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Acceptability of colacasia leaf powder incorporated finger millet biscuits

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Abstract
Increase in non-communicable diseases in the country is diverting the people to increase the inclusion of green leafy vegetables and millets in their diet to reduce the diseases. Finger millet is enriched with fibre, protein, calcium, chromium, magnesium, zinc, and sufficient quantity of copper and manganese. Colacasia leaves are concentrated sources of protein, iron, phosphorous, calcium, fibre and vitamins (vitamin C and Niacin). This paper is aimed to represent the results of standardization and evaluation of acceptability of colacasia leaf powder incorporated finger millet biscuit. Biscuits were prepared with 3 different ratios of basic ingredients i.e., 90:10:0(Formulation 1), 70:20:10 (Formulation 2), 65:20:15 (Formulation 3) of finger millet flour, whole wheat flour and colacasia leaf powder respectively in 6 different varieties (Three sweet and three salt). Organoleptic evaluation of biscuits was carried out by 20 panel members using hedonic rating scale. Results showed that the biscuits formed with formulation 2 containing 70 g of finger millet flour, 20 g of wheat flour and 10 g of colacasia leaf powder are highly acceptable while biscuits prepared with the formulation 3 containing 65 g of finger millet flour, 20 g of wheat flour and 15 g of colacasia leaf powder are least acceptable.

Keywords: Finger millet, colacasia leaves

Introduction
Eating both appetizing and healthy food is a major challenge in today's life situation. Minerals such as iron and calcium are mainly deficient in vulnerable group of people. Prevalence of diabetes and anemia is also increasing in India due to absence of eating well balanced diet. In such critical phase there is a necessity for focusing concentration towards alternatives in diet, which can be maintained through green leafy vegetables and millets.

Millets are foremost food sources for mankind. Millets are special among the cereals as they are the concentrated sources of fibre, protein, polyphenols and calcium (Devi *et al*., 2011). Among the millets, Finger millet (*Eleusine coracana* L.) is major millet which is highly cultivated in regions of India and it is the leading producer of finger millet which contributes nearly 60% of global production (Kamini and Saritha, 2011).

Finger millet can be recognized as a pool for carbohydrate (72-92.5%) and contains free sugar (1.04%), starch (65.5%) and non-starch polysaccharides (Malleshi and Desikachar, 1985). It even has a high dietary fibre content (11.5%) which is better than the fibre composition of brown rice, polished rice and all other millets (Gopalan *et al.*, 1971). It is one of the significant food crops due to its best nutritious value and better storage property (Shashi *et al.*, 2007).

Finger millet contains large amount (44.7%) of essential amino acids (Mibithi *et al.*, 2000) and even contains sulphur containing amino acids which is equal to that of milk (Antony *et al.*, 1996). Prolamins are the chief protein part of finger millet (Virupaksha *et al*., 1975). Sufficient and useful quantity of linoleic & alpha linolenic acid were present in finger millet (Fernandez *et al.*, 2003).

Finger millet is enriched with calcium (344 mg) which is 8 times greater than that of a pearl millet (Gopalan *et al.*, 2009) and 5-10fold times higher than other grains (Kumar *et al.*, 2013).It contains high amount of chromium, Mg, Zn, and sufficient quantity of copper, manganese (Tripathi and Platel, 2010).

Phytochemicals and phenolic compounds (which show health benefits) are also present in this finger millet and due to their high phenolic content they can exhibit anti-oxidant activity (Shobana *et al.*, 2009). Daily uptake of whole grain finger millet, its product can shield the body against the risk of CVD, gastro intestinal cancer, Diabetes, and other health problems (McKeown *et al.*, 2002).

A green leafy vegetable occupies an important place in food groups.

They are highly concentrated sources of minerals, vitamins, and antioxidants like riboflavin, beta carotene, vitamin C, calcium, phosphorous, iron, folic acid and fibre which are lacking in staple foods. They are economical of all the vegetables within the availability for poor man, being concentrated in their nutritional value (Kuhnlein *et al.*, 1996). A majority of pharmacological studies revealed that consumption of green leafy vegetables is good for health as they can act as blood tonic, joint pain reliever and also helps in eye problem prevention.

