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Optimization of organoleptically acceptable and Nutritious instant Finger millet (*Ragi*) cake for menopausal women

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Abstract

Back ground: Menopause is associated with a decline in estrogen levels, which can lead to a decrease in bone density and increase the risk of osteoporosis.

Objective: This study aimed to standardized develop millet-based sponge cakes from finger milled for postmenopausal women, ages 45 to 65, from rural and urban area of Ayodhya district. Nutritional and sensory qualities of product was done in in department of food science and nutrition, ANDUAT, Kumarganj, Ayodhya.

Methods: Four distinct cake formulations were made with different percentages of wheat and finger millet flour, along with a control sample made entirely of wheat flour. Furthermore, highest acceptable cake was also formulated with different sources of sugar such as; dates, jaggery, sugar free and table sugar. Proximate and sensory evaluations were conducted with semi-trained panel participants. The findings showed that there were discernible variations between these items in terms of visual puffiness, appearance, texture/mouth feel, moistness, odour, overall acceptability. Based on the panel's sensory assessments of the products using a 9-point hedonic rating scale, every product received a score higher than 6, indicating that the panel found all sensory aspects to be at least somewhat pleasing. The panel's overall assessment of the samples' appeal suggested that all of the goods were respectable, with Sample T2 (Dates flavour) being the most favoured.

Results: The proximate analysis of the formulations indicated an improvement in the nutritional content (Protein, carbohydrate, fat, ash, energy) with mean increases of $2.3 \pm 0.2\%$ for ash and $25.05 \pm 2.32\%$ for fat compared to 5.53% and 30.96% for the control sample, respectively. There was no discernible variation in the protein composition ($7.1 \pm 0.92\%$ versus 7.25%). In contrast to the control sample, which had a carbohydrate content of 76.43% , there was a decrease ($74.1 \pm 7.38\%$).

Conclusion: In an attempt to provide a healthy option to post-menopausal women substitution of refined wheat flour with whole wheat flour and ragi flour in cake preparation was found successful. Cake containing wheat flour: ragi flour (25:75) was found superior to control in term of sensory acceptability and nutritional quality like calcium, iron, fibre.

Key words: Post-menopause, millets, ragi cake, sensory evaluation, proximate analysis

Introduction

Menopause remains a largely mysterious and often overlooked aspect of human existence. It marks the end of a woman's reproductive years and is a step in the continuum of life stages. Except in rare cases involving specialized fertility treatments, pregnancy is not possible after menopause (World Health Organization, 2022). Research indicates that 60% of women experience mild symptoms, 20% experience severe symptoms, and 20% experience no symptoms at all. (Tumbull

S., 2010). Age of menopause differs from woman to woman however, generally menopause occurs at 45-55 years of age (Deva, 2021). There are three phases of menopause- pre-menopause, perimenopause and post-menopause.

Women going through menopause frequently report symptoms such as hot flushes, night sweats (Amruthavalli and Venkataramana, 2015) heart discomfort, sleep problems, joint or muscle pain (Poomalar & Arounassalam, 2013), hormonal imbalances, sore breasts, mood swings, irritability, anxiety, headaches, weight gain, hair loss, physical or mental fatigue, sexual issues, bladder problems, vaginal dryness, urinary incontinence, and sexual dysfunction (Dennerstein L. et al., 2009). However, longitudinal studies, even when controlling for age and other factors, consistently link only vasomotor symptoms, vaginal symptoms, and sleep disturbances with the menopausal transition (Digumarti L., 2013).

The dietary habits and preferences of menopausal women are influenced by the changes associated with menopause. Proper nutrition can significantly help prevent and manage changes in body composition. Essential nutrients, which are crucial for human life but cannot be synthesized by the body, must be obtained through food and drink. Hence, it is important to develop nutritious food products that can alleviate menopausal symptoms (Fouad S, 2018). Functional foods, defined as those enhanced with new ingredients or increased levels of existing ones to provide additional health benefits or disease prevention, contain numerous bioactive phytochemicals that have been shown to positively impact health.

