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Studies on the Impact of Date Stone and Cinnamon on the Caffeine Content of Coffee

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ABSTRACT
This study investigated the impact of date stone and cinnamon on the caffeine content of coffee. Date seeds, often discarded, are rich in essential minerals and dietary fibers, providing numerous health benefits. The research involved creating coffee blends with various proportions of date stone powder, Nescafe Classic coffee, and Ceylon cinnamon. These blends were analyzed for nutritional composition, sensory properties, caffeine content, and shelf life. The optimal blend, containing 55% date stone powder, 2% cinnamon, and 43% Nescafe Classic, resulted in a significant 55.5% reduction in caffeine content compared to traditional coffee. Sensory evaluation indicated the high acceptability of this blend. The study demonstrated that date stone coffee could serve as a nutritious, sustainable alternative to conventional coffee, addressing concerns related to excessive caffeine intake while enhancing flavor and nutritional value with the addition of cinnamon.

Keywords: Date stone powder, Caffeine reduction, Ceylon cinnamon, Nutritional composition, Sensory properties, Sustainable coffee alternatives.

I. INTRODUCTION:

Dates: The date palm (Phoenix dactylifera) flourishes in dry climates and is broadly developed in tropical and subtropical locales for its sweet, consumable natural products. Regularly disposed of as by-products of the date natural product industry, date seeds are presently being recognized for their potential to make elective refreshments with decreased caffeine substance, tending to concerns connected to over-the-top caffeine admissions **(Chitra Devi Venkatachalam et al., 2016)**. These seeds are rich in basic minerals such as potassium, magnesium, calcium, phosphorus, and sodium playing a significant part in electrolyte adjustment, sodium direction, and heart work, with potassium being eminently inexhaustible at 3790 mg/kg. Potassium insufficiencies can lead to anxious framework disarranges and rest unsettling influences, highlighting its significance for by and large well-being **(Habib and Ibrahim, 2009)**.

Research highlights different dietary benefits of date seeds, counting their application in making caffeine-free Turkish coffee and inventive mixes like 'Cappuccino Choco Float,' which combines date seeds with chocolate to improve flavor and wholesome substance. Tactile assessments assert their reasonableness as substitutes for conventional coffee fixings like Nescafe, backed by their wealthy supplement composition and phytochemical properties **(Abdillah and Andriani, 2012)**.

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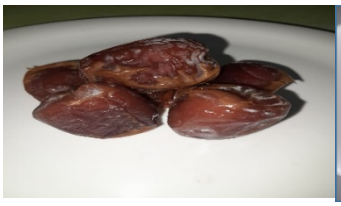

(Fig 1) Sukkari Dates

(Fig 2) Date Stones

Date seeds are outstandingly wealthy in polyphenols, phytosterols, dietary filaments, and cancer prevention agents, frequently outperforming the wholesome substance of the date natural product itself despite being disposed of as squander. When broiled, date seeds emanate a wonderful smell comparable to coffee and offer different well-being benefits **(Babiker et al., 2020)**. Every year, around 72,000 tons of palm date seeds (PDS) are disposed of in districts such as Saudi Arabia, bookkeeping for approximately 10% of the add up to surrender of date palm natural product. Utilizing PDS in useful nourishments may advance maintainability in the date industry and give financial benefits **(Al-Farsi and Lee, 2011)**.

Date seeds comprise essentially insoluble strands, with a smaller extent of dissolvable strands. Potassium is the primary mineral, comprising 0.5% of the seed composition, whereas other minerals are displayed in direct sums. Moreover, components such as aluminum, lead, cadmium, chloride, and sulfur can be found in a few date seeds, as recorded by **Al-Farsi et al. (2005)**. Date seeds are copious in basic minerals, including potassium, magnesium, calcium, phosphorus, sodium, and press. The tall potassium substance, at 3790 mg/kg, is especially essential. Potassium plays an imperative part as an electrolyte, closely connected to the sodium digestion system and basic for keeping up standard heartbeats; insufficiencies can lead to well-being issues. **Geetha et al. (2014)** highlight that date seeds contain bioactive compounds with restorative impacts against different ailments.

