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Development and Sensory Evaluation of Tea Biscuit Using Unique Properties of Betel leaf oil

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A B S T R A C T

A biscuit is a baked, commonly flour-based food product. They are made with baking powder or baking soda as a chemical leavening agent rather than yeast. Biscuit's ingredients are wheat flour, sugar, butter or oil, eggs and baking powder. Sometimes other ingredients like fruit pieces, nut, raisins, improver and stabilizer are used. In this present study a novel tea-biscuit was produced by incorporating betel leaf oil as essential oil in the formulation of the biscuit. Essential oils are mainly considered as GRAS materials. So, in this formulation of tea-biscuit 0.025%, 0.05%, 0.075% and 0.1% essential oil of betel leaf was used in volume by weight of flour. When the novel tea-biscuit was produced it underwent the process of determination of sensory and physical properties and chemical analysis. Sensory test of preferences was done using a 9-point hedonic scale. After the test, it was found that the tea-biscuit having 0.075% essential oil was best among all novel tea-biscuits. Physical property like hardness, spread ratio, % spread was measured for all the samples of biscuits. It has been found that the values of hardness for the novel tea-biscuit having 0.075% essential oil were 1390.5 g-force, while the control one has lesser values than the novel one. In novel-tea biscuit protein content, fat content, crude fiber content was 8.52%, 24.77%, 1.65%, respectively. The energy of developed tea biscuit was highest among all samples which were about 478.65Kcal/100g. After all the tests were concluded the economic feasibility of the baking process was done, where it has been found that if the selling is done at the rate of Rs. 9 per 50 g(10 biscuits), there will be more than 10% profit in this process and the price is within the range of the market available biscuits. Therefore, commercialization of the process can be done since the process is economically viable and self-sustainable.

Introduction

Biscuit is a dry, baked product mainly consisting of wheat flour. Betel chewing is considered as a good and cheap source of dietary calcium. Betel leaf is a nutritious item particularly for its high calcium and mineral content. The surplus production of betel leaf which leads to the wastage ranging from 10-70% each year, whereas it possesses numerous beneficial properties including digestive, stimulating and medicinal ones. Essential oil of betel leaf has not yet been used as ingredient of any bakery product which could

not only help in minimizing wastage but could also be a source of novel food product. In view of the alarming losses, attempts are being made to minimize the wastage by drying the leaves, controlling senescence by chemical treatments, manipulation of storage temperature, adopting better packaging materials and methods besides curing and bleaching of the leaves and extraction of essential oil, which is a GRAS (generally recognized as safe) material accepted by FDA.

In view of its unique beneficial properties and to mitigate its wastage, it was thought worthwhile to study prospects of essential oil of betel leaf as an ingredient of biscuit; this study will develop a novel biscuit with essential oil of betel leaf in order to improve taste, value, medicinal properties, which have not yet been tried by any research worker.

Keeping the above points in mind, the present study was taken up with the following objectives:

To develop a tea-biscuit with essential oil of betel leaf and thereby minimize wastage of surplus betel leaves.

To evaluate the developed tea-biscuit by comparing its proximate analysis, organoleptic and texture properties with control biscuit.

To work out economic feasibility of production of tea-biscuit with unique properties of betel leaf.

Ismail *et al.,* (2002) described that baking of biscuit occurs mainly in two stages, one is the 'heating up' period and the other is 'cooling' period. During the heating up to 200^0 C for 11 min and then put it for 30 min at room temperature for cooling the biscuit.

Ali Asghar *et al.,* (2006) have stated that, the egg white has specific functional properties in food processing like foaming and stability properties. Major functional properties of whole egg are stability, emulsification, foaming and gelling ability. Whole egg is also applied as colorants.

Bhawna *et al.,* (2013) stated that hardness increases with increase in level of sugar and fat replacers and decrease in fat level. With increase in ammonium bicarbonate, diameter and spread ratio increase. Interactive effect of increased fat and water level decreases spread ratio.

Guha (2007) stated that 10% of the production of the betel leaves remain surplus and subjected to wastage every year particularly during rainy season. To minimize the wastage surplus betel leaves can be for extraction of essential oil from the leaves.

Dwivedi *et al.,* (2010) conducted gas chromatography mass spectrometry (GC-MS) analysis of the hexane and benzene extracts of the *Piper betle* L.

The compounds were identified by comparing their retention time and covate indexes with that of literature and by interpretation of mass spectra. Many of them are used in industry for various applications like perfumes, flavors, deodorants, antiseptic and pharmaceuticals.

Guha (2006) stated that the essential oil obtained from betel leaf may be used as an industrial raw material for manufacturing medicines, perfumes, mouth fresheners, tonics, food additives etc.

Tripathi *et al.,* (2012) observed that *Piper betle* L. leave extract contains large number of bioactive molecule like polyphenol, alkaloids, steroids, saponin and tannin. *Piper betel* is used to treat alcoholism, bronchitis asthma leprosy and dyspepsia, nerve tonic hepatic marker, anti-diabetic, anti-anxiety activity.

