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DEVELOPMENT AND OPTIMIZATION OF FINGER MILLET COOKIE ENRICHED WITH BALLOON VINE; NUTRIENT RICH AND SUSTAINABLE APPROACH

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Abstract:

This study focused on the development and optimization of finger millet cookies enriched with balloon vine nutrients, employing sustainable practices. Balloon vine (Cardiospermum halicacabum) was recognized for its richness in essential nutrients such as vitamins, minerals, and antioxidants, making it a valuable addition to food products. Finger millet, renowned for its nutritional richness and environmental sustainability, served as an ideal base for these cookies. The Indian population, with 31% being children and adolescents aged 2 to 16 years, faced challenges with low calcium content and the potential for low bioavailability of calcium due to dietary patterns. Consequently, Consequently, there had been a need to study those patterns and develop strategies to enhance calcium content and bioavailability in plant-based diets.. Finger millet, with its high concentrations of carbohydrates, dietary fiber, phytochemicals, essential amino acids, and essential minerals, offered various health benefits such as aiding in natural weight loss, strengthening bones, preventing diabetes and aging, maintaining blood pressure levels, protecting against disease, and improving hemoglobin status in children. Peak bone mass (PBM) was crucial for bone strength and resilience against fractures later in life. Factors influencing PBM included race, gender, genetics, and environmental factors like physical activity, calcium and protein intakes, and weight. Optimizing calcium and protein intake along with weight-bearing physical activity during growth was vital for acquiring optimal PBM and bone strength to prevent fractures in later life. Adequate calcium intake during childhood was pivotal for skeletal formation and determined its weight and density peak. Optimal calcium intake in childhood reduced the risk of density loss and osteoporosis in adulthood. However, studies showed that young girls consumed significantly less total dietary calcium, potentially affecting their long-term bone health. Furthermore, a 10% increase in peak bone mass could reduce the risk of osteoporosis in late life by 50% and delay its onset by 13 years. In conclusion, standardization and assessing the physiochemical properties of finger millet cookies incorporated with balloon vine might have helped in promoting peak bone mass and preventing juvenile idiopathic arthritis for school-going children.

Keyword*: Finger millet, balloon vine, peak bone mass, juvenile idiopathic arthritis, cookies, school going children.*

1. Introduction:

At birth, skeletal mass ranged from 70 to 95 grams, progressively increasing to 2400–3300 grams in young adults. Throughout the initial two decades of life, bones underwent growth in both length and width, with bone mass accruing steadily during childhood and accelerating notably during adolescence, marking the attainment of peak bone mass (PBM). The timing of PBM attainment varied across skeletal sites and between genders. Generally, in the axial skeleton, PBM was achieved by the end of the second decade, with girls reaching it earlier than boys, correlating with pubertal progression. Conversely, the range for reaching PBM in the appendicular skeleton spanned from 17 to 35 years in cross-sectional studies. Hereditary factors likely contributed to 75% of the variance in PBM, with environmental factors accounting for the remaining 25%. Subsequent bone loss occurred with aging, albeit at a variable rate influenced by illness and other factors. Establishing strategies to optimize PBM may have represented the most effective preventive approach against osteoporosis (McDevitt et.al, 2010).

Throughout typical childhood and adolescence, the skeleton experienced significant transformations via modeling and remodeling processes, ultimately attaining its adult form and reaching peak bone mass (Michael A. Levine, 2012).

Throughout childhood and adolescence, the attainment of a robust peak bone mass was crucial for optimal bone health, serving as a significant determinant of future fracture risk in adulthood. Various physiological and lifestyle elements, including genetic factors, hormonal balance, calcium and vitamin D intake, physical activity, and nutrition, were demonstrated to impact the bone health of youngsters. Notably, hand grip strength had been linked to bone density and mineral content in children and adolescents (Alghadir et.al, 2023).

Calcium plays two major roles in bone health. The first is structural, as it constitutes the largest portion of mineral content. Increasing mass represents one parameter of enhancing bone strength. Despite low calcium intakes, pubertal girls only partially adapt and experience negative calcium balance.

The second function is to reduce bone resorption. With every additional milligram of calcium absorbed in adolescents, bone resorption decreases by a similar amount, resulting in a more positive bone balance. Increased dietary calcium leading to reduced bone turnover has been proposed to decrease skeletal fragility through a separate mechanism from changes in bone mass. The benefits to bone manifest long before distinctions in bone mineral density measures can be observed (Stephanie A. Atkinson et.al, 2008).

Peak bone mass (PBM) was a key determinant of bone mass and fragility fractures later in life. The increase in bone mass during childhood and adolescence was mainly related to an increase in bone size rather than changes in volumetric bone density. Race, gender, and genetic factors were the main determinants of PBM achievement. Therefore ensuring optimal calcium and protein intake, combined with weight-bearing physical activities during growth, had been recognized as essential for attaining ideal PBM and bone strength. However, environmental factors like physical activity, calcium and protein intake, weight, and age at menarche, had also been influential in bone mass accrual during growth. This comprehensive approach aimed to mitigate the risk of fractures later in life (Thierry Chevalley MD et.al, 2022).

