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EFFECT OF DIETARY POLYPHENOLS ON HEMOGLOBIN LEVEL OF ADOLESCENT GIRLS OF HARYANA (INDIA)

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ABSTRACT

Free radicals or reactive oxygen species (ROS) are formed in the body as result of oxidation. Oxidation by products of normal metabolism cause damage to body resulted into degenerative diseases. Antioxidant defense mechanism diminishes action of free radicals. Source of natural antioxidants are mainly plant phenolic compounds. The present study was carried out to develop products and their organoleptic evaluation. The impact of polyphenol rich supplements on hemoglobin level of adolescent girls was also studied. Polyphenol and nutrient rich products were developed. Developed products were evaluated on 9-point hedonic scale. All developed products were found acceptable. The total polyphenol content (TPC) in the developed supplements ranged between 0.58 to 4.14 g/100 g tannic acid equivalent on dry weight basis. Adolescent girls (18 to 19 years) having low hemoglobin 9.0-9.5g/dl were selected for study. Polyphenol as well as nutrient rich products were fed to adolescent girls for 6 weeks. Supplementation showed slight increase in the level of hemoglobin level of adolescent girls. Anemia was more prevalent among adolescent girls. It signifies that plant derived phenolic compounds have beneficial health effects. Fruits, vegetables, beverages especially tea and coffee are good sources of phenolic compounds.

Key words: ROS, Tannic acid equivalent, Total Polyphenol Content, antioxidants, Organoleptic, Polyphenols

INTRODUCTION

In recent years plant phytochemicals have received a great deal of attention mainly on their role in preventing diseases caused due to oxidative stress. Oxidative stress is defined as the imbalance between pro-oxidants and antioxidants. Oxidative stress releases oxygen species such as free radicals (Diplock, 1994; Thomson, 1995). Free radicals or reactive oxygen species are formed in our body due to biological oxidation. These free radicals cause extensive damage to DNA, protein and lipids. Oxidative damage is associated with chronic degenerative diseases including cancer, coronary heart disease, hypertension, diabetes etc. (Lee et al., 2000). Antioxidants play an important role in oxidative damage. Antioxidants are mainly present in fruits and vegetables recommended to reduce cardiovascular and neurodegenerative diseases (McCall et al., 2011). These positive health effects are attributed to a variety of bioactive compounds such as phenolics generally termed as polyphenols. The word polyphenols means chemical substances having more than one phenol unit. Polyphenols represent a wide variety of compounds of plant origin. Several thousand compounds of polyphenol structure have been identified in plants till date. These compounds can be classified into various groups depending on their chemical structure. Polyphenols are mainly grouped into phenolic acids, flavonoids, stilbenes and lignans. Phenolic acids can be divided into two subclasses derivatives of benzoic acids and derivatives of cinnamic acids. They are known as hydroxybenzoic acids and hydroxycinnamic acids. Flavonoids are subdivided in to flavonols, flavones, flavanones, isoflavones, flavanols, proanthocyanidins and anthocyanins. Good sources of polyphenols in human diet are fruits, vegetables and beverages (Cieslik et al., 2006: Kaur and Kapoor, 2001). Cereals, chocolates and dry legumes also contribute to intake of polyphenols in diet (Vinson et al., 2001, 2002).

Nutritional deficiencies in adolescence period are more prevalent in India. There are 253.2 million adolescents in India, which constitutes 20.9 percent of total Indian population (Census, 2011). Adolescence is a significant period of human growth and maturation. During this period requirement of all the nutrients increases as individual move towards physical and psychological maturity, economic independence and acquire their adult identity. Keeping in view the importance of adolescent period the present study was carried out with following objectives: The present study was aimed to develop products rich in nutrients as well as polyphenols. Developed products were tested on 9-point hedonic scale, supplemented to adolescent girls and the effect of supplementation on their hemoglobin level was studied.

MATERIALS AND METHODS

AREA OF STUDY

Present study was conducted in Rohtak and Sonepat districts of Haryana (India).

SAMPLE SIZE

A dietary survey was carried out on 200 adolescent girls (18 to 19 years). Two hundred adolescent girls were selected from Rohtak and Sonepat district of Haryana purposively. One hundred adolescent girls having low hemoglobin level (9.0-9.5g/dl) were selected for further study.

INCLUSION CRITERIA FOR SELECTION OF SUBJECTS

Individuals eligible for study fulfilled the following criteria.