Materials and Methods

The experiments were conducted at Agricultural and Food Engineering Department, IIT Kharagpur in Paschim Midnapur District, West Bengal, India. IIT Kharagpur

Tools, equipments and instruments used for the experiments

The equipments and instruments used for the experiment were Betel leaf oil extractor, Weight measuring device, Volume measuring cylinder, dough mixer, Mixing bowl, Spoons, Baking pad, Baking oven, Texture analyzer instrument, CM-5 spectrophotometer, hot air oven, Muffle furnace, Kjeldatherm apparatus, Soxtherm apparatus and Fibra plus pelican equipments

Betel leaf oil extractor

Essential oil from betel leaf was extracted by the help of modified Clevenger apparatus called 'betel leaf oil extractor'. It works on the basis of distillation process. At first fresh betel leaf was torn into small pieces and put into the round bottom flask and dipped by pouring tap water into the flask. After that the Clevenger part of the instrument was attached supported by the stand. Cold water line was then attached for the condensation of the oil and water vapour. Heat was provided by an electric heater under the round bottom flask which leads to production of oil and water vapour. The vapour then goes up and gets condensed and finally accumulates at the receiver on the top of the water surface. After 3 to 4 hours heating was stopped and oil was collected using the stopcock (Fig. 1).

Spectrophotometer

The color measurement of biscuit was done by the apparatus called CM-5 spectrophotometer. During the test the powder form of biscuit was kept in Petri dish that was put on the target mask of the spectrophotometer and value of L*, a*, b*, c*, h* was recorded (Fig. 2).

Muffle furnace

It is used for determine the ash content of food product. It is a heater in which the subject material is separated from the fuel and all of the products of fire including gases and flying ash (Fig. 3).

Kjeldatherm apparatus

Nitrogen content is estimated by the kjeldahl method. Plant proteins contain 16 % of nitrogen. To determine protein content N% is multiplied by 6.25 (Fig. 4).

Soxhlet extraction apparatus

Fat in a food is extracted from an oven dried sample using a soxhlet extraction apparatus. The ether is evaporated and the residue weighed.

Fibra plus apparatus

Crude fiber refers to the residue of a feed that is insoluble after successive boiling with dilute acid and alkali, when the sample is subjected to acid and alkali digestion, we obtain a residue comprising ash (mineral matter) of the feed and the resistant fraction of carbohydrate.

When the residue is ignited the organic matter gets oxidized leaving the inorganic residue or ash. Thus the difference in weight of the residue before and after ashing gives the weight of crude fiber.

Methodology

The experiments were conducted in two parts, first was to develop the product and second

analysis of the physical, chemical and organoleptic properties between the developed products.

And finally the economic feasibility of the study was carried out.

Part – I: Development of the novel biscuits

Betel leaf oil was extracted from the fresh betel leaves using the modified Clevenger, which was used as essential oil in the formulation of the biscuit.

Formulation of biscuit

Formulation means the determination of amount of each ingredient which should be taken for the production.

Formulation

Flour: Wheat Flour 100g

Butter: 60% and 30% of Wheat Flour,

Eggs: 40 g

Sugar: 50% of flour (w/w),

Baking powder: 2% of flour (w/w),

Essential oil (Betel leaf): 0.025%, 0.05%, 0.075%, 0.1% of flour (v/w)

Process details

The process of baking of biscuit was carried out in following steps.

The betel leaf oil sample was taken as essential oil in raw state as it was extracted.

During processing, at first eggs were taken into a mixing bowl and essential oil mix thoroughly.

Butter has been taken in another mixing bowl and creaming process was done till light white colour appears.

Then flour was added in 3 to 4 part for proper mixing of flour. Flour was added gradually, otherwise gluten formation may occur.

After that sugar and baking powder was added and proper mixing was done with the dough mixer.

Finally the biscuits were placed into the baking oven previously kept at 200^{o}C.

The biscuits were kept into the oven for 11 minutes for baking.

After 11 minutes the biscuits were taken out from the oven and cooled at room temperature for 30 mins.

Finally the biscuits with different amount of betel leaf oil and also the control one underwent the process of organoleptic test, physical properties and proximate test (Table 1).

Part – II: Analysis of organoleptic, physical and chemical properties of the novel tea biscuit

Thereafter the developed novel biscuits underwent the different processes of organoleptic, physical properties, colour measurement and proximate analysis.

In table 2 the value was calculated on the basis of judges' preferences. For each sensory property there was 9-point hedonic scale, having values from 9 to 1.

This values was multiplied by the number of judges preferred that sample on a particular level of preference.

So, the colour value of 1st sample = (9*a + 8*b + 7*c + …) / (a + b + c + …) (3.1)

As like the colour value values for other sensory properties of every sample were calculated and tabulated. For the 'overall' value of a particular sample was calculated by taking the average of all sensory properties of that particular sample.

Like, Overall value = (Colour value + Taste value + Aroma value + Mouthfeel Value) / 4 (3.2)

Physical properties analysis

Spread ratio

Spread ratio was calculated by dividing the average value of diameter by average value of thickness of biscuits. Percent spread was calculated by dividing the spread ratio of supplemented biscuits with spread ratio of control biscuits and multiplying by 100.

Hardness

The physical property of the product measured was 'hardness'. The measurement was done by the instrument named "Texture analyzer". Hardness = peak force during first bite

Proximate analysis of developed biscuit

The proximate analysis consists in determining percentage of the moisture content, ash content, fat, protein and crude fiber.

Part – III: Economic feasibility of the process for the development of novel biscuits

After conclusion of all the experiments and processes finally the economic feasibility of this study was done.

Results and Discussion

Evaluation of sensory properties

The analysis of sensory properties was done by 25 different judges for different concentration of developed novel biscuits.