Colacassia antiquorum is an herbaceous plant which belongs to the Araceae family and is mostly grown in south India and also southern east part of Asia (Prajapath *et al.*, 2011). Leaves, stem and tubers of this plant have different medicinal properties.

Colacasia leaves are abundant in protein (23%) and has high amount of iron, phosphorous, calcium, fibre, vitamin C and Niacin (Dubois and Savage, 2006). Cooked colacasia leaves contain iron, folic acid and beta carotene which reduces the risk of anemia (FAO, 1990). Colacasia leaves exhibit anti-microbial and anti-inflammatory properties. In ancient days these colacasia leaves were used for treating hepatic problems due to occurrence of free radical scavenging property in them (Tuse *et al.*, 2009). This leaf juice is a stimulant and also can be used in treating blood clots (Pawar *et al.*, 2018). Presence of cyanoglucoside makes them hypoglycaemic (Phillip *et al.*, 2001).

By keeping in view the nutritional significance of finger millet and colacasia leaves, a study was undertaken to evaluate the acceptance of finger millet and colacasia leaves incorporated biscuit.

Materials and methods

Location of the study

The study was carried out at Department of Foods and Nutrition, APGC, Acharya N.G Ranga Agricultural University, Lam, Guntur.

Selection and procurement of raw material

Sample of one variety of Finger millet (Godavari) was procured from Agricultural research Station, Peddapuram. The finger millet was dehulled and the dehulled grains were cleaned in one lot and used for the study. Bulk samples of colacasia leaves, free from blemishes and damage were collected from the field near Guntur and all other raw material required for biscuit preparation were purchased from local market of Guntur.

Preparation of colacasia leaf powder

- **Blanching of colacasia leaves:** Blanching of leaves is generally done to ensure a complete inactivation of enzymes responsible for oxidation (Mutiara *et al.*, 2012). In the present study colacasia leaves were washed with cold water to remove dirt, dust etc., after washing, blanching was done by immersing the cleaned leaves in boiling water at 100°C for 5 minutes.
- **Drying of colacasia leaves using hot air easy drier:** Blanched colacasia leaves were dried in hot air easy drier at about 60°C for about 2 hours.
- **Preparation of colacasia leaf powder:** Dried colacasia leaves were ground into fine powder using electric mixer, followed by sieving and packing in polyethylene bags.

Development of biscuits using different recipe formulations and variations

The biscuits were prepared using three different levels/ratios of basic ingredients i.e., 90:10:0, 70:20:10, 65:20:15 of finger millet, whole wheat flour and colacasia leaf powder respectively in 6 different variations (3 sweet and 3 salt). The three sweet variations of biscuit were prepared by adding i) cocoa powder ii) tuity fruity iii) desiccated coconut powder. The three salt variations of biscuits were prepared by adding iv) cumin (jeera) powder v) ajwain (vamu) powder vi) ginger. The schematic representations of sweet and salt biscuit preparation process are presented in Figure 1 and 2 respectively.