Casper RF and Yen SS. 1985). study examines the usage of a newly developed product that treats menopausal symptoms and provides women with vital nutrients by using millet, often known as ragi. The following signs are being emphasised: Warm Baths: Hot flashes, which typically last two to thirty minutes, are sudden, intense sensations of heat accompanied by perspiration and a racing heartbeat. Apples, bananas, broccoli, soy products, berries, pears, cucumbers, fennel, licorice, shatavari, black cohosh, brahmi, and other foods fight disease. Night Sweats: The frequent occurrence of profuse sweating while you sleep is known as night sweats. Sage herbs, fenugreek, black cumin, oats, berries, panax ginseng, fennel, shatavari, Brahmi, etc. are foods that fight (Aiello EJ., 2004). Hormonal imbalance: An endocrine disorder that develops when the body produces too many or too few hormones (Ray S and Dasgupta A., 2012). To develop a new food product specifically designed for menopausal women experiencing symptoms such as hot flashes, night sweats, insomnia, anxiety, and mood swings due to hormonal imbalances, various ingredients that help alleviate these symptoms have been researched. The selected ingredients for this recipe are as follows:

Material Methods:

2.1 Treatment Details:

The *Ragi* cake experimental formulations consisted of composite flour containing varying proportions of *Ragi* flour and wheat flours in the ratios of 100:0, 75:25, 50:50 and, 0:100 respectively. The control sample was prepared using 100 per-cent wheat flour. The incorporation of *Ragi* was intended to enhance the protein, fiber and mineral content as well as antioxidant properties.

Table: 1 Treatment Details of Products

Treatments	Wheat flour : <i>Ragi</i> flour
C	100:0,
T1	50:50,
T2	25:75
T3	0:100

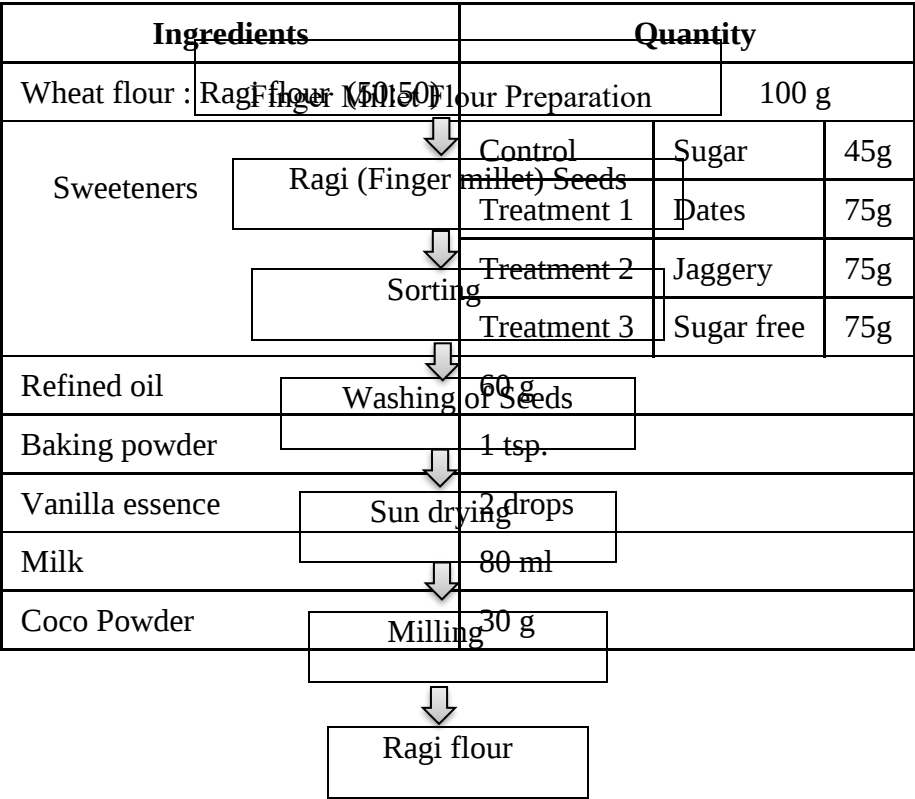
The physical, chemical and sensory attributes were analysed to determine the effects of incorporating different levels of *Ragi* and wheat flour pancake quality parameters. On the basis of sensory evaluation 50:50 (T2) treatment was overall accepted and liked by semi – panellist. Furthermore 50:50 treatment was prepared in 3 treatments with different source of sweeteners i.e. Date, Jaggery, Sugar free. The Control sample was prepared using Common Sugar.