The data were collected for sensory properties of all the biscuits and tabulated as shown below:

Sensory properties analysis for novel biscuits

The novel biscuits were produced in the laboratory with different composition as shown in table 2 and given to the judges and their preferences were collected and tabulated as shown in 4.2:

Comparison of sensory properties of different sample

After collection and calculation from all the data obtained from the preferences of different judges on different sensory properties for different sample preferences were obtained.

Thus the most and least preferable biscuits were worked out and marked for further study.

The comparison among the biscuit samples are shown in table 2.

In table 2 all the values of different sensory properties were calculated by using equation no. 3.1 while overall values were calculated by using equation no. 3.2 as mentioned in the previous chapter.

After the process of sensory properties test was over it has been found that the 'Sample 4 Biscuit'(Betel leaf oil content 0.075% & butter content 60%) is the most preferable biscuit by the judges.

Sensory properties analysis for most preferable novel biscuits with and without tea

The most preferable novel biscuit was produced in the laboratory and given to the 15 judges and their preferences were collected and tabulated as shown below:

Comparison of sensory properties of most preferable novel biscuits with and without tea

After the process of sensory properties test was over it has been found that the 'Sample 4 Biscuit' (Betel leaf oil content 0.075% & butter content 60%) with tea is the most preferable biscuit by the judges.

Evaluation of physical properties

Spread ratio

Spread ratio was calculated by dividing the average value of diameter by average value of thickness of biscuits. Percent spread was calculated by dividing the spread ratio of supplemented biscuits with spread ratio of control biscuits and multiplying by 100.

Hardness

Hardness of the biscuits was measured with the help of "Texture Analyzer" instrument as mentioned earlier. Hardness is the amount of peak force required during first bite. The equations used for the calculation as mentioned in the previous chapter.

Hardness analysis for novel biscuits

All the biscuits underwent the process of textural analysis and the graphs obtained by the software named 'Texture Expert' from the computer are shown below having time (sec) in 'X' axis and force (g) in 'Y' axis.

From the Figure 7 graphical representation it can easily be observed about the texture analysis of the 'Sample 1'. As test starts during first bite the force required to penetrate the probe into the biscuit is about 523.7 g-force, 611.4 g-force, 740.1 g-force which is read from the scale of the 'Y' axis.

From the Figure 8 graphical representation it can easily be observed about the texture analysis of the 'Sample 2'. As test starts during first bite the force required to penetrate the probe into the biscuit is about 983.2 g-force, 1144.8 g-force, 1051.6 g-force which is read from the scale of the 'Y' axis.

From the Figure 9 graphical representation it can easily be observed about the texture analysis of the 'Sample 3'. As test starts during first bite the force required to penetrate the probe into the biscuit is about 1257.5 g-force, 1254.3 g-force, 1214.9 g-force which is read from the scale of the 'Y' axis.

From the Figure 10 graphical representation it can easily be observed about the texture analysis of the 'Sample 4'. As test starts during first bite the force required to penetrate the probe into the biscuit is about 1311.9 g-force, 1275.8 g-force, 1583.7 g-force which is read from the scale of the 'Y' axis.

From the Figure 11 graphical representation it can easily be observed about the texture analysis of the 'Sample 5'. As test starts during first bite the force required to penetrate the probe into the biscuit is about 1616.8 g-force, 1584.0 g-force, 1608.5 g-force which is read from the scale of the 'Y' axis. From the Figure 12 graphical representation it can easily be observed about the texture analysis of the 'Sample 6'. As test starts during first bite the force required to penetrate the probe into the biscuit is about 1961.9 g-force, 1914.2.0 g-force, 1892.7 g-force which is read from the scale of the 'Y' axis.

From the Figure 13 graphical representation it can easily be observed about the texture analysis of the 'Sample 7'. As test starts during first bite the force required to penetrate the probe into the biscuit is about 2001.4 g-force, 2137.8 g-force, 2003.4 g-force which is read from the scale of the 'Y' axis.

From the Figure 14 graphical representation it can easily be observed about the texture analysis of the 'Sample 8'. As test starts during first bite the force required to penetrate the probe into the biscuit is about 2496.8 g-force, 2554.3 g-force, 2546.3 g-force which is read from the scale of the 'Y' axis.

From the Figure 15 graphical representation it can easily be observed about the texture analysis of the 'Sample 9'. As test starts during first bite the force required to penetrate the probe into the biscuit is about 2868.6 g-force, 2618.2 g-force, 3117.4 g-force which is read from the scale of the 'Y' axis.

From the Figure 16 graphical representation it can easily be observed about the texture analysis of the 'Sample 10'. As test starts during first bite the force required to penetrate the probe into the biscuit is about 3440.5 g-force, 3325.3 g-force, 3238.6 g-force which is read from the scale of the 'Y' axis.

Calculations

The data were collected from the graph obtained from computer and values of different physical properties were calculated. The values obtained from the graph for different samples were put into the equations to determine the different physical properties for all the samples. After calculation using the above mentioned formulas the values of the physical properties are shown in table 5.

Hardness of biscuit prepared with 60% butter ranged from 625.1 g/mm^2 to 1603 g/mm^2 and average value was 1184.16 g/mm^2. On the other hand, hardness of biscuit with 30% butter ranged from 1922.3 to 3334.8 g/mm^2. it is interesting to note that biscuit prepared with 30% butter (without essential oil of betel leaf, control) was harder than biscuit prepared with 60% butter (without essential oil of betel leaf, control). This necessarily indicates that addition of more amount of butter reduces hardness and increases softness of biscuits which is desirable characteristic. Therefore biscuit with higher amount of butter (60%) should be manufactured.

