



EFFECT OF SUPPLEMENTATION OF FUNCTIONAL FOOD BASED COOKIES ON NUTRITIONAL STATUS AND COGNITIVE FUNCTIONS IN SCHOOL CHILDREN.

K.V.N. Swetha

Department of Food, Nutrition and Dietetics, College of Science & Technology, Andhra University, Visakhapatnam

M. Rajeswari

Department of Food, Nutrition and Dietetics, College of Science & Technology, Andhra University, Visakhapatnam - Corresponding Author

B. V. Sandeep

Department of Food, Nutrition and Dietetics, College of Science & Technology, Andhra University, Visakhapatnam

ABSTRACT

The Present investigation aimed to evaluate the impact of functional food based cookies on nutritional status and cognitive functions of school children. Functional food based cookie was formulated using buck wheat, flaxseeds, almonds, fresh turmeric, *Astercantha longifolia* leaves and *Bacopa monneira* extract, standardised and organoleptically tested for acceptance. The developed cookie was analysed for its nutrient content and then supplemented to 30 school children in the age group of 9-10 years for 12 weeks. The nutritional status and cognitive functions were tested before and after supplementation. The results of the study indicated that the cookie was rich in nutrients and found to improve the nutritional status and cognitive functions as evident from the increase in weight, Total RBC, Hemoglobin, Haematocrit and scores of Standard Progressive Matrices and Star counting test. The functional food cookie can be used as healthy snack for children for improving nutritional status and cognitive functions.

KEYWORDS : Functional food, Cognitive functions, Nutritional status , Supplementation

Introduction

Cognition is the mental process by which knowledge is acquired which include perception, reasoning, acts of creativity and problem solving. Cognitive abilities are the basis for the learning process and hence, their development is essential from very young age. Medicinal plants and foods contain complicated mixtures of organic chemicals, which may include fatty acids, sterols, alkaloids, flavonoids, glycosides, saponins, tannins, terpenes and essential nutrients. Several dietary components have been identified as having effects on cognitive abilities. Dietary factors can affect multiple brain processes by regulating neurotransmitter pathways, synaptic transmission, membrane fluidity and signal-transduction pathways. From many studies it is evident that particular nutrients influence cognition by acting on molecular systems or cellular processes that are vital for maintaining cognitive function (Phanikumar and Farhath, 2012). This raises the exciting possibility that dietary manipulations are a viable strategy for enhancing cognitive abilities and enhancement of nutritional status. Though, there are studies focusing on cognitive properties of individual foods, there is dearth of information on cumulative and synergistic effects of combination of functional foods which are also potential sources of nutrients with cognitive properties.

The present investigation is an innovative and unique experimentation to evaluate the synergistic effects of six functional foods with proven cognition enhancing properties namely Buck Wheat, Flaxseeds, Almonds, Turmeric, *Astercantha longifolia* leaves and *Bacopamonneira* extract fortified in to a single product of cookies. All the functional foods are also good sources of cognition enhancing nutrients such as Amino acids, Iron, Zinc, Vitamin A, Vitamin C, and Omega3 Fatty acids (Singh and Dhawan ,1997). Hence a study was undertaken to evaluate the effect of functional foods based cookie on cognitive enhancing ability and improving the nutritional status of school children.

Materials and Methods

Cookies were developed using six functional foods and a total of six trials were conducted with variations in the amounts of the ingredients. The best one evaluated for sensory characteristics using a 5 point Hedonic scale, amongst them was selected for supplementation. The proximate composition, minerals, vitamins, trace minerals and total phenols were estimated using standard methods (Raghuramulu et al. 2003). A total of 30 students were selected in the age group of 9 to 10 years. Extremely malnourished children were excluded from the study. In order to evaluate the effect of supplementation weight and complete blood count (CBC)

of children were measured before and after supplementation. For assessing the cognitive functions SPM (Standard progressive matrices) and Star Counting Test was used. The Standard Progressive Matrices (SPM) is a group or individually administered test that nonverbally assesses intelligence and general mental ability in children and adults through abstract reasoning tasks. Star counting test (To test the working memory, attention and intelligence of an individual) is directly aimed at measuring a person's ability to activate and inhibit processes in working memory (De Jong PF and Das-Smaal EA,1995). An increase in the raw scores of these tests after supplementation was considered as an improvement in the cognitive functions.

Results and Discussion

It was observed that the functional food based cookie was rich in all essential nutrients and its supplementation has shown significant improvement in the haemoglobin status and cognitive abilities. Table 1. Shows that the cookie is a rich source of minerals and vitamins.