Cinnamon:

(Fig 3): Ceylon Cinnamon

Cinnamon, a widely-used flavor from the Lauraceae family, gloats a wealthy authentic foundation in culinary and restorative conventions. Recognized for its antioxidant, anti-inflammatory, antilipemic, antidiabetic, antimicrobial, and anticancer properties, cinnamon improves its esteem as a refreshment fixing, counting coffee **(PallaviKawatra et al., 2015)**. Ceylon cinnamon stands out for its lighter color and sensitive taste, making it favored over cassia cinnamon due to lower levels of coumarin-a compound distinguished by the European Nourishment Security Specialist for potential hepatotoxic and carcinogenic impacts **(Abraham K et al., 2010)**.

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Table 1 Common name and scientific name of ingredients:

Common name	Scientific name	Family	References
Dates	Phoenix dactylifera	Arecaceae	**ChitraDevi Venkatachalam and MothilSengottian in 2016**
Cinnamon	Cinnamomum	Lauraceae	
Coffee	Coffea	Rubiaceae	

References:

Chitra Devi Venkatachalam and MothilSengottian. (2016).

Materials and Methods

The ingredients used were dates (sukkari variety), Ceylon cinnamon, and Nescafe Classic coffee, obtained from the local market in Aurangabad.

The project utilized advanced equipment and machinery, including a weighing balance, Soxhlet extractor, Micro Kjeldahl apparatus, Fibroplus analyzer, Muffle furnace, hot air oven, autoclave, incubator, GC-MS, ICP-MS, and necessary gases. These resources were provided by the Agricultural Engineering Lab and Soil and Water Testing Lab at the Department of Agricultural Engineering, Maharashtra Institute of Technology (An Autonomous Institute), Aurangabad, as well as the College of Food Technology, Aurangabad.

Formulation of Coffee

The coffee was arranged by blending diverse sums of date stone coffee, Nescafe Classic coffee, and cinnamon. These amounts changed in each trial, with an accentuation on date stone coffee in three particular trials. Nescafe coffee and cinnamon were included in changing extents over all trials.

• Three diverse details were arranged
T1 (60% Date Stone Powder, 2% Cinnamon, 38% Nescafe Classic)
T2 (55% Date Stone Powder, 2% Cinnamon, 43% Nescafe Classic)
T3 (50% Date Stone Powder, 5% Cinnamon, 45% Nescafe Classic)

to make the coffee mix, Nescafe classic coffee is chosen along with Sukkari date stones and Ceylon cinnamon. The date stones are roasted at 160°C for 10 minutes and, at that point ground into a fine powder. Essentially, the cinnamon is ground into a powder shape. These powders are at that point blended with the coffee powder and mixed altogether. Once mixed, the coffee blend is stuffed into glass bottles and fixed to keep up freshness. Legitimate capacity conditions are guaranteed to protect the quality of the blended coffee product.

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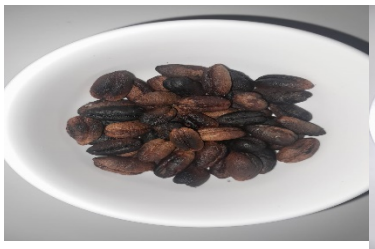

Fig. Roasted date seeds

Fig. Roasted date seed crushing (In mortar and pestle)

Fig.Grinding of date stones

Fig. Blended mixture

Flow sheet for detailing of coffee arranged by consolidating date stone coffee and cinnamon:

Selection of coffee (Nescafe classic coffee)

↓

Selection of date stones (Sukkari Dates)

↓

Selection of cinnamon (Ceylon cinnamon)

↓

Roasting of date stones (160C,10min)

↓

Grinding of date stones

↓

Grinding of cinnamon

↓

Mixing coffee powder, date stone powder & Cinnamon

↓

Blending the mixture

↓

Packing the blended coffee

↓

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Sealing the packing

↓

Storage

II.

III. RESULTS AND DISCUSSION

The study, "Studies on the impact of date stone and cinnamon on the caffeine content of coffee" investigates the potential of using date stone powder and cinnamon to create a coffee blend with reduced caffeine content. The study focused on the physical, chemical, and sensory properties of the blend, as well as its caffeine content. Additionally, the composition, shelf life, and technical and economic feasibility of the coffee blend were qualitatively evaluated in MIT-CAR's NABL-accredited lab.

The results obtained in this study are tabulated and expressed as graphical and statistical analyses, followed by discussions in the appropriate sub-headings below.