The "King of Human Miseries" refers to inflammatory diseases, including various types of rheumatic diseases, which constitute a significant cause of morbidity among the working force worldwide (Manju Shree S, 2019).

The only form without an adult equivalent, affects up to 4 joints at presentation, typically large ones, particularly those of the lower limbs, with the knee being the most frequently involved joint. Less than one third of cases exhibit symmetric joint involvement. The general clinical classification of JIA is determined by the number of involved joints and the presence of systemic symptoms and signs.Chronic juvenile arthritis was the most common childhood rheumatic disease, with an incidence ranging between 7 and 21/100,000 in population-based studies from the US and Northern European countries. Prevalence rates between 121 and 220/100,000 were reported in population-based studies,A meta-analysis encompassing both practitioner- and clinic-based studies yielded an overall figure of 132 per 100,000 (95% CI 119, 145) (Andrea T. Borchers et.al, 2006).

Finger millet (Eleusine coracana) stood out among the small millets globally due to its significant nutraceutical value. Its adaptability to various soil types and climates made it a preferred choice for many millet farmers. Finger millet thrived in hot climates with limited rainfall as well as in cooler climates with warmer millets. Often dubbed as the "crop of the poor" in several countries, it held a vital place in agricultural landscapes (Dhanushkodi Vellaiyan et.al, 2023).

Finger millet presented itself as an ideal candidate for calcium biofortification, possessing both quantitative and qualitative attributes. It stood out as the most abundant source of calcium among all cereals, boasting three times more calcium than milk and ten times higher calcium content compared to brown rice, wheat, or maize. Beyond its calcium content, finger millet was also a rich source of iron, essential amino acids like methionine, slowly digestible starch, and beneficial phytochemicals such as polyphenols. Furthermore, it served as a gluten-free, low-fat cereal that was non-allergenic and easily digestible (Swati Puranik et.al, 2017).

Balloon vine, utilized in Ayurveda and folk medicine, served various medicinal purposes including treating cough, hyperthermia, rheumatism, lumbago, nervous illnesses, and amenorrhea. Its therapeutic applications extended to the treatment of rheumatism, lumbago, earache, and fever. The plant exhibited a range of activities such as antioxidant, antifungal, antiphrastic, antidiarrheal, anxiolytic, rubefacient, antipyretic, and management of painful, arthritic inflammatory conditions (Amit S. Sharma et.al, 2018).

Juvenile idiopathic arthritis, the most prevalent chronic rheumatic disease of unknown etiology in childhood, was highlighted (Kenan BARUT et.al, 2017).

2. MATERIALS AND METHODS

2.1 MATERIALS

2.1.1 Raw materials:

Raw materials such as finger millet, balloon vine, dark chocolate chips, brown sugar, milk, butter, wheat flour, and cashew nuts were purchased from the local market of Chennai.

2.2 Methodology:

In a large mixing bowl, the softened butter and brown sugar were combined. They were creamed together until the mixture became light and fluffy. The finger millet flour, wheat flour, balloon vine powder, and chopped cashew nuts were added to the creamed mixture. All the ingredients were mixed well until fully incorporated. The milk was gradually poured in while continuing to mix until a soft dough formed. If the dough seemed too dry, a little more milk was added, 1 teaspoon at a time, until the desired consistency was reached. Once the dough was well mixed and smooth, the dark chocolate chips were gently folded in until evenly distributed throughout the dough. The oven was preheated to 350°F (175°C), and a baking sheet was lined with parchment paper. Small portions of the dough were taken and rolled into balls, then placed onto the prepared baking sheet, leaving some space between each one. A fork was used to gently flatten each dough ball. The cookies were baked in the preheated oven for 12-15 minutes, or until they were lightly golden brown around the edges. After baking, the cookies were taken out of the oven and left to cool on the baking sheet for a few minutes. Then, they were moved to a wire rack to cool completely.

Table: 1 Formulation of cookies

Ingredients	Sample weight
Finger millet	150g
Balloon vine	5g
Butter	75g
Brown sugar	75g
Wheat flour	25g
Milk	15ml
Dark chocolate chips	50g
Cashew nuts	10g