Table:2 Treatment details on the basis of various sources of sweeteners

2.2 Development of Ragi Cake

The preparation of finger millet flour, commonly known as ragi flour, prepare with the selection of raw ragi seeds. These seeds are first sorted to remove impurities or damaged grains, ensuring that only high-quality seeds are used. Following sorting, the seeds are washed thoroughly to eliminate dirt and contaminants. After washing, the seeds undergo sun drying, which removes any remaining moisture and prepares them for milling. Once dried, the seeds are milled into a fine powder, resulting in the final product: ragi flour, ready for use in various culinary dishes.

2.2 Flow diagram: Preparation of finger millet flour



2.3 Sensory evaluation

Trained, semi- untrained panelists were chosen for the sensory analysis after their consent was obtained and their demographic details collected using the Cape Coast Polytechnic Research Consent and Sample Survey Form. The panelists were given coded for tasting each sample. Each panelist evaluated every samples based on visual puffiness, appearance/color, smell/aroma, taste, overall texture/ mouthfeel, moistness, and overall liking using a 9-point hedonic scale (1=dislike extremely, 5=neither like nor dislike, 9=like extremely). Their evaluations were recorded on Sensory Analysis Forms. Sensory evaluation has been defined as the sensory attributes of colour, appearance, texture, flavour, taste and overall acceptability by using nine-point hedonic scale score and scientific discipline used to evoke, measure, analyze and interpret those responses to products as perceived through the senses of sight, smell, touch and hearing Sipos, L et al., 2021.

2.4. Proximate Analysis of cake

The cake was evaluated for protein content (calculated as 6.25 times the Nitrogen percentage), as well as for fats, ash, and moisture content, using standard AOAC methods. The carbohydrate content was determined by subtracting these values from the total weight. The measurements for different cake samples were also carried out using standard AOAC, 2000 methods.

Formula for calculating Nutrients

1. Moisture

$$\text{Moisture \%} = \frac{\text{Wt. of the sample before drying(g)} - \text{Wt. of the sample after drying(g)}}{\text{Weight of sample}} \times 100$$

2. Crude Fat

$$\text{Crude Fat \%} = \frac{\text{Weight of Fat(g)}}{\text{Weight of Sample (g)}} \times 100$$

3. Crude Fibre

$$\text{Crude fiber (\%)} = \frac{\text{Wt. of Sample (before ignition)(g)} - \text{Wt. of Sample (after ignition)(g)}}{\text{Weight of Sample (g)}} \times 100$$

4. Carbohydrates

Total Carbohydrate (%) = 100–[(Moisture % + Crude Protein % + Crude Fat % + Crude Fiber % + Total Ash %)]

5. Ash

$$\text{Ash \%} = \frac{\text{Weight of Ash}(g)}{\text{Weight of Sample}(g)} \times 100$$

Results and Discussion

Study Population

Table: 1 presents demographic data concerning individuals residing in rural and urban areas, with each group comprising 150 individuals. The data is segmented into four age groups: 45-50, 51-55, 56-60, and 61-65. In the age group 45-50, there are 47.9% menopausal women, while in urban areas, 52.1% of women. the age group 51-55, rural areas have 51.4%, whereas urban areas reported 48.6%. Similarly, in the age group 56-60, rural areas host (48.9%), and urban areas consist of (51.1%). Lastly, in the age group 61-65, rural and urban areas accommodate (56.8%), (43.2%) respectively. χ^2 value is given as 0.801, it suggests that there is a weak association between the age group among rural and urban area.