Table 1: Nutritive value of functional food cookie (One cookie / 10 grams)

Nutrient	AMOUNT (MEAN ± SD)
MOISTURE	0.38 ± 0.03 %
ASH	3.14 ± 0.04 g
TOTAL SUGARS	4.114 ± 0.45 g
PROTEINS	0.7 ± 0.02 g
FAT	1.98 ± 0.15 g
FIBRE	0.2 ± 0.13 g
CALCIUM	2.30 ± 0 mg
PHOSPHORUS	5.132 ± 5.416 mg
POTASSIUM	0.07 ± 0.096 mg
IRON	3.8 ± 0.212 mg
PHENOLS	2.6 ± 0.1909 mg
ZINC	0.2 ± 0.0039 mg
COPPER	0.01 ± 0.0014 mg
SELENIUM	0.27 ± 0 mg
VITAMIN C	11.88 ± 4.669 mg
VITAMIN A	12.44 ± 0 µg

From Table 2. It is evident that there was a significant increase in weight of the subjects after supplementation which could be because of the protein content of the cookie (1.4 gms/2 cookies)

providing 3% RDA/ day for children. Two cookies provide approximately 80 kcal. of energy which is 4% RDA for children.

Table 2. Effect of supplementation of cognitive cookies on weight and Complete Blood Count

Parameters	Before Supplementation	After Supplementation	Units	t-Value	Significance
Weight	29.07±6.0652	30.15±6.67	Kgs	0.6562	S
WBC (Total white blood cells)	9.8 ± 1.382	10.829 ± 1.404	X 10 ³ /μL	2.5588	S
RBC (Total red blood cells)	4.271 ± 0.429	4.641 ± 0.361	X 10 ⁶ /μL	3.2329	S
HGB (Hemoglobin)	12.214 ± 0.2129	12.3857 ± 0.11217	g/dL	3.4914	S
HCT (Hematocrit)	36.51 ± 3.372	36.991 ± 3.149	%	0.5107	NS
MCH (Mean corpuscular hemoglobin)	27.67 ± 6.244	25.3625 ± 3.562	pg	1.5726	NS
MCHC (Mean corpuscular hemoglobin concentration)	33.974 ± 7.329	32.6875 ± 2.20	g/dL	0.8236	NS
PLT (platelet count)	277.75 ± 75.097	319.958 ± 66.917	X 10 ³ /μL	2.0557	S
LYM% (relative (%) content lymphocytes)	41.14 ± 10.083	41.875 ± 8.112	%	0.2776	NS
MXD% (relative (%) content of the mixture, monocytes, basophils, and eosinophils)	13.088 ± 5.046	13.408 ± 5.943	%	0.2011	NS
NEUT% (relative (%) content of neutrophils)	45.15 ± 11.997	46.137 ± 8.911	%	0.5206	NS
RDW (Red blood cell distribution width)	39.814 ± 3.697	40.804 ± 3.468	fL	0.9607	NS
PDW (Platelet Distribution Width)	9.52 ± 1.361	10.629 ± 1.504	fL	2.6785	S
MPV (Mean platelet volume)	7.715 ± 1.808	7.875 ± 0.570	fL	0.4151	NS
P-LCR (ratio of large platelets)	11.794 ± 4.502	12.874 ± 3.839	%	0.8933	NS

The cookie was found to enhance the haematological status of the children as evident from the incremental values of Total RBC, Haemoglobin, Haematocrit, and relative % content of neutrophils. The cookie also seems to enhance the profile of WBCs and Platelets, showing its effect on health and immunological status of the subject. It is interesting and encouraging to note that there was a significant (p> 0.5%) increase in mean scores of General mental/ cognitive ability as measured by Standard Progressive Matrices and mean scores of Working memory and attentiveness showing the potential of cookie in enhancing cognitive functions. These improvements were expected because of the high amounts of cognition enhancing nutrients and antioxidants contained in the cookie

Table 3. Effect of supplementation of cognitive cookies on Cognitive functions in children

Cognitive Test	Mean Scores		t-value	Significance
	Before Supplementation	After Supplementation		
Standard Progressive Matrices (General mental ability)	20.5 ± 9.797	30.266 ± 11.001	3.6311	S
Star Counting Test (Working memory & attentiveness)	8.928 ± 5.9936	11.357 ± 6.025	1.5124	S

Conclusion:

From the present study it can be concluded that the developed functional food cookie enhances nutritional status and cognitive functions in children and can serve as a healthy snack for children with immense market potential

References

1. Phani Kumar G and Farhath K, Neuroprotective potential of phytochemicals, Pharmacogn Rev.2012 Jul-Dec,6(12):81-90
2. De Jong PF and Das-Smaal EA, Attention and Intelligence: The Validity of the Star counting Test, J of Educational Psychology. 1995, 87(1):80-92
3. Raghuramulu, N., M.K. Nair and S. Kalyansundaram, 2003. A Manual of Laboratory Techniques, National Institute of Nutrition, ICMR, pp: 101-150
4. Singh HK and Dhawan BN. Neuropsychopharmacological effects of the Ayurvedic nootropic Bacopa monniera Linn (Brahmi). Indian J Pharmacol. 1997;29s:359-365