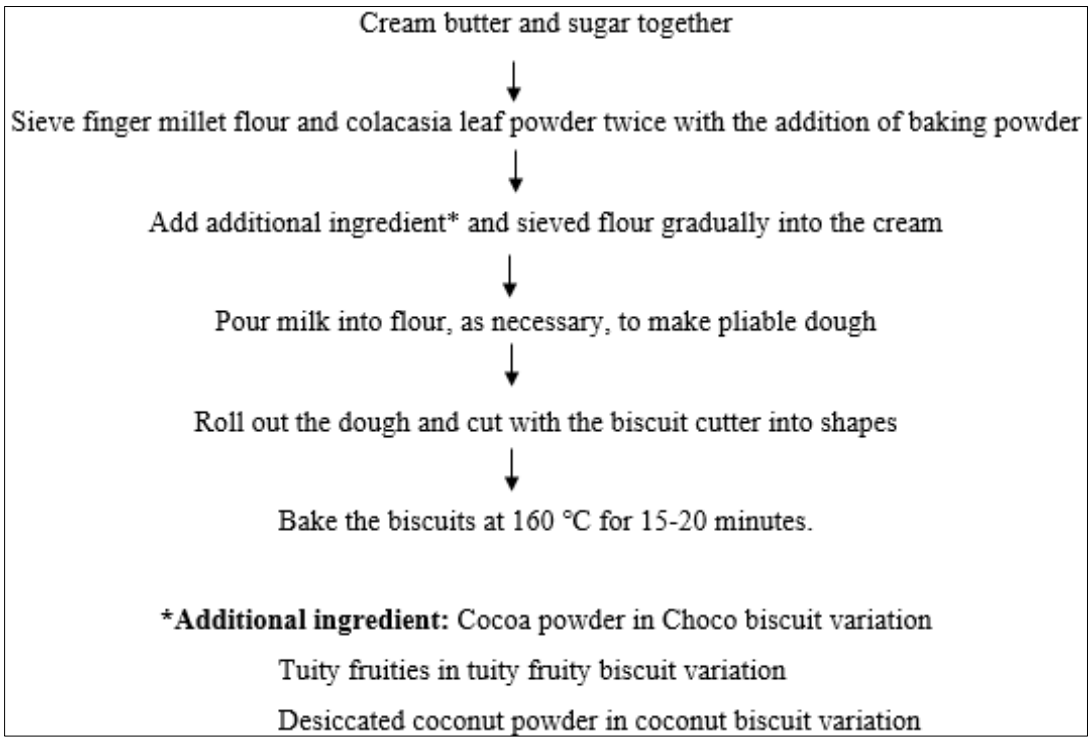

Fig 1: Schematic representation of sweet biscuit preparation process

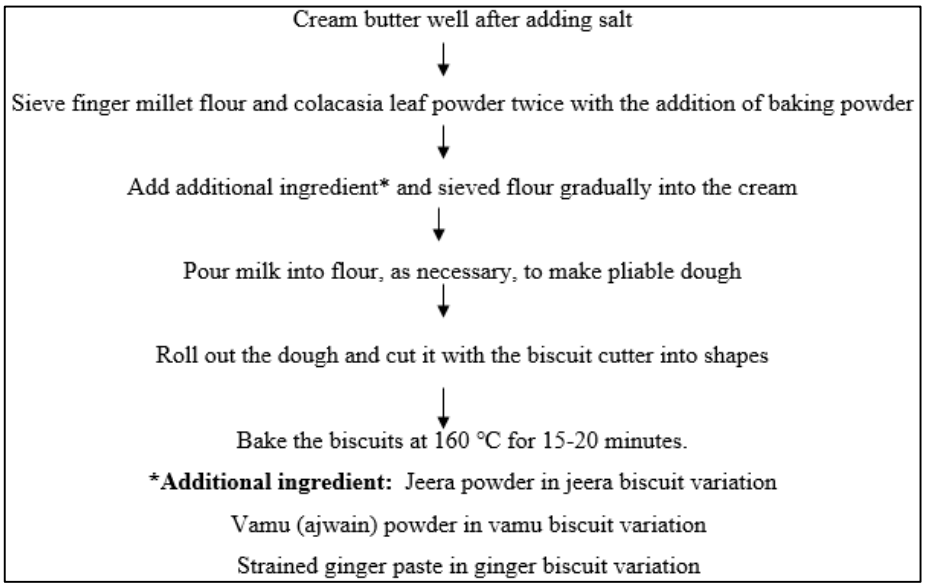

Fig 2: Schematic representation of salt biscuit preparation process

Organoleptic evaluation by using hedonic rating scale

Hedonic rating scale is the most commonly used scale for measuring food product acceptability. The specific characteristics of a food product are rated separately. This method is helpful in grading products and comparison of quality attributes by indicating the faulty characteristics in a poor product. In the present study sensory evaluation of biscuits was carried out by 20 panel members who include both staff and students from the APGC, Acharya N. G. Ranga Agricultural University, and Guntur.

Statistical analysis

The sensory parameters were tested for significance using Krushkal Walli H-test (one way non parametric analysis).

Results and Discussion

Development and organoleptic evaluation of biscuits

Various standardization trials were conducted to develop highly acceptable finger millet colacasia leaf powder biscuit by using different ratios of finger millet four, colacasia leaf powder and wheat flour.