The marital status of post -menopausal women living in rural and urban areas. In rural areas, 71.3%, are married, while in urban areas, 63.3%, are married. unmarried in rural and urban areas representing 1.3%, 4.7%. As for widowed, constituting 20.7% and urban areas have 17.3%. Regarding divorced rural areas has reported 6.7%, while urban areas have 8.7%. 0.302 χ^2 value suggests that there is little evidence to conclude a significant relationship between the distribution of age groups and whether individuals reside in rural or urban areas.

Significant associations were found between socio-demographic factors such as marital status, education level, parity, exercise habits, chronic disease status, and both higher MRS scores and poor quality of life **Alsaleem,et al, (2016)**

Table:1 Socio-demographic profile of post- menopausal women

	Rural N=150	Urban N=150	X ²
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Age Group	45-50	n	69	75	0.801 ^{NS}
		%	47.9	52.1	
	50-55	n	38	36	
		%	51.4	48.6	
	55-60	n	22	23	
		%	48.9	51.1	
	60-65	n	21	16	
		%	56.8	43.2	
	Married	n	107	104	
		%	71.3	69.3	
Marital Status	Unmarried	n	2	7	0.302 ^{NS}
		%	1.3	4.7	
	Widow	n	31	26	
		%	20.7	17.3	
	Divorce	n	10	13	
		%	6.7	8.7	
Monthly Income	<15000	n	31	19	0.008
		%	20.7	12.7	
	15000-30000	n	51	36	
		%	34	24	
	31000-50000	n	48	56	
		%	32	37.3	
	> 50000	n	20	39	
		%	13.3	26	
	1,000,00	n	13	26	
		%	13.3	26	

Monthly income distribution among post-menopausal women residing in rural and urban areas. In rural areas, comprising 20.7%, earn less than 15,000, whereas in urban areas, accounting for 12.7%, fall into this income .Next 15,000-30,000 income range, rural areas having 34%, while urban areas it was 24%. In the 31,000- 50,000 income rural areas representing 32%, whereas urban area, accounting for 37.3%. Lastly, in the income exceeding 50,000 to 1,00,000, rural and urban areas accounting 13.3%, 26%.respectively Overall data has conclude that most of the rural post -menopausal women have earn less than 15,000 while in urban area women are functional and shelf dependent 37.3%. accounting for the 31,000-50,000 income and income exceeding 50,000 to 1,00,000 in urban area while urban areas constituting 26% while it was reported in rural women i.e. 13.3%.

2. Mean Sensory Score of *Ragi* cake on Nine Point Hedonic Rating Scale

The table compares different mixtures of wheat flour and ragi flour (100:0, 50:50, 25:75, and 0:100) based on sensory attributes such as appearance, colour, texture, flavour, and overall acceptability. The 25:75 wheat-to-ragi ratio (T2) consistently received the highest scores across

most attributes, particularly in appearance, colour, texture, and flavour, making it the most preferred blend. The 100% wheat flour mix (C) generally scored the lowest, except in texture, where it performed better than the 0:100 ratio. The data also shows that as the proportion of ragi flour increases, the overall sensory attributes improve.

Table 2. Mean Sensory Score of Ragi cake on Nine Point Hedonic Rating Scale

Treatments	Wheat flour : Ragi flour				
	C 100:0	T1 50:50	T2 25:75	T3 0:100	CD (0.5)
Appearance	6.25	7.75	8.75	6.75	0.20
Colour	7.25	8	9	7.75	0.30
Texture	7.5	7.5	8.75	8	0.03
Flavour	6.5	8.75	9	7	0.20
Overall Acceptability	7.38	7.69	8.62	7.88	0.30

*Cake containing wheat flour: ragi flour (25:75) scored highest for sensory acceptability