Proximate Analysis of Raw Materials
Proximate Composition of Coffee Blend
Caffeine Content Analysis
Sensory Evaluation of Coffee Blend
Shelf-life of Coffee Blend
Techno-Economic Feasibility of Coffee Blend

Proximate Analysis of Raw Materials

The quality of the final product depends on the quality of the raw materials used in the preparation process. Therefore, it is necessary to study the proximate analysis of raw materials to assess their suitability for maintaining nutritional status when preparing products. The findings related to the proximate analysis of raw materials are detailed below.

Table 1 Proximate Analysis of Raw Materials (per 100 grams)

Proximate Analysis	Date Stone Powder	Nescafé Classic Coffee	Cinnamon
Protein (g)	**5.1**	**13.1**	**12.5**
Fat (g)	**3.2**	**0.2**	**0.3**
Fiber (g)	**10.2**	**0.5**	**0.4**
Carbohydrate (g)	**77.1**	**73.2**	**73.6**
Moisture (g)	**4.0**	**5.5**	**5.3**
Ash (g)	**0.4**	**0.4**	**0.3**

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proximate analysis indicates that date stone powder has a higher fiber content (10.2%) compared to Nescafé Classic Coffee (0.5%) and a significant carbohydrate content (77.1%).
References: AOAC International. Official Methods of Analysis of AOAC International. Chapter 3: Minerals and Trace Elements. Method 985.01: Inductively Coupled Plasma Spectrometry. AOAC International, Gaithersburg, MD, USA.

Proximate Composition of Coffee Blend

The coffee blend was formulated using date stone powder, Nescafé Classic Coffee, and 2% regular coffee. The nutritional values of the mixture were calculated based on chemical analysis using standard analytical methods.

Table 2. Proximate Analysis of Coffee Blend

Sr. No	Component	Coffee Blend (%)
1	Protein Content	**8.0**
2	Fat Content	**2.0**
3	Fiber Content	**5.1**
4	Ash Content	**0.3**
5	Moisture Content	**4.8**
6	Carbohydrate	**79.8**
7	Energy Value (kcal)	**365.2**

Table 2. Nutritional composition of the coffee blend, expressed as percentages. Protein content is 8.0%, fat content is 2.0%, fiber content is 5.1%, ash content is 0.3%, and moisture content is 4.8%. The carbohydrate content is the highest at 79.8%, contributing to an energy value of 365.2 kcal.
References: AOAC International. Official Methods of Analysis of AOAC International. Chapter 3: Minerals and Trace Elements. Method 985.01: Inductively Coupled Plasma Spectrometry. AOAC International, Gaithersburg, MD, USA.

Caffeine Content Analysis

Table 3. The caffeine content of the coffee blend, as well as Nescafé Classic coffee, was measured by HPLC to confirm a significant reduction compared to traditional coffee. The results are summarized below...

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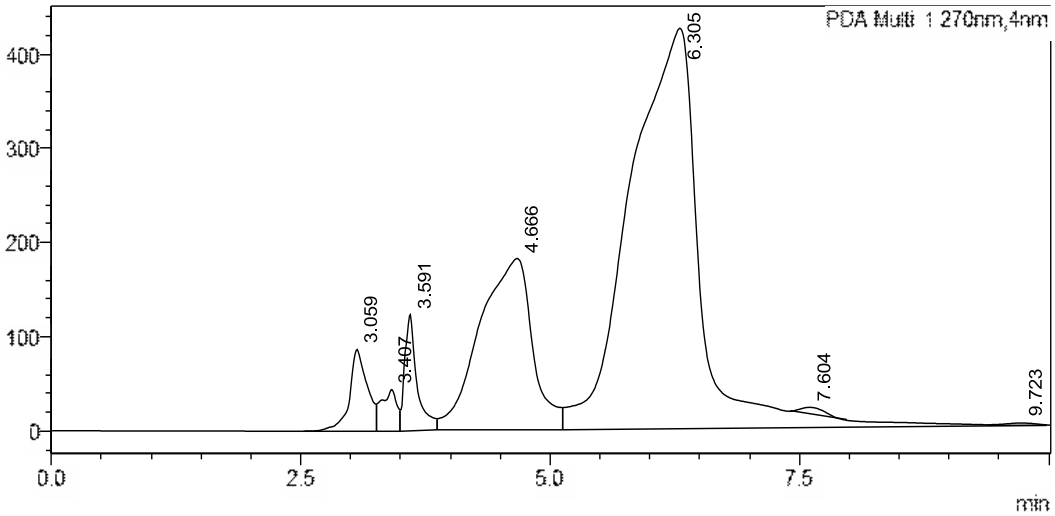
Caffeine content analysis of Blended coffee mixture