It is also very interesting to note that biscuit manufactured either with 30% or 60% butter become harder within increase in amount of essential oil added to the biscuit. This may be attributed to fact that addhieveness of particle were increased by addition of essential oil. Similar results were obtained for cupcake by Ray (2010).

Colour analysis of developed biscuit

The most common technique to assess the food colour is by colorimeter. There are several colour scales in which the surface colour can be represented. The L*, a*, b* values were obtained as shown in table 6.

From table 6 the value of L*, a*, b*, c*, h* and ΔE of the different samples can be observed easily.

As the colour difference (ΔE) is minimum so it can be concluded that all sample are same in colour which is best for any food product.

Proximate analysis of developed biscuit

Biscuit was analyzed for moisture content, besides crude fat by soxhlet isotherm method. Total ash and total protein (N x 6.25) were analyzed according to AOAC method no. 923.03 and 920.8 respectively.

Table.1 Different composition of novel biscuits

Sample	Sample Specification	
	E.O. (%)	Butter (%)
S_1	0.000	60
S_2	0.025	60
S_3	0.05	60
S_4	0.075	60
S_5	0.1	60
S_6	0.000	30
S_7	0.025	30
S_8	0.05	30
S_9	0.075	30
S_{10}	0.1	30

Table.2 Comparison of sensory properties

Sample	Colour	Texture	Taste	Mouthfeel	Smell	Overall
S_1	7.80	7.64	7.68	7.64	7.32	7.62
S_2	7.76	7.52	7.56	7.52	8.24	7.72
S_3	8.12	7.84	7.8	7.76	7.72	7.85
S_4	8.32	8.16	8.20	8.32	8.24	8.25
S_5	8.24	7.20	7.16	7.28	7.08	7.39
S_6	7.84	7.12	7.20	7.24	7.44	7.37
S_7	7.96	7.40	7.36	7.16	7.40	7.46
S_8	7.96	7.40	7.60	7.64	7.48	7.62
S_9	8.16	7.76	7.92	7.56	7.56	7.79
S_{10}	8.08	7.44	6.96	6.72	7.32	7.30

Table.3 Overall preference list

Sample	Sample Specification		Overall Value	Order of Preference
	E.O. (%)	Butter (%)		
S_1	0.000	60	7.62	5^{th}
S_2	0.025	60	7.72	4^{th}
S_3	0.05	60	7.85	2^{nd}
S_4	0.075	60	8.25	1^{st}
S_5	0.1	60	7.39	8^{th}
S_6	0.000	30	7.37	9^{th}
S_7	0.025	30	7.46	7^{th}
S_8	0.05	30	7.62	5^{th}
S_9	0.075	30	7.79	3^{rd}
S_{10}	0.1	30	7.30	10^{th}

Table.4 Comparison of sensory properties

Choice	Biscuit without Tea	Biscuit with Tea
Taste	8.07	8.53
Mouthfeel	7.8	8.20
Overall	7.94	8.37

Table.5 Physical properties of different sample of biscuits

Sample	Avg. Diameter (mm)	Avg. Thickness (mm)	Spread Ratio	% Spread	Avg. Hardness (g/mm^2)
S	40.12	4.91	8.17	100	625.1
S_2	40.00	4.90	8.16	99.88	1059.9
S_3	40.31	4.94	8.16	99.88	1242.2
S_4	38.21	4.70	8.13	99.51	1390.5
S_5	38.58	4.74	8.14	99.63	1603.1
S_6	39.50	4.87	8.11	99.27	1922.3
S_7	40.02	4.94	8.10	99.14	2047.5
S_8	38.87	4.81	8.08	98.90	2532.7
S_9	39.50	4.92	8.04	98.41	2868.1
S_{10}	38.71	4.78	8.10	99.14	3334.8

Table.6 Colour value of different sample of biscuits

Samples	L*	a*	b*	c*	h*	ΔE
Sample 1	59.85	10.02	29.20	30.87	71.06	-
	61.01	9.74	30.28	31.81	72.17	1.60
	60.08	9.67	29.10	30.67	71.63	0.46
Sample 2	57.16	11.62	30.25	32.23	69.82	-
	54.76	12.39	29.75	32.22	67.38	2.94
	55.85	11.48	29.56	31.71	68.77	1.52
Sample 3	60.14	9.90	28.93	30.58	71.11	-
	61.03	10.18	29.90	31.59	71.20	1.35
	59.66	10.27	29.84	31.56	71.01	1.09
Sample 4	57.94	10.63	28.01	29.96	69.22	-
	59.25	10.43	29.28	31.08	70.39	1.33
	58.10	10.66	29.05	30.94	69.85	1.05
Sample 5	59.22	9.62	27.76	29.38	70.88	-
	56.53	10.66	28.32	30.26	69.36	2.94
	61.53	9.65	29.62	31.16	71.97	2.96
Sample 6	60.81	9.98	28.67	30.36	70.81	-
	64.70	8.80	27.74	29.10	72.40	2.81
	58.92	11.25	29.70	31.76	69.25	2.49
Sample 7	63.43	9.87	30.19	31.76	71.90	-
	63.73	9.57	30.07	31.56	72.34	0.30
	63.40	9.27	29.85	31.26	72.74	0.69
Sample 8	62.55	9.27	28.56	30.02	72.02	-
	64.09	8.83	27.78	29.14	72.37	1.78
	60.80	9.28	29.14	30.58	72.34	1.84
Sample 9	65.63	7.94	26.81	27.94	73.50	-
	60.97	9.33	27.10	28.67	71.00	2.48
	63.33	8.95	27.77	29.18	72.14	2.68
Sample 10	59.13	9.75	26.54	28.28	69.83	-
	58.78	10.13	27.42	29.23	69.72	3.60
	56.84	12.09	29.74	32.10	67.88	1.02