3. Mean Sensory Score of Ragi cake with different source of sweeteners on Nine Point Hedonic Rating Scale

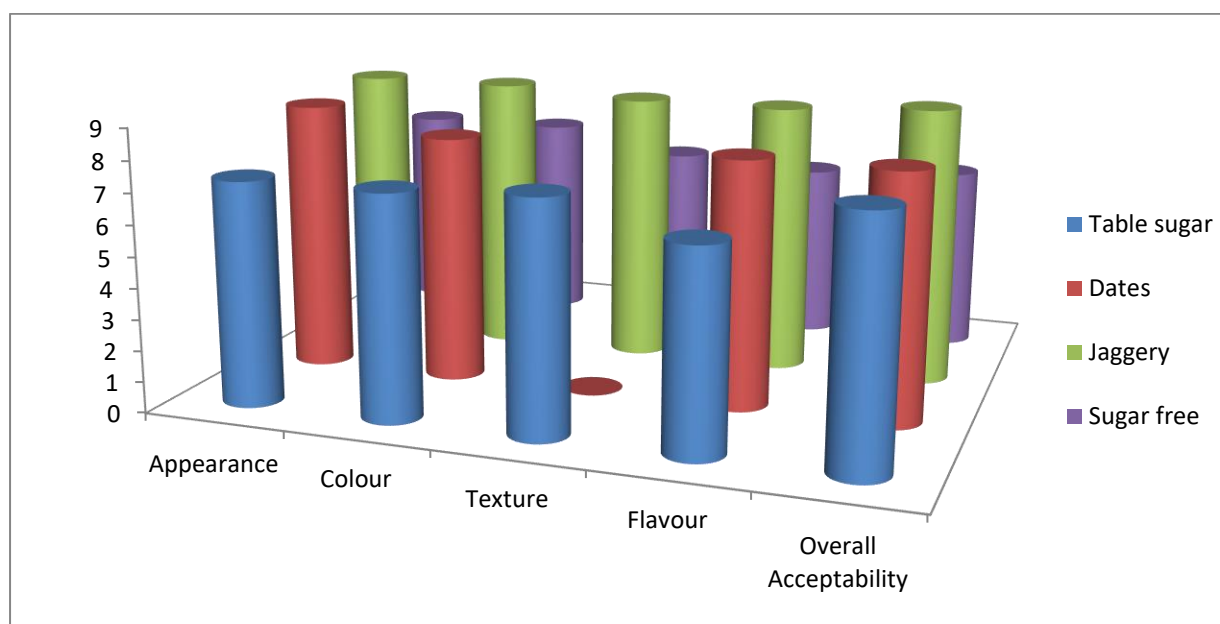
The table presents sensory evaluation scores for a wheat-ragi flour blend (25:75) sweetened with table sugar, dates, jaggery, or a sugar-free alternative. Across all attributes—appearance, colour, texture, flavour, and overall acceptability—the date-sweetened product scored highest, followed by jaggery. Table sugar had moderate scores, and the sugar-free option scored lowest. The mean scores with standard deviations (Mean $\pm$ SD) indicate general satisfaction, with the highest variability seen in flavour and texture. The critical difference (CD at 0.5) values suggest the significance threshold for these sensory differences.

Table: 3 Mean Sensory Score of Ragi cake with different source of sweeteners on Nine Point Hedonic Rating Scale

Treatments/ Source of Sweetness	Wheat flour : Ragi flour (25:75)
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	Table sugar	Dates	Jaggery	Sugar free	Mean±SD	CD (0.05)
Appearance	7.25	8.75	9.0	6.75	7.94±0.96	0.35
Colour	7.25	8.0	9.0	6.75	7.75±0.85	0.31
Texture	7.5	7.5	8.75	6.0	7.42±1.12	0.21
Flavour	6.5	8.0	8.75	5.75	7.25±1.19	0.41
Overall Acceptability	7.88	8.0	9.0	6.0	7.72±1.08	0.53

Figure: 1 Mean Sensory Score of Ragi cake with different source of sweeteners on Nine Point Hedonic Rating Scale