The various ratios of finger millet flour, wheat flour and colacasia leaf powder used in this study were 90:10:0 (formulation 1), 70:20:10 (formulation 2), 65:20:15 (formulation 3). Even the trials were conducted with inclusion of 20 g of colacasia leaf powder (formulation 4) but those level of biscuits were not acceptable as it gave some itchy sensation after eating due to high level of incorporation of colacasia leaf powder. So further formulations with increasing colacasia leaf powder were stopped and only formulation 1, 2, 3 were finalized.

For these three basic formulations, different additional ingredients were added and biscuits were produced in 6 variations in which 3 were sweet variety biscuits and other 3 were salt varieties. Sweet varieties included choco biscuit (CHB) with formulation 1 (coded as CHBF1), formulation 2 (CHBF2), formulation 3 (CHBF3), Tuity fruity biscuits (TFB) with formulation 1 (TFBF1), formulation 2 (TFBF2), formulation 3 (TFBF3), and coconut biscuit (CB) with formulation 1 (CBF1), formulation 2 (CBF2) and formulation 3 (CBF3).

Salt varieties included jeera biscuits (JB) with formulation 1 (JBF1), formulation 2 (JBF2), formulation 3 (JBF3), vamu biscuits (VB) with formulation 1(VBF1), formulation 2 (VBF2), formulation 3 (VBF3) and ginger biscuits (GB) with formulation 1 (GBF1), formulation 2 (GBF2) and formulation 3 (GBF3).

The information regarding quantity of ingredients used for preparation of different sweet and salt biscuits with different formulations are depicted in Table 1 and Table 2 respectively.

Table 1: Quantity of ingredients used for preparation of various sweet biscuits of different formulations.

Quantity of ingredients (g)										
S. No	Ingredients	Variations								
		Choco biscuits			Tuity fruity biscuit			Coconut biscuits		
		Formulations								
		CHBF1	CHBF2	CHBF3	TFBF1	TFBF2	TFBF3	CBF1	CBF2	CBF3
1	Finger millet flour	90	70	65	90	70	65	90	70	65
2	Wheat flour	10	20	20	10	20	20	10	20	20
3	Colacasia leaf powder	0	10	15	0	10	15	0	10	15
4	Butter	50								
5	Sugar	50								
6	Milk	As required								
7	Baking powder	1.25								
8	Vanilla essence	Few drops								
11	Choco powder	10	10	10	_	_	_	_	_	_
12	Tuity fruities	_	_	_	10	10	10	_	_	_
13	Desiccated coconut	_	_	_	_	_	_	10	10	10

Table 2: Quantity of ingredients used for preparation of different various biscuits of different formulations

Quantity of ingredients (g)										
S. No	Ingredients	Variations								
		Jeera biscuits			Vamu biscuit			Ginger biscuits		
		Formulations								
		JBF1	JBF2	JBF3	VBF1	VBF2	VBF3	GBF1	GBF2	GBF3
1	Finger millet flour	90	70	65	90	70	65	90	70	65
2	Wheat flour	10	20	20	10	20	20	10	20	20
3	Colacasia leaf powder	0	10	15	0	10	15	0	10	15
4	Butter	50								
5	Salt	As per taste								
6	Milk	As required								
7	Baking powder	1.25								
8	Vanilla essence	Few drops								
11	Jeera	10	10	10	_	_	_	_	_	_
12	Vamu	_	_	_	10	10	10	_	_	_
13	Ginger	_	_	_	_	_	_	10	10	10

These 18 standardised biscuits were kept for sensory evaluation with hedonic rating scale and the results of evaluation were shown in the Table 3