Table.7 Proximate composition of developed biscuit

Sample	E.O. (%)	Moisture Content (%)	Ash Content (%)	Fat Content (%)	Protein Content (%)	Crude Fiber Content (%)	Carbohydrate (%)	Energy (Kcal/ 100g)
S_1	0.00	3.81	1.86	22.23	8.74	1.40	61.96	463.49
S_2	0.025	2.30	1.91	22.79	8.75	1.45	62.80	471.75
S_3	0.05	2.67	1.62	22.84	8.94	1.55	62.38	471.21
S_4	0.075	3.27	1.67	24.77	8.52	1.65	60.12	478.65
S_5	0.1	3.67	1.88	24.16	8.64	1.70	59.95	473.16
S_6	0.00	2.35	1.76	14.44	7.56	1.30	73.59	430.59
S_7	0.025	2.22	1.84	14.57	7.68	1.40	72.29	430.41
S_8	0.05	2.13	1.69	15.59	7.75	1.65	71.19	435.63
S_9	0.075	2.51	1.63	15.92	7.60	1.50	70.84	436.79
S_{10}	0.1	2.71	1.50	15.23	7.63	1.53	71.40	432.81

Table.8 Cost of materials

Item	Quantity/day	Rate (Rs.)	Price (Rs.) approx.
Flour	1kg	25/kg	25.00
Butter	600 g	35/100g	210.00
Sugar	500 g	32/kg	16.00
Egg	7 pieces	5/piece	35.00
Baking Powder	20 g	25/100 g	5.00
Betel Leaf oil	0.75 ml	35/ml	26.25
Total =			317.25