4. Proximate Analysis of cake

4.1 Proximate Composition of Ragi Cake per 100g

The table examines the nutritional composition of various wheat and ragi flour blends (100:0, 50:50, 25:75, and 0:100). As the proportion of ragi flour increases, moisture content decreases, with the 0:100 ratio having the lowest moisture level. Protein content rises, reaching its peak in the 25:75 blend. Fat content is highest in the 100% wheat flour mix and declines as more ragi is added. Fiber content varies slightly, with the 50:50 blend showing the highest fibre. Ash content, indicating mineral presence, is highest in the 25:75 mixes. Carbohydrate content increases with more ragi, peaking at the 0:100 ratio. Energy levels are also highest in the 25:75

blends. Overall, increasing the ragi proportion enhances protein, carbohydrate, and ash content while reducing moisture and fat.

Sharma and Yamer (2022) developed value-added products using finger millet and evaluated their nutritional value. research highlights the potential of finger millet in improving the flavor, texture, appearance, and nutrition of existing food products, benefiting a wide range of consumers.

Table:4.1 Proximate Composition of Ragi Cake per 100g

Treatments	Wheat flour: Ragi Flour					
	100:00	50:50	25:75	00:100	Mean± SD	CD (0.05)
Moisture (g)	16.32	16.13	14.79	11.5	15.4±5.2	0.32
Protein (g)	6.21	6.78	7.81	7.45	6.2±0.6	0.31
Fat (g)	32.5	19.2	18.82	18.6	23.5±5.5	0.77
Fibre (g)	5.2	6.1	5.46	5.82	5.6±0.4	0.25
Ash (g)	1.76	1.45	2.55	1.52	1.3±0.2	0.07
Carbohydrate (g)	66.87	69.78	76.11	77.35	70.1±3.7	2.4
Energy (kcal)	425	393	434	413	417.3±17.7	2.25

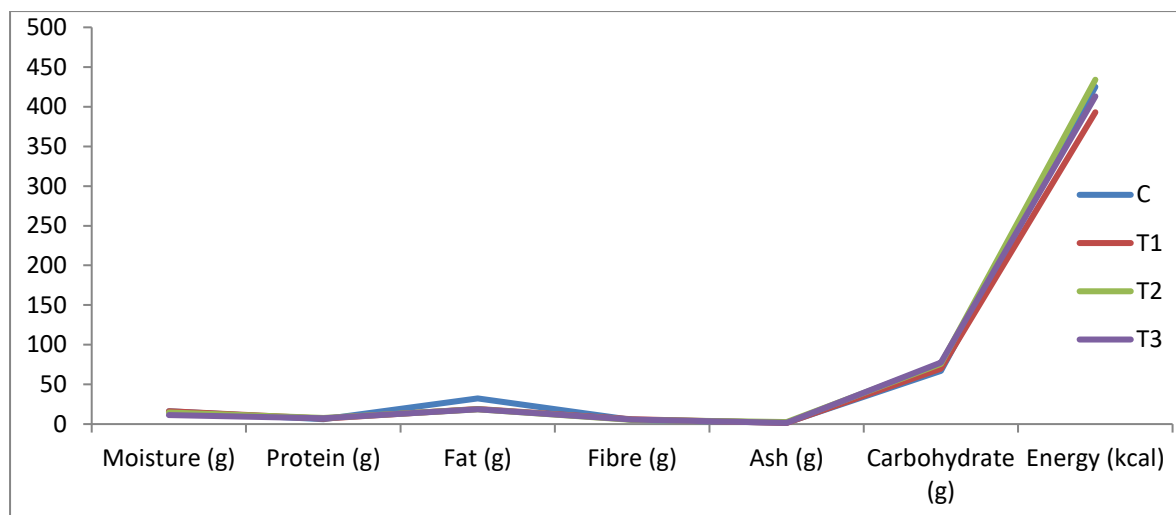


Figure:2 Proximate Composition of Ragi Cake per 100g

Table: 4.2 Proximate composition of *Ragi* cake with different source of sweeteners