- Girl's institution having hostels from Rohtak and Sonepat districts, one from urban area and one from rural area.
- Adolescent girls in the age group of 18 to 19 years.
- Adolescent girls residing in the hostel.
- Adolescent girls willing to participate in study.
- Adolescent girl who had given written consent to involve in study.

RATIONALE

Present study was carried out to assess impact of dietary polyphenols on adolescent girls. Dietary polyphenols have beneficial health effects. Malnutrition is more prevalent among adolescent girls.

ESTIMATION OF HEMOGLOBIN LEVEL

Hemoglobin level of adolescent girls was checked using cyanmetheamoglobin method described by Dacie and Lewis (1975) in City diagnostic laboratory, Rohtak. Blood samples of the adolescent girls were collected by technician. Hemoglobin level of adolescent girls was recorded before and after intervention.

DEVELOPMENT OF PRODUCTS

Nutrient and polyphenol rich products namely *Amla balls*, *Guava toffees*, *Amaranth ladoos* and *Spinach namakpare* were developed. Nutrients in products were evaluated using AOAC, 2000. Polyphenols in the developed products was estimated using spectrophotometer (Singh and Jambunathan, 1981).

ORGANOLEPTIC EVALUATION

Developed products were evaluated for organoleptic characters by twelve experts. Developed products were evaluated for color, appearance, aroma, texture, taste and overall acceptability. Judges recorded quality characteristics on 9 point hedonic scale. Mean scores were calculated and statistically analyzed.

FEEDING TRIAL

Research approval has been given by Ethical committee of the institution. A written consent from the subjects involved in study was also taken before starting the study. Developed products were fed in four groups for a period of 6 weeks. Each group was consisted of 25 adolescent girls. Combination of two products was made considering daily mean polyphenol intake by adolescent girls. Each group was supplemented with 1.2-1.3 g of polyphenols in addition to their daily intake of polyphenols. Each adolescent girl of their respective group was given supplement combination as mentioned below.

Groups (each group=25 adolescent girls)	Combination of products	Polyphenol content
Group I	Two guava toffees + 50 g spinach namakpare	1.28-1.29 g
Group II	Two guava toffees + one Amla ball	1.3 g
Group III	One amaranth ladoo + Amla ball	1.2 g
Group IV	One amaranth ladoo+ 50 g spinach namakpare	1.2 g

STATISTICAL ANALYSIS

Data were analyzed using the Statistical Analysis System software package. Mean and Standard deviation was calculated for organoleptic scores. F- test was used to test significance among scores of different products and compared with f-critical value. Student's t-test was used for testing significance level. Level of significance was used for comparison at 0.05 levels. P values >0.05 were considered to be significant.

RESULTS AND DISCUSSION

ORGANOLEPTIC EVALUATION

Organoleptic scores of all the developed products are projected in Table 1. The developed polyphenol-rich products namely *Amla balls*, *Guava toffees*, *Amaranth ladoos* and *Spinach namakpare* were evaluated for color, appearance, aroma, texture, taste and overall acceptability characteristics by a panel of ten judges using nine point hedonic scale (Table 1 and Figure 1). These characteristics have been discussed individually as follows:

Figure1. Developed products

COLOR

The mean scores of color were the highest for guava toffees (8.70) and the lowest for *spinach namakpare* (7.90). The color of all the developed products was liked by the judges and scores were more than the minimum acceptability score of five. Color of all the developed products were compared, they were significantly (f-critical 2.86) different from each other.

APPEARANCE

The Mean scores of appearance of different products ranged from 7.90 to 8.60. It was highest for *guava toffee* and least for *amla ball*. The appearance for all the products was acceptable. However mean scores differed significantly among each other.

AROMA

All the developed products were found to be acceptable in terms of aroma. The mean scores of aroma were highest (8.20) for *guava toffees*. The score was observed to be the lowest for *amla balls* (7.70). Non-significant differences were observed in terms of scores of different products.

TEXTURE

The Mean scores of appearance of different products ranged from 7.70 to 8.40. It was highest for *guava toffees* and least for *spinach namakpare*. The texture for all the products was acceptable. Non-significant difference was observed in mean scores of texture of different products.

TASTE

Amaranth ladoos and *guava toffees* had the highest (8.40) mean score of taste, while *spinach namakpare* got the lowest (8.00). All the products were moderately liked by the judges. Mean scores of taste of all developed products were not significantly differed each other.