Fig.1 Betel leaf oil extractor

Fig.2 Spectrophotometer

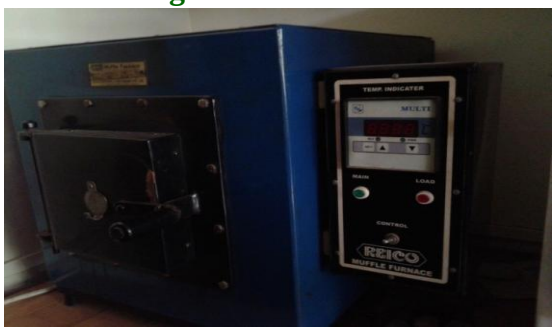

Fig.3 Muffle furnace

Fig.4 Kjeldatherm apparatus

Fig.5 Soxhlet extraction apparatus

Fig.6 Fibra plus apparatus

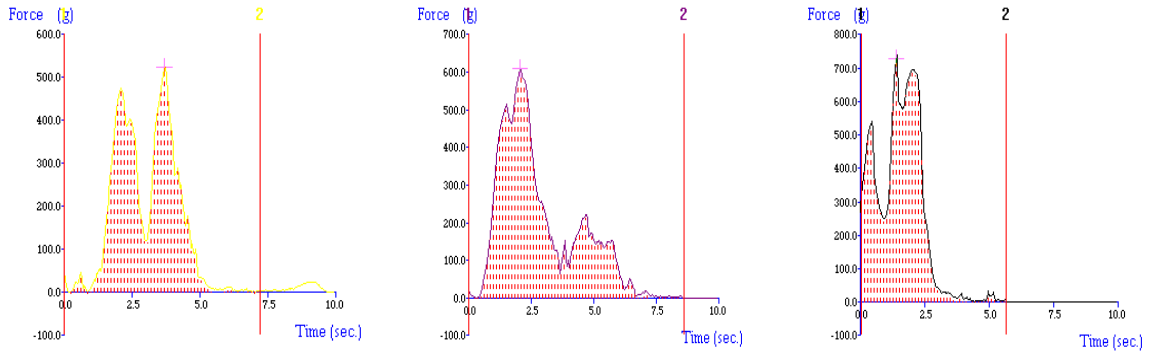

Fig.7 Textural graph obtained for Sample 1

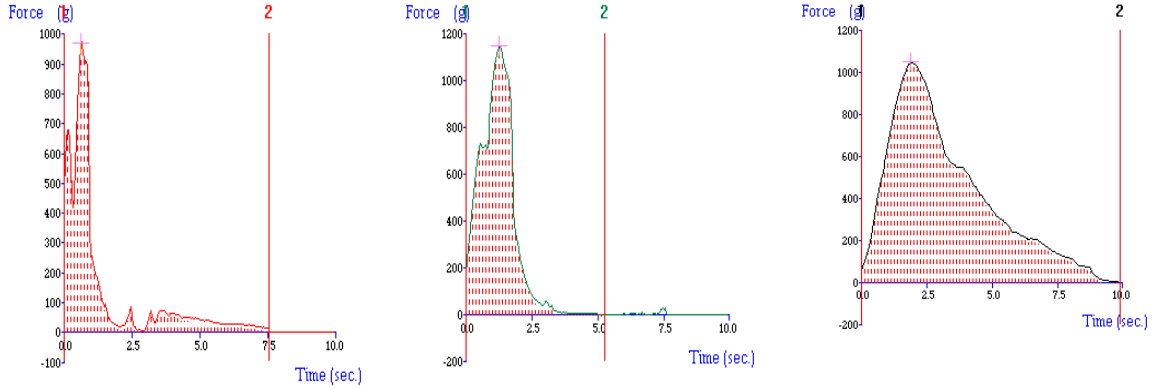

Fig.8 Textural graph obtained for Sample 2

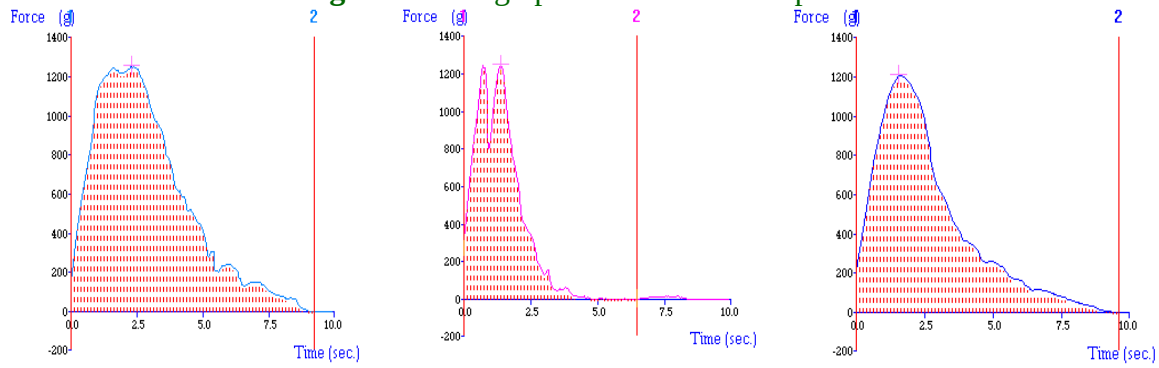

Fig.9 Textural graph obtained for Sample 3

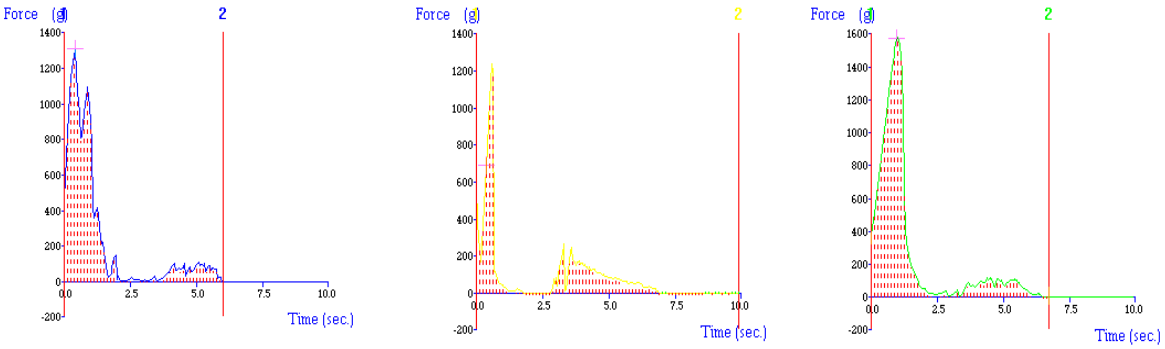

Fig.10 Textural graph obtained for Sample 4

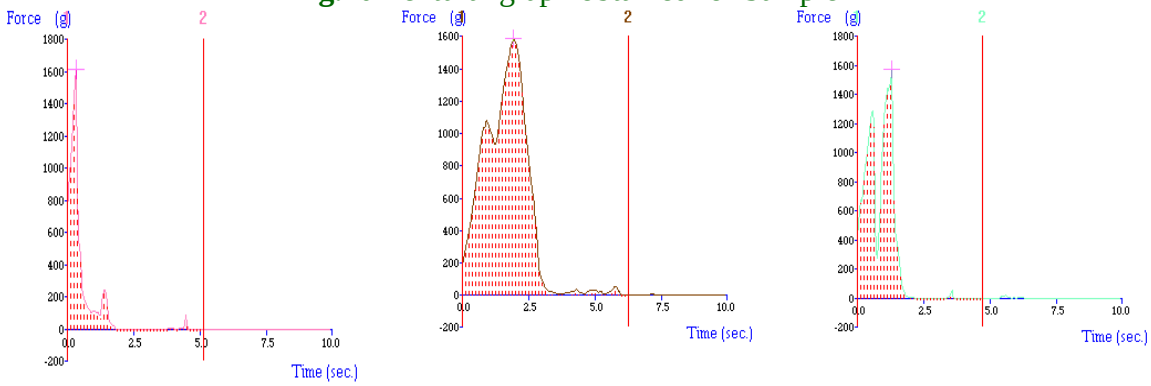

Fig.11 Textural graph obtained for Sample 5

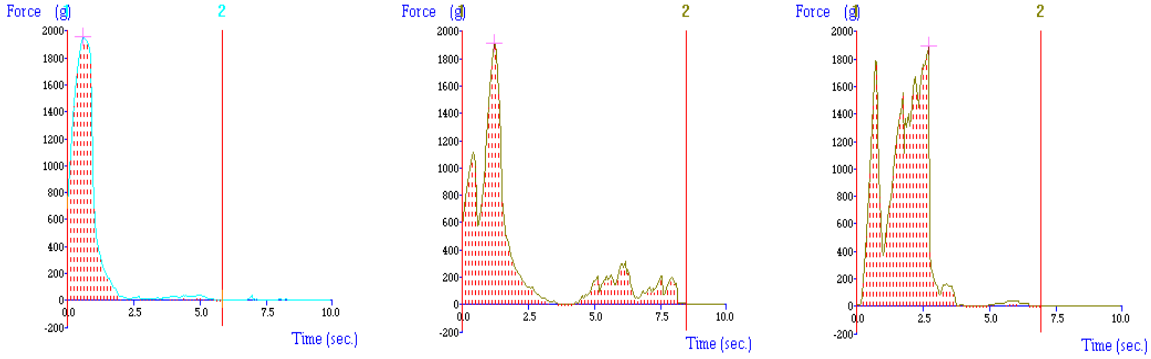

Fig.12 Textural graph obtained for Sample 6

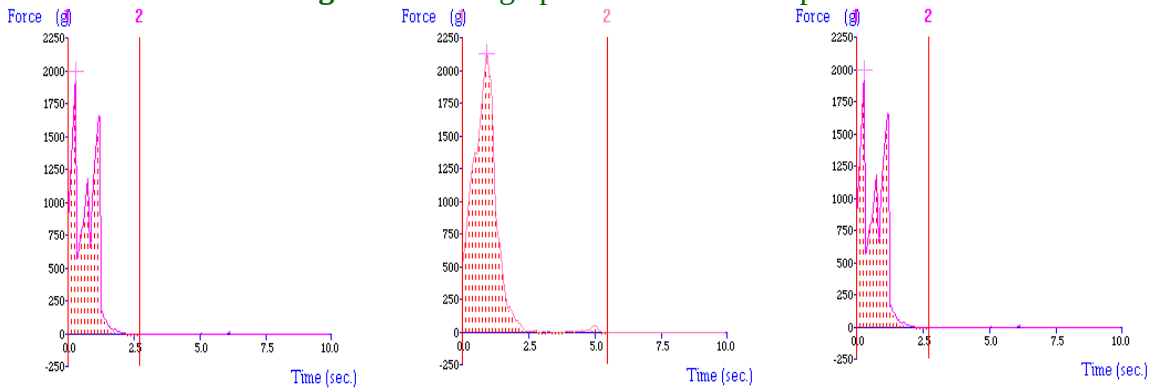

Fig.13 Textural graph obtained for Sample 7

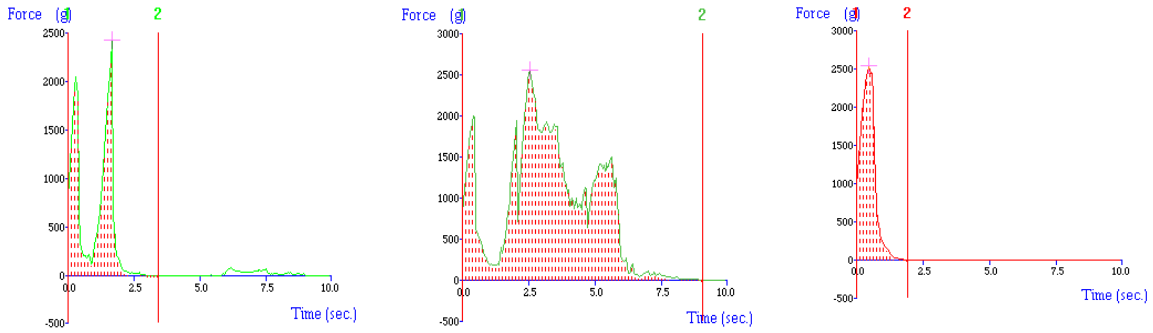

Fig.14 Textural graph obtained for Sample 8

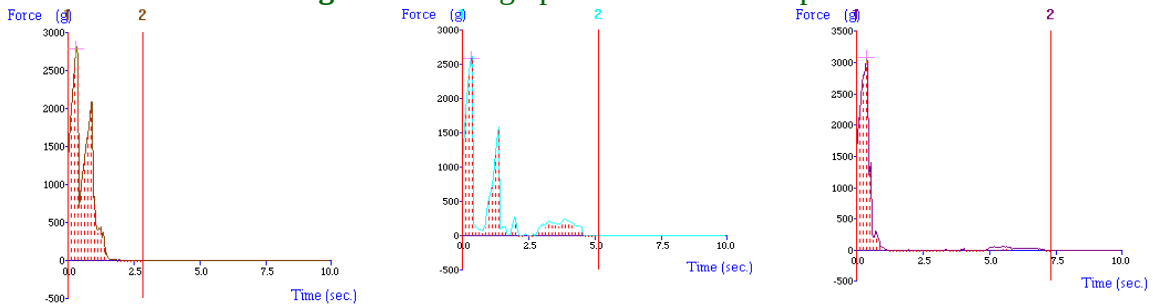

Fig.15 Textural graph obtained for Sample 9

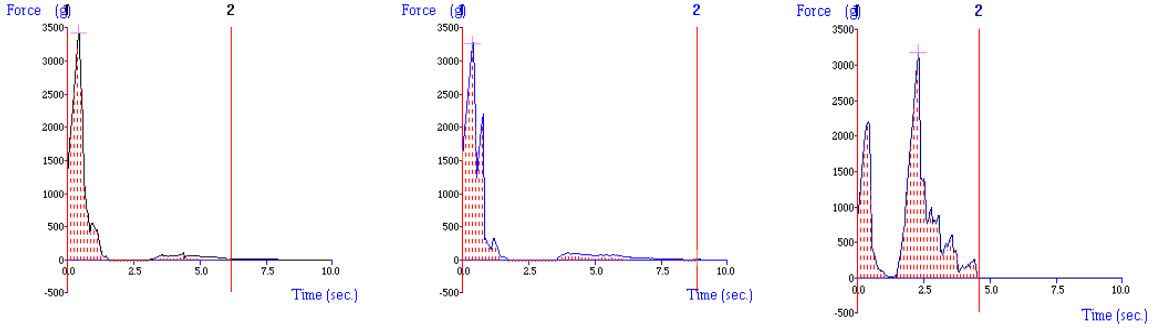

Fig.16 Textural graph obtained for Sample 10

The total carbohydrate was calculated by the difference method. Energy values were calculated by applying the factor 3.2, 9.0, 3.8 for each gram of protein, fat and carbohydrate respectively. The table of proximate analysis of developed biscuits is given in table 7.

From table 7 it can easily be observed about that the moisture content, ash content, fat content, protein content, crude fiber content, carbohydrate are same so it can concluded that due to incorporation of essential oil there is not much significant difference in chemical composition. But when we reduced the amount of butter from 60% to 30% then fat content also reduced by half. Butter has a little amount of protein content so there is very slight difference in protein content.

Economic feasibility test of biscuit production from betel leaf oil

