	24×10^1	28×10^1	16×10^1
60	11×10^4	54×10^4	9.1×10^2

There was significant difference in total fungal count, Total Plate count of different treatment combination. Maximum microbial count was recorded in the sample of T1 found more than two samples due raw material handling as well as hygiene practices applied. The colifrom count showed negative result assuring hygienic production of the product.

V CONCLUSION

After analysis of the product it was found that popped sorghum, jaggery and ragi flour were used in this study because of a similar incorporated was present in application of three ingredients. The use of all these ingriedients gave a nutritionally value added product in low cost. The gained values and results from the calibration and calculation that a brittle was successfully produced popped sorghum, jaggery and ragi flour brittle (brittle). After the optimization of various ingredients, the treatment T2 (9:86:5) was most favorable because the high nutrition value and it scored maximum for consumer appeal and low microbial flora count within the acceptable standards limit. Popped sorghum, jaggery and ragi flour brittle gave more health benefits as well as marketing value than previously present.

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