The table compares the nutritional content of a product sweetened with different sources: table sugar, dates, jaggery, and a sugar-free alternative. Moisture content varied across the sweeteners, with dates having the highest (17.1 g) and the sugar-free option the lowest (11.5 g). Protein content was slightly higher in products sweetened with dates, jaggery, and the sugar-free option (ranging from 7.4 to 7.7 g) compared to table sugar (6.2 g). Fat content was relatively consistent across all sweeteners, with values ranging from 26.2 g to 28.6 g. Fiber content was highest in products with dates (7.1 g) and lowest with table sugar (5.2 g). The ash content, representing the mineral content, was highest in products with dates (2.5 g) and lowest in those sweetened with the sugar-free alternative (1.5 g).

Table:3 Proximate composition of *Ragi* cake with different source of sweeteners

Treatments	Sources of sweeteners				
	Table sugar	Dates	Jaggery	Sugar free	CD (0.05)
Moisture (g)	16.3	17.1	15.0	11.5	0.32
Protein (g)	6.2	7.5	7.7	7.4	0.31
Fat (g)	28.5	26.2	27.8	28.6	0.77
Fibre (g)	5.2	7.1	6.4	5.8	0.25
Ash (g)	1.7	2.5	2.0	1.5	0.07
Carbohydrate (g)	66.8	69.7	76.1	77.3	2.4
Energy (kcal)	425	393	434	413	22.25

Carbohydrate levels were highest in products sweetened with jaggery (76.1 g) and sugar-free alternatives (77.3 g), and lowest in those sweetened with table sugar (66.8 g). The energy content was highest in jaggery-sweetened products (434 kcal) and lowest in those sweetened with dates (393 kcal). The critical difference (CD) at the 0.05 significance level indicates that moisture, protein, fat, fiber, ash, carbohydrate, and energy vary significantly depending on the sweetener used. A ready-to-eat popped pearl millet bar was developed by **Singh, Singh, and Nain (2021)**.

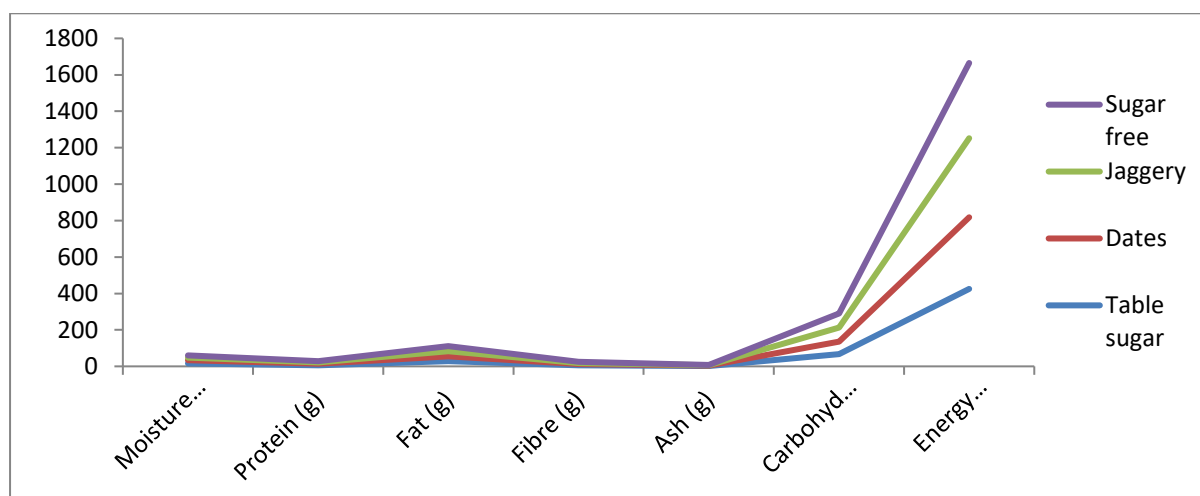


Figure:2 Proximate Composition of Ragi Cake with different source of sweeteners per 100g