To determine the economic feasibility of the novel biscuit production we need to go through the all input cost as well as determine the sell price to get good profit from the production. It was also done for the confirmation further study on the product to get more benefit during production. So, the process to determine economic feasibility

undergoes many as shown below:

Cost calculation

Cost of process:

Manual labor: Rs. 50/batch
Electricity: Rs. 20/batch
Utensils: Rs. 1.50/batch
Baking oven: Rs. 5/batch
Hand Mixer: Rs. 0.14/batch

Total before bank interest: Rs. 393.89/batch

Bank Interest @12%: Rs. 0.98/batch

Miscellaneous: Rs. 1.10/batch

Total Cost = Material cost + Process cost + Bank interest + Misc.: = Rs. 396 (approx)

Price calculation

Nos. of biscuit produced: 500 pieces/ batch

Cost: 396/500= Rs. 0.792/biscuit = 7.92/10 biscuits

Profit calculation

Commission for vender/10 biscuits: Rs. 0.25/10 biscuits

Sell price (Cost + 10% profit + commission to vender): Rs. 8.962 ~ Rs. 9/10biscuit

Net profit: Rs.9 – (0.25 + 7.92) = Rs. 0.83/10biscuit

Total net income: 50* 0.83 = Rs. 41.50/batch

This economic feasibility test confirmed that this novel biscuit developed with 0.075% essential oil of betel leaf can be commercially produced with a sell price of Rs.9 per 10 biscuit. By market survey it was found out that price of similar biscuits ranges from Rs 10 to Rs.15, so the selling of this novel product @ Rs.9 per Packet (10 biscuit) is economically feasible with market available biscuit. So the commercialization of the produce is economically viable and self-sustainable (Table 8).

The common name of betle leaf is *Paan*, which is mainly found in Asian countries like India, Srilanka, Bangladesh, Pakistan, Nepal, Indonesia, Malaysia etc. The main use of betel leaf is as mouth refresher. Betel leaf oil can be extracted from the fresh betel leaves. As essential oils are considered as GRAS (generally recognized as safe) material, the betel leaf oil can be used as a food ingredient in many food items. Therefore, the present study was undertaken for the use of betel leaf oil in biscuits.