OVERALL ACCEPTABILITY

The mean score of all the developed products were: 8.60 (*guava toffees*), 8.50 (*amaranth ladoo*), 8.40 (*amla balls*) and 8.10 (*spinach namakpare*). Non significant differences were observed in terms of scores of overall acceptability of different products. From sensory evaluation of products, it can be concluded that all the developed products were acceptable on 9-point hedonic scale and selected for feeding trial. The findings were reported by Nazni and Pradeepa, 2010.

EFFECT OF SUPPLEMENTATION ON HEMOGLOBIN LEVEL OF ADOLESCENT GIRLS

Hemoglobin level of adolescent girls was recorded before and after intervention of polyphenol-rich products. Adolescent girls having hemoglobin level between 9 to 9.5g/dl were selected for intervention. Combinations of two different products contained polyphenol content (1.2 to 1.3g) were fed to four different groups and impact on hemoglobin is presented in Table 2.

Table 1: Organoleptic evaluation of developed polyphenol rich products

Products	Color	Appearance	Aroma	Texture	Taste	Overall acceptability
Amla balls	8.50±0.52	7.90±0.87	7.70±0.82	7.90±0.73	8.20±0.78	8.40±0.69
Guava toffees	8.70±0.48	8.60±0.51	8.20±0.78	8.40±0.69	8.40±0.96	8.60±0.51
Amaranth ladoos	8.30±0.67	8.20±0.63	8.00±0.81	8.10±0.87	8.40±0.51	8.50±0.52
Spinach namakpare	7.90±0.56	8.00±0.47	8.10±0.56	7.70±0.82	8.00±0.66	8.10±0.56
F-value	3.62	3.11	0.16	1.43	0.64	1.37

Table 2: Effect of supplementation on hemoglobin level of adolescent girls

Hemoglobin level(g/dl of blood)				
Experimental Group (n=25)	**Before intervention period**	**After intervention period**	**Difference**	**'t' value**
I	9.21 ± 0.68	9.30± 0.73	0.11	0.41^{NS}
II	9.00 ± 1.01	9.26 ± 0.67	0.26	1.26^{NS}
III	9.57 ± 0.96	11.14± 1.30	1.57	8.30*
IV	9.10 ± 0.67	9.16±0.69	0.06	0.32^{NS}

[1] Values are mean ± SD

't' value indicate comparison of values at pre and post exposure stage

*Significant at 5% level, Values are mean ± SD, F –critical (2.86), NS Non significant

GROUP I

Group I comprised of 25 adolescent girls was supplemented with two *guava toffees* (approx.12-15g each) and 50g *spinach namakpare.* It was observed that hemoglobin level of adolescent girls changed from 9.21 to 9.30 g/dl. Data in Table 2 showed that there was non-significant increase in hemoglobin of adolescent girls.

GROUP II

Adolescent girls of this group were supplemented with two guava toffees (approx.12-15g each) and amla ball weighed up to 9-10g. There was non-significant ($p<0.05$) increase in their hematological status. A slight change in their hemoglobin level was noted (Table 2).

GROUP III

An amaranth ladoo (approx. 48g in weight) and amla ball (9-10g of weight) was supplemented to adolescent girls of group III. There was little increase in their hemoglobin level, which was found significant at 5% level.

GROUP IV

This group was supplemented with *amaranth ladoo* (approx. 48g) and 50g *spinach namakpare.* The mean value of hemoglobin in adolescent girls before intervention was 9.10g/dl which was increased to 9.16g/dl. Change in hemoglobin was non-significantly higher than

value before intervention. Results showed that rise in hemoglobin were non-significant.

CONCLUSION

Prevalence of iron deficiency anemia was observed among adolescent girls. Supplementation slightly increased hemoglobin level of adolescent girls. But increase in hemoglobin was not significant in three groups; this was due to the fact that diets of adolescent girls were already deficient in fruits, green leafy vegetables, other vegetables, pulses, milk and milk products which led to lesser intake of energy, protein, iron and vitamin C. Therefore supplementation resulted in slight increase in hemoglobin level. More over period of supplementation was only 6 weeks which was too short. Results revealed that intervention of polyphenol rich developed products were rich source of polyphenols as well other nutrients. It can be concluded that polyphenols might be helpful in increase of hemoglobin level.

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