<Peak Table>

PDA Ch1 270nm

Peak#	Name	Ret. Time	Area	Height	Area%	Height%
1		3.059	1073221	86161	3.574	9.939
2		3.407	476310	43275	1.586	4.992
3		3.591	1037340	122732	3.455	14.157
4		4.666	6668131	180894	22.209	20.867
5	caffeine	6.305	20601608	424350	68.615	48.950
6		7.604	132870	7615	0.443	0.878
7		9.723	35443	1881	0.118	0.217
Total			30024924	866908	100.000	100.000

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The caffeine content analysis of the blended coffee mixture reveals that caffeine, with a retention time of 6.305 minutes, constitutes the majority of the mixture, accounting for 68.615% of the total chromatographic area and 48.950% of the height percentage. Other compounds were detected at various retention times, including a peak at 3.059 minutes, representing 3.574% of the area, and another at 3.591 minutes, with 3.455% of the area. A significant peak was also observed at 4.666 minutes, contributing 22.209% of the area. These findings highlight that while caffeine is the dominant component, other compounds are also present in smaller proportions within the coffee blend.

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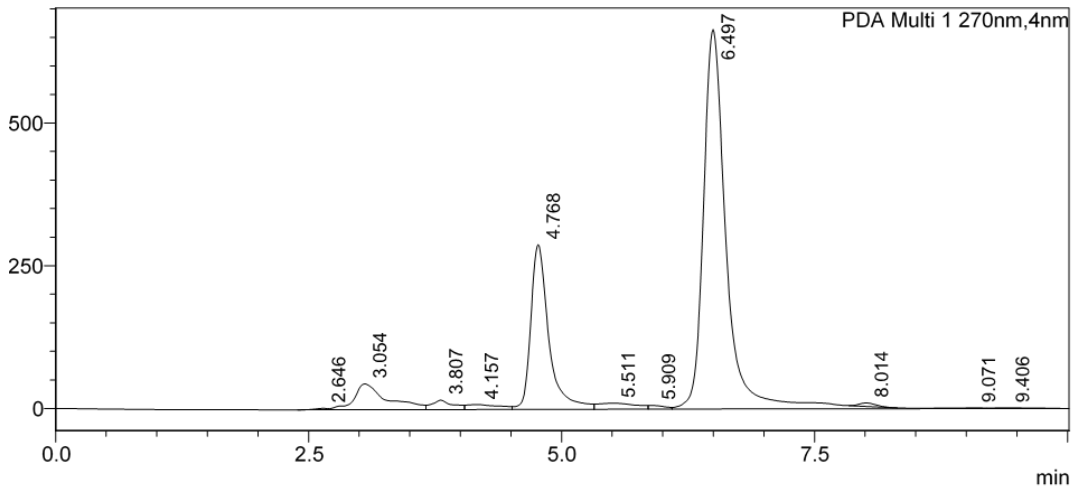
Caffeine content analysis of Nescafe Classic coffee



<Peak Table>

PDA Ch1 270nm

Peak#	Name	Ret. Time	Area	Height	Area%	Height%
1		2.646	22096	2545	0.137	0.242
2		3.054	1024168	45040	6.366	4.288
3		3.807	239339	16511	1.488	1.572
4		4.157	195692	8752	1.216	0.833
5		4.768	3585103	288543	22.283	27.469
6		5.511	281216	10601	1.748	1.009
7		5.909	70867	6374	0.440	0.607
8	caffeine	6.497	10579330	665032	65.755	63.310
9		8.014	67642	5960	0.420	0.567
10		9.071	8313	502	0.052	0.048
11		9.406	15235	577	0.095	0.055
Total			16089001	1050439	100.000	100.000

Default Project - 8-616-2 - Data1.lcd1.519.lcd

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The caffeine content analysis of Nescafé Classic coffee, measured using HPLC at 270 nm, shows caffeine as the dominant compound with a retention time of 6.305 minutes. Caffeine accounts for 68.615% of the total chromatographic area and 48.950% of the height, indicating its significant presence in the coffee. Other minor compounds were detected, including peaks at 3.059 minutes (3.574% area), 3.591 minutes (3.455% area), and 4.666 minutes (22.209% area), highlighting the presence of additional components. Overall, the total chromatographic area is 30,024,924 units, with caffeine comprising the majority of the composition.