The main ingredients of a biscuit were flour, sugar, butter, eggs, and baking powder. So, the betel leaf oil is incorporated in the formulation of biscuit as an essential oil to produce a novel product. The objectives of the study were to incorporate betel leaf oil into biscuit, and to determine the organoleptic, physical and chemical properties of the developed product, and finally determine whether the process is economically feasible or not.

The study leads to the following conclusions:

Betel leaf oil can be incorporated as an essential oil in biscuits.

It can be used at the rate of 0.025% to 0.1% v/w of flour, among which the biscuit having oil content of 0.075% v/w is best the novel biscuit produced.

Biscuit with tea is more preferable than biscuit without tea.
Incorporation of essential oil increases the

hardness of the product. The hardness of the product with 0.075% v/w oil content was 1390.5 g-force while the hardness is only 625.1 g-force in case of control biscuit.

The average diameter of novel tea biscuit was 38.21 mm and thickness was 4.70 mm.

There is not much difference in spread ratio and % spread of the product and the control, which are approximately same and ranged from 8.04 to 8.16 and from 98.41 to 99.88 respectively.

There is not much difference in colour value of the biscuit which is near about same, and colour difference (ΔE) value has very less difference from 0.30 to 3.60 which shows all the sample has uniform colour.

The moisture content of developed tea-biscuit was 3.27 and ash content was 1.67.

The energy of developed novel tea-biscuit was highest among all samples which were about 478.65Kcal/100g.

In novel tea-biscuit protein content, fat content and crude fiber content was 8.52%, 24.77%, 1.65% respectively.

The process can be commercialized as it is economically viable and self-sustainable.

The selling of novel tea biscuits can be done at the rate of Rs. 9 per packet (10 biscuits) with more than 10% profit, which also fits with the present situation of price of biscuits available in the market.

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