Discussions

In an attempt to provide a healthy options to post-menopausal women substitution of refined wheat flour with whole wheat flour and ragi flour in cake preparation was found successful. Cake containing wheat flour : ragi flour (25:75) was found superior to control in term of sensory acceptability and nutritional quality like calcium, iron, fibre. No egg was used in the preparation of this cake therefore it is healthy option for vegetarian. Different sources of sweeteners was used so as to provide different option as per the choice of the consumer and cake containing jaggery as a source of sweetness scored highest in term of sensory acceptability therefore healthy vegetarian cakes containing wheat flour and ragi flour and jaggery can be recommended not only post-menopausal women but also for children and pregnant and lactating mother.

Reference:

Alsaleem, M. (2016). *The prevalence of symptoms experienced during menopause, influence of socio-demographic variables on symptoms and quality of life among women at Abha, Saudi Arabia*. 28.

AOAC (2000). Official methods of analysis. Washington DC, USA: Association of Official Analytical Chemists

Amruthavall, M. B., & Venkataramana, G. (2015). Impact of socio-economic factors on health problems of menopausal Muslim women, a study in Anantapuramu District, Andhra Pradesh. *Education*, 158(4.6), 42-7.

Aiello, E.J. Yasui, Y. and Tworoger, S.S. 2004. Effect of a yearlong, moderate-intensity exercise intervention on the occurrence and severity of menopause symptoms in postmenopausal women. *Menopause*.11:382.

Casper, R.F. and Yen, S.S. 1985. Neuroendocrinology of menopausal flushes: an hypothesis of flush mechanism. *Clinical endocrinology*.22:293–312

Digumarti, L. Agarwal, N. Vaze, N. Shah, R. Malik, S. 2013. Clinical practice guidelines on menopause: An executive summary and recommendations *J Midlife Health*. 4:77–106

Dennerstein, L., Hayes, R., Sand, M., & Lehert, P. (2009). Attitudes toward and frequency of partner interactions among women reporting decreased sexual desire. *The Journal of Sexual Medicine*, 6(6), 1668-1673.

Deva, P. P. I. (2021). A descriptive study to assess the level of knowledge regarding menopause among rural women of age group 45-55 years at Kot Bhalwal, Jammu. *International Journal of Advances in Nursing Management*, 9(3), 315-316.

Fouad, S. E. Shebini, S. Moaty, M. Ahmed, N.H. Hussein, A.S. Gendy, A. Essa, H.A., & Tapozada, S.T. 2018. Nutritional supplement prepared from whole meal wheat flour, soya bean flour, Flaxseed and Anise seeds for alleviating the menopausal symptoms. *J Biol Sci* 18(7). 381–388.

Poomalar, G. K., & Arounassalame, B. (2013). The quality of life during and after menopause among rural women. *Journal of clinical and diagnostic research: JCDR*, 7(1), 135.

Ray, S. and Dasgupta, A. 2012 An assessment of QOL and its determining factors of postmenopausal women in a rural area of west Bengal, India: A multivariate analysis *Int J Med Public Health*.;2:12–9.

Sustainability, Agri, Food and Environmental Research, (ISSN: 0719-3726), 12(X), 2024: <http://dx.doi.org/10.7770/safer-V12N1-art694>

Sipos, L. Nyitrai, Á. Hitka, G. Friedrich, L.F Kókai, Z. 2021. Sensory Panel Performance Evaluation—Comprehensive Review of Practical Approaches. *Appl. Sci*. 11. 11977

Sharma, D., & Yamer, P. (2022). Value addition of products from finger millet (*Eleusine coracana*). *Journal of Postharvest Technology*, 10(2), 120-138.

Singh, R., Singh, K., & Nain, M. S. (2021). Nutritional evaluation and storage stability of popped pearl millet bar. *Current Science (00113891)*, 120(8).

Tumbull, S. 2010. Yoga as a treatment for menopausal symptoms. *J Yoga Ontogenet and Therap Investig.*14–5.