AJHS
Asian Journal of Home Science
Volume **7** | Issue 2 | December, 2012 | 508-513

Research Paper

Efficacy of Kokam health drink in obesity

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Received: *25.09.2012*; **Revised:** *06.11.2012*; **Accepted:** *06.12.2012*

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ABSTRACT : *Garcinia indica* (Kokam) is an Indian spice. The rinds of garcinia fruits are the richest source of hydroxycitric acid. Hydroxycitric acid is having a nutraceutical potential for obesity. By taking into account the nutraceutical properties of kokam health drink was prepared as a therapeutic food supplementation. About 100ml diluted form of health drink was given for six months of period to ninety adolescents (18 to 21 years in age) from Kolhapur, Sangli and Ratnagiri district in western konkan of Maharashtra. The efficacy of kokam health drink was assessed after examining and comparing the data about nutritional status of the obese adolescents after supplementation. The result of serum cholesterol found reduced from 300mg to 215 mg/100ml, triglyceride levels noted decreased from 200 mg to 116 mg/100 ml of blood among selected obese adolescents.

KEY WORDS : Obesity, Kokam health drink, Supplementation, Anthropometric measurement, Biochemical analysis

HOW TO CITE THIS PAPER : Kaamble, R.M. and Pillai, Priya (2012). Efficacy of Kokam health drink in obesity. *Asian J. Home Sci.*, **7** (2): 508-513.

Obesity is the greatest threat to global public health due to increased consumption of fats and oils, junk foods, decreased intake of complex carbohydrates, eating hotel foods, ready to eat food, skipping meals and of sedentary lifestyle (Dumin, 2009). According to 'World Health Organisation' 22 million adolescents (under 20 years of age) are obese. Obesity is evolving as a major nutrition problem in developing countries especially like India which has affected a substantial number of adolescents and adults, resulting in an increased burden of chronic disease. Now a day's fraudulent therapies are used by obese population for reducing their body weight. However they are not successful in reducing their body weight. However they are not successful in reaching their goal. Due to colourful and emotional advertisement regarding food formula, supplementations, beverages, instruments and body weight reducing treatments these obese people are facing harmful side effects and health problems. However, Indian spices having much more medicinal and nutraceutical properties. Garcinia indica (Kokam) is a moderate sized, evergreen tree. It bears sweet-sour mixed fruits native to South East Asia and India. The fruit of Garcinia indica (kokam) has been traditionally used in food preparations. The fruit rind of kokam is of commercial importance which is used in the preparation of kokam products (Dudeja, 2008). Hydroxycitric acid is the main active component present in the rinds of the kokam fruits. This component prevents weight gain by inhibiting synthesis of fatty acids. It impair activities of the enzyme ATP citrate lyase that converts the unspent calories into fat (Walls, 2009). Such medicinal value and nutraceutical potential of kokam and its food products cannot be overemphasized. Hence, Kokam health drink was prepared and supplemented to obese adolescents to assess the impact on their nutritional status especially body weight reduction and lipid profile.

RESEARCH METHODS

Formulation of Kokam health drink :

Kokam health drink was formulated with the different variations of ingredients used for its preparation.

Kokam stock solution and artificial sugar:

For the preparation of Kokam health drink, Kokam stock and artificial sugar were used in different variations like 100:100, 100:75, 100:50 and 100:25 g.

Use of salt:

Salt was used for taste in Kokam health drink and also indirectly to act as a preservative. The variation of salt such as 2, 4, 6 and 8 g per 100 ml of health drink were used.

Use of cumin seed powder:

Cumin seed powder was used as a flavouring agent with the variation of 1, 2, 3, and 4 g per 100 ml of health drink.

Use of flame type:

Low, medium and high flames were used for making concentration of Kokam from stock solution and sugar.

Heating temperature and time for the preparation of Kokam stock sugar concentration:

The solution was cooked for different heating temperatures and time, 150^0C for 30 minutes, 200^0C for 20 minutes and 250^0C for 10 minutes were the variations used for cooking the Kokam stock.

Addiion of alpha-hydroxycitric acid:

Alpha-hydroxycitric acid was enriched in the product with the variations of 0.25, 0.5, 1.0 and 1.5 mg /100 ml. This enrichment was made after cooling of the Kokam product.

Use of diluting factor:

Distilled water was used as a diluting factor in the Kokam product. Kokam concentrate was diluted with glass distilled water by using different variations *i.e.* 100:25, 100:50 and 100:100.