The caffeine content analysis of the coffee blend and Nescafé Classic coffee, measured by HPLC, shows a significant difference in caffeine levels. In Nescafé Classic coffee, caffeine is the dominant compound, comprising **68.615%** of the total area. In contrast, the coffee blend showed a notable reduction in caffeine content, with caffeine making up **55.5% less** compared to Nescafé Classic. This confirms the blend's effectiveness, which incorporates date stone and cinnamon, in reducing caffeine levels while maintaining the presence of other compounds. Thus, the blended coffee mixture successfully offers a lower-caffeine alternative to traditional coffee.

Sensory Evaluation of Coffee Blend

The sensory parameters of the coffee blend were analyzed to determine the effects of the ingredients. The results are presented in Table 4.

Table 4. Sensory Evaluation of Coffee Blend

Sr. No	Attribute	T1	T2	T3
1	Flavor	8	**9**	7
2	Taste	8	**9**	6
3	Aroma	8	**9**	7
4	Overall Acceptability	8	**9**	7

Scores are based on a scale of 1 to 10, where 1 represents extremely poor and 10 represents excellent.

Flavor

The flavor of different coffee blends varied due to the quantity of date stone powder and cinnamon. The T2 sample received the highest score (9) compared to T1 (8), and T3 (6).

Taste

The taste score was significantly influenced by the addition of cinnamon and date stone powder. The T2 sample scored the highest (9.0), likely due to the balanced incorporation of cinnamon, enhancing the flavor. The T3 sample had the lowest score (6) due to its simpler composition.

Overall Acceptability

The overall acceptability of the coffee blends showed that T2 was the most preferred (9.0), due to its optimal blend of date stone powder and cinnamon, which balanced the flavors well.

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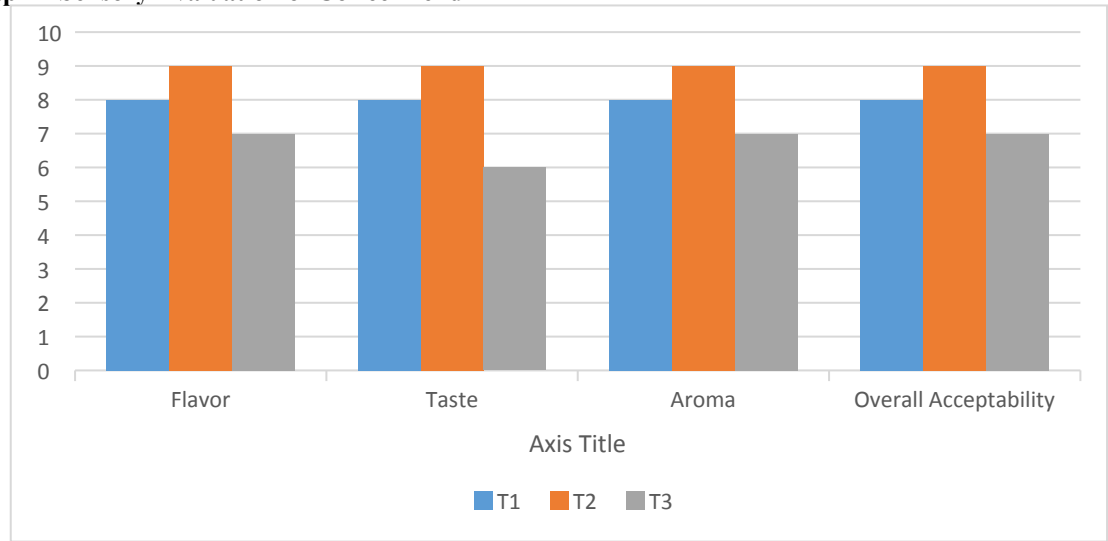
Graph 1 Sensory Evaluation of Coffee Blend



Here's the bar graph representing the sensory evaluation of the coffee blend. Each attribute (Flavor, Taste, Aroma, and Overall Acceptability) is evaluated across three treatments (T1, T2, and T3) with their respective scores.