Table 3: Mean scores of sensory evaluation

Mean scores							
Variations	Formulations	Quality parameters					
		Appearance	Colour	Taste	Texture	Flavour	Overall acceptability
Choco biscuits	CHBF1	8.4	8.3	8.3	8.4	8.3	8.3
	CHBF2	8.3	8.1	8.7	8.7	8.6	8.7
	CHBF3	7.9	7.5	7.4	7.8	7.6	6.8
Tuity fruity biscuit	TFBF1	8.6	8.5	8.2	8.3	8.2	8.1
	TFBF2	8.5	8.2	8.5	8.5	8.4	8.5
	TFBF3	8	7.9	7.3	7.5	7.5	6.2
Coconut biscuits	CBF1	8.5	8.4	7.9	8.0	8.1	7.8
	CBF2	8.3	8.0	8.0	8.3	8.3	8.2
	CBF3	7.6	7.6	7.1	7.4	7.4	6.1
Jeera biscuits	JBF1	8.5	8.2	8.2	8.3	8.2	8.2
	JBF2	8.3	8.1	8.6	8.6	8.5	8.6
	JBF3	7.9	7.5	7.4	7.8	7.5	6.7
Vamu biscuit	VBF1	8.5	8.3	8	8.2	8.1	8.0
	VBF2	8.2	8.1	8.4	8.4	8.3	8.4
	VBF3	7.9	7.4	7.0	7.4	7.4	6.2
Ginger biscuits	GBF1	8.5	8.1	7.8	7.9	8.0	7.5
	GBF2	8.3	8.0	8.0	8.2	8.2	7.8
	GBF3	7.7	7.3	6.9	7.3	7.3	6.1

Table 3 presents the mean scores of quality parameters of all biscuits. Significant differences among mean scores were calculated by using Krushkal Wali H –Test which is a non-parametric test. Significant difference was observed between formulation 1, 2 and 3 in all varieties of biscuits.

Colour of formulation 2 and formulation 1 biscuits were "liked very much" while colour of the biscuits prepared with formulation 3 was "liked slightly" by panellists for all variations. Formulation 1 scored highest (8.1 to 8.5) for colour acceptance followed by formulation 2 (8-8.2) and formulation 3 (7.3-7.9) in all the 6 varieties. This decrease in colour acceptance from formulation 1 to formulation 3 in all varieties was because of an increase in the green colour of biscuit which was due to inclusion of colacasia leaf powder. The upper limit mean score for colour was found for Tuity fruity biscuit with formulation 1 (8.5) and minimum mean score was found for ginger biscuit with formulation 3 (7.3).

The mean of taste and texture ranged from 6.9-8.7('liked slightly- liked very much") and 7.3-8.7 ("liked moderately – liked very much") respectively, for all the 18 biscuits. Uppermost mean score for taste (8.7) and texture (8.7) was found in choco biscuit with formulation 2 among all the biscuits and the lower amount mean score for taste (6.9) and texture (7.3) was found in ginger biscuit with formulation 3 among all the biscuits. In terms of formulations, mean score for taste and texture was highest for formulation 2 then by formulation 1 and formulation 3 for all variations.

Equivalent to taste and texture, flavor scores of the biscuits were also highest for formulation 2 followed by formulation 1 and formulation 3 for all the variations. Flavor score ranges from 7.3-8.6 for 18 biscuits. Choco biscuits with formulation 2 gained highest mean score (8.6) for the flavor.

Based on the appearance, color, taste, flavor and texture quality parameters panelists also have given scores for overall acceptability of biscuits. Mean scores of overall acceptability ranged from 6.1- 8.7 ("liked slightly to liked very much"). Choco biscuit with formulation 2 biscuit gained highest overall acceptability with 8.7 mean score and lowest overall acceptability was found for ginger biscuit with formulation 3 and coconut biscuit with formulation 3 biscuit with 6.1 mean score. In terms of formulations the overall acceptability was highest for formulation 2 followed by formulation 1 and then followed by formulation 3 for all variations.

The overall results showed a decline in appearance and colour score from formulation 1 to formulation 3 steadily for all the variations but taste, texture, and flavor score was maximum for formulation 2 followed by formulation 1 and formulation 3, thus overall acceptability was also high for the formulation

2 followed by formulation 1 and formulation 3, so the highest acceptability biscuits were with formulation 2 and lowest acceptability biscuits were with the formulation 3.

Conclusion

Sensory analysis revealed that finger millet biscuits prepared with incorporating 10g of colacasia leaf powder was highly acceptable. The study proved that there existed a potential for finger millet flour and also for colacasia leaf powder (up to certain extent) incorporation in to baked products.

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