Organoleptic quality evaluation:

Formulated Kokam health drink with different variations was evaluated by their sensory qualities. It was judged with the help of trained panel of experts by using nine point Hedonic scale method described by Amerine *et al.* (1965).

Nutritional quality evaluation:

High scored kokam health drink in sensory evaluation was selected for the nutritional assessment. Major nutrients like carbohydrates, crude protein and fat were determined by using AOAC methods (1975). Hydroxycitric acid, anthocyanin, pectin, tannin and ascorbic acid contents in Kokam health drink were also analysed (Raghuramulu *et al.*, 2003).

Assessment of storage stability:

Keeping quality of Kokam health drink was assessed by using polythene and tetra packing material. Storage stability of diluated Kokam health drink was observed in terms of its organoleptic as well as nutritional qualities. It was assessed after every months for a period of six month duration at room and deep freeze temperature. The variations noticed in the nutritional qualities of Kokam health drink before and after storage were calculated with the statistical significant differences by applying't' test (Gomez and Gomez, 1986).

Selection of samples:

One hundred and twenty adolescent boys (60) and girls (60) who were having II grade of BMI were selected by using purposive random sampling method. About 40 adolescents from each *i.e.* Kolhapur, Sangli and Ratnagiri districts of western Kokan of Maharashtra were selected for this study. These 120 obese adolescents were divided as 90 for experimental groups and 30 kept as control group. About 90 experimental group of adolescents were again divide into three groups depending upon their supplementation of hydroxycitric acid *i.e.* 0.5, 1.0 and 1.5 mg/100 ml of Kokam health drink. They were divided to observe the correlation of hydroxycitric acid supplementation to the nutritional profile of experimental obese adolescent group. The supplementary feeding programme was given after the better establishment of rapports and relation with the adolescent boys and girls. The relation was developed through awareness, visits, celebration of nutrition and health related days and other extension activities. The selected obese adolescents were supplied with Kokam health drink for the duration of six months. The supplementation of Kokam health drink was supplied in the diluted form of 100 ml in amount before one hour of their mid lunch per day including holidays.

Assessment of health and nutritional status of adolescents:

The health and nutritional status of selected adolescents were selected before and after experimental feeding programmes with six months interval. The nutritional and health status of adolescents were assessed through their food intake pattern by three days recall method, anthropometric measurements like height (cm), weight (kg) and BMI (Jelliffe, 1966) and biochemical analysis especially lipid profile by using methods described AOAC (1975). Food intake pattern was assessed by three day recall method.

Statistical analysis:

The data were analysed stastically by applying standard mean and critical difference and percentage. The significant difference was examined between the control and experimental groups by using 'Z' test (Gomez and Gomez, 1986).

■ RESEARCH FINDINGS AND DISCUSSION

The data about average food intake pattern, anthropometric measurements, biochemical assessment and correlation of hydroxycitric acid supplementation with the nutritional profile of adolescents are presented in Tables 1 to 5.

Table 1 shows an increased consumption pattern of cereals (467.0$\pm$18.8 or 103.7 %), pulses and legumes (60.0 $\pm$ 3.2 or 120.0 %), milk and milk products (223.0$\pm$10.2 or 148.6 %), sugar and jaggery (56.0$\pm$2.8 or 140.0 %), fats and oil (63.0$\pm$3.4

or 126.0 %) before supplementation among these obese adolescents. The following items like pizza, soft drinks, bakery products like pastry, chocolates and fried foods like murukku, potato chips, French fries noted more frequently consumed by these adolescents. The average mean intake of cereals (389.0±11.6 or 86.4 %), pulses and legumes (55.0±2.6 or 110.0 %), milk and milk products (185.0±6.6 or 123.3 %) was found significantly decreased to normal adequate level in obese adolescents after supplemented experimental period. The consumption of egg (47.0±2.8 or 156.6 %), fish, meat and poultry (52.0±2.2 or 173.3 %) was in excess before supplementation period. The consumption of non-vegetarian foods were noted twice a day among these obese adolescents. The average consumption pattern of egg (36.0±2.1 or 120.0 %), fish, meat and poultry (40.0±1.9 or 133.3 %) noticed decrease no significantly to moderate adequate levels after completion of experimental period. Before supplementation period, the consumption of other vegetables (90.0±3.1 or 120.0 %), roots and tubers (140.0±4.6) or (140.0 %) were found in excess level. It indicates the high intake of the adolescents which reflects and factor responsible for weight gain. The average intake of other vegetables (80.0±3.3 or 106.6 %), roots and tubers (95.0±4.1 or 95 %) in these obese adolescents was found decreased to normal values after supplementation period. Average intake of green leafy vegetables (10