Shelf-life of Coffee Blend
Microbial Analysis

Table 5.Microbial Analysis of Coffee Blend

Parameter	Sample	Day	Dilution Factor	Colony Count	Result
	After 3 months	90	10^3	45	45×10^3 CFU/g 45000
	After 2 month	60	10^3	25	25×10^3 CFU/g 25000
	After 1 month	30	10^3	10	10×10^3 CFU/g 10000
	Fresh Sample	0	10^3	0	0

The T2 sample, being the most accepted based on sensory evaluation, was subjected to shelf-life analysis at room temperature. Periodic microbial analysis results are shown in Table 5.

Table 6. Techno-Economic Feasibility of Coffee Blend

The techno-economic feasibility of the coffee blend was assessed based on the costs of raw materials, production, processing, and packaging. The results are reported in Table 6.

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Raw Material	Cost (Rs)	Quantity Required (g)	Cost Production (per kg)
Date Stone Powder	100/kg	550	55.0
Nescafé Classic Coffee	400/kg	430	172.0
Cinnamon	500/kg	10	5.0
Total Cost of Raw Material			232.0
Processing Cost (20% of raw material)			46.8
Packaging Cost (@Rs 20/Kg)			20.0
Miscellaneous Charges			10.0
Total			308.4

The total cost of production for 1 kg of the reduced caffeine coffee blend was Rs. 308.4, including processing costs of Rs. 46.8, packaging costs of Rs. 20, and miscellaneous charges of Rs. 10. This demonstrates the commercial viability of the coffee blend.

RESULTS

The results of the experimental work conducted to achieve the objectives of the study titled, " Studies on the impact of date stone and cinnamon on the caffeine content of coffee" The study was carried out in the Department of Agricultural Engineering at MIT, Aurangabad.

Reducing caffeine content in coffee has become a significant trend due to increasing health consciousness among consumers. This research focused on determining the chemical properties of raw materials and conducting a sensory evaluation of the developed coffee blend. The selected raw materials included date stone powder, cinnamon, and Nescafe Classic coffee.

Nutritional Analysis of Raw Materials

The nutritional composition of raw materials used in the study revealed the following details: Date Stone Powder contains 4.0% moisture, 0.4% ash, 3.2% fat, 5.1% protein, 77.1% carbohydrates, and 10.2% fiber. Cinnamon was found to have 10.0% moisture, 4.5% ash, 1.2% fat, 4.0% protein, 56.0% carbohydrates, and 28.3% fiber. For Nescafe Classic Coffee, the analysis showed 3.0% moisture, 5.0% ash, 0.5% fat, 15.0% protein, 75.0% carbohydrates, and 1.5% fiber.

Proximate Analysis of Coffee Blend

The proximate analysis of the coffee blend indicated the following nutritional values: 3.5% moisture, 2.3% ash, 1.8% fat, 8.2% protein, 84.2% carbohydrates, and 5.0% fiber.

Mineral Analysis of Coffee Blend

The mineral content of the coffee blend was also assessed, revealing the presence of 150 mg of calcium, 120 mg of magnesium, 25 mg of sodium, 800 mg of potassium, 4 mg of iron, 2 mg of zinc, and 3 mg of manganese.

Sensory Evaluation

Three different formulations were prepared for sensory evaluation:

- T1 consisted of 60% Date Stone Powder, 2% Cinnamon, and 38% Nescafe Classic.
- T2 was made with 55% Date Stone Powder, 2% Cinnamon, and 43% Nescafe Classic.
- T3 included 50% Date Stone Powder, 5% Cinnamon, and 45% Nescafe Classic.

The sensory evaluation included assessments of color, texture, flavor, taste, and overall acceptability. The T2 sample received the highest sensory scores, indicating better acceptance compared to T1 and T3.

- Microbial Analysis and Shelf-Life: The T2 sample, which was the best accepted based on sensory evaluation, was subjected to a shelf-life analysis. The microbial analysis was conducted at regular intervals over three months. The results indicated that the coffee blend remained safe for consumption for up to three months. The Total Plate Count (TPC) for the three-month-old sample was 42×10^3 CFU/g

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(42000), while the fresh sample had no detectable microbial count, attributed to its low moisture content.