Figure: 1 Finger millet incorporated with balloon vine cookies

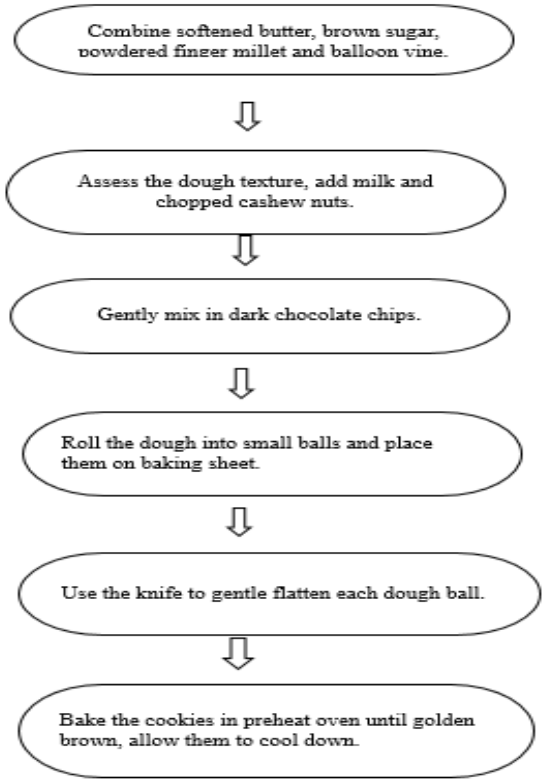

Figure: 2 Process flow sheet for preparation of cookies

2.2.1 SENSORY ANALYSIS:

The sensory analysis of cookie samples was conducted with fifty untrained participants, using a 9-point hedonic scale. The method evaluated overall liking based on taste, texture, aroma, and appearance. Valuable insights into consumer preferences and perceptions were gleaned from the scores provided.

2.2.2 STATISTICAL ANALYSIS:

The sensory analysis data collected from the evaluation of cookie samples, utilizing a 9-point hedonic scale with fifty untrained participants, underwent thorough statistical analysis. Disruptive statistics were applied, with a specific focus on calculating the mean and standard deviation. This statistical approach enabled a detailed examination of the sensory attributes, providing valuable insights into the central tendency and variability of the participants' responses.

3. RESULT AND DISCUSSION:

3.1Physical characteristics of cookies:

The weight of the cookies is 10g and color of the cookies is slightly brown.

3.2 Organoleptic characteristics of cookies:

Organoleptic characteristics data for the developed cookie, denoted as Sample, are illustrated in Table 2, focusing on the average sensory scores. The organoleptic characteristics evaluated include appearance, flavor/taste, aroma, texture, mouthfeel, and overall acceptability. Sample received scores of 8.66 for appearance, 8.52 for flavor/taste, 8.48 for aroma, 8.42 for texture, 8.46 for mouthfeel, and 8.68 for overall acceptance.

Table: 2 Organoleptic characteristics of cookies

APPEARANCE	FLAVOUR /TASTE	AROMA	TEXTURE	MOUTHFEEL	OVERALL ACCEPTABILITY
8.66±0.51	8.52±0.61	8.48±0.64	8.42±0.67	8.46±0.83	8.68±0.55

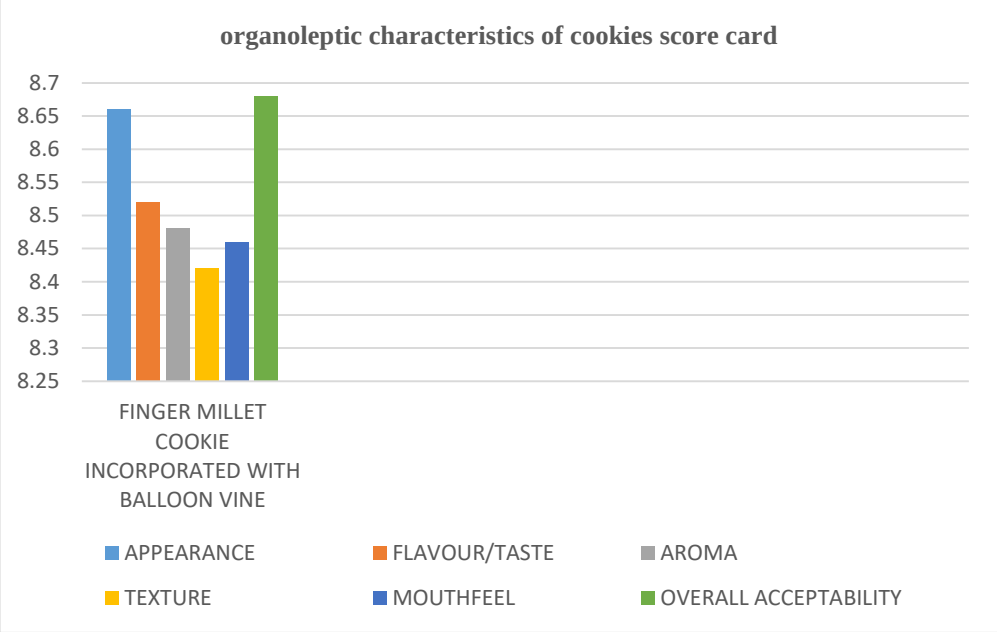

Figure: 3 score card of organoleptic characteristics

CONCLUSION:

I developed finger millet cookies incorporated with balloon vine to address that dual concerns of juvenile idiopathic arthritis and suboptimal peak bone mass for school going children, through sensory analysis, the product achieved an impressive overall acceptability score of 8.68, indicating its potential to satisfy the taste preferences of this demographic. By harnessing the nutritional benefits of finger millet and balloon vine, these cookies offer a delicious and healthful snack option. I am hopeful that, this initiative positively impact the lives of children by providing them with a delicious and nutritious snack option that supports their bone health and overall well-being.

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