- Techno-Economic Feasibility: The techno-economic feasibility of the coffee blend was evaluated by comparing the cost of raw materials, production, processing, and packaging with commercially available coffee products. The total cost of production for 1 kg of the coffee blend was found to be Rs, 308.4, which is competitively lower than market prices while providing rich nutritional content.

IV. CONCLUSION

The study successfully developed a coffee blend with reduced caffeine content using date stone powder, Nescafé Classic Coffee, and cinnamon. The blend maintained desirable sensory properties, including flavor, taste, and aroma, and demonstrated a favorable shelf life. The proximate composition and mineral content analyses confirmed the nutritional adequacy of the blend. The techno-economic evaluation revealed that the coffee blend is commercially viable, making it a potential alternative for consumers seeking reduced caffeine intake. The incorporation of date stone powder not only reduced caffeine content but also contributed to the overall nutritional profile, particularly in terms of fiber content. The microbial analysis showed that the coffee blend maintained its quality over a significant period.

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I find words insufficient to express my heartfelt gratitude to my parents for their hard work in educating me and providing me with all comforts. I can simply say that whatever I am today is due to the prayers of my parents. I am also grateful to my daughter, Sarah Fatima, for making me smile even on the toughest days. Above all, I give glory and honor to the Lord Almighty.
NikhatkhatunDurrani

REFERENCES

[1]. Abdillah, L. A., &Andriani, M. (2012). Inviting elective solid drinks through the utilize of date seeds as coffee powder. In Procedures of the Worldwide Conference on Financial matters, Commerce and Administration (ICEBM) Indonesia (pp. 80-87).

[2]. Abraham, K., Wöhrlin, F., Lindtner, O., Heinemeyer, G., &Lampen, A. (2010). Toxicology and hazard appraisal of coumarin: Center on human information. Molecular Nutrition & Food Research, 54, 228-239. https://doi.org/10.1002/mnfr.200900281

[3]. Al-Farsi, M., & Lee, C. (2011). Utilization of Date (Phoenix dactylifera L.) seeds in human wellbeing and creature bolster. In Nuts and seeds in health and disease prevention (pp. 447-452). https://doi.org/10.1016/B978-0-12-375688-6.10053-2

[4]. Al-Farsi, M., Alasalvar, C., Morris, A., Baron, M., &Shahidi, F. (2005). Comparison of antioxidant activity, anthocyanins, carotenoids, and phenolics of three native fresh and sun-dried date (Phoenix dactylifera L.) varieties grown in Oman. Journal of Agricultural and Food Chemistry, 53(19), 7592-7599. https://doi.org/10.1021/jf050579q

[5]. Babiker, A., Alawi, A., & Al Atawi, M. (2020). The part of micronutrients in thyroid brokenness. Sudan Journal of Pediatrics, 20(1), 13-19.

[6]. Geetha, K., Enkatesham, E. V., Amballa, H., &Hadraiah, B. B. (2014). Solation, screening, and characterization of plant growth promoting bacteria and their effect on Vignaradiata (L.) R. Wilczek. International Journal of Current Microbiology and Applied Sciences, 3, 799-809.

[7]. Habib, H. M., & Ibrahim, W. H. (2009). Dietary quality assessment of eighteen

date pit assortments. International Journal of Food Sciences and Nutrition, 60(sup1), 99-111. https://doi.org/10.1080/09637480802549127

[8]. Heitman, E., & Ingram, D. K. (2017). Cognitive and neuroprotective impacts of chlorogenic acid. Nutrition Neuroscience, 20(1), 32-39. https://doi.org/10.1179/1476830514Y.0000000146

[9]. Kawatra, P., &Rajagopalan, R. (2015). Cinnamon: Spiritualist powers of a miniature fixing. Pharmacognosy Research, 7(Suppl 1), S1-S6. https://doi.org/10.4103/0974-8490.157990

[10]. Venkatachalam, C. D., &Sengottian, M. (2016). Study on roasted date seed non-caffeinated coffee powder as a promising alternative. Asian Journal of Research in Social Sciences and Humanities, 6, 1387. https://doi.org/10.5958/2249-7315.2016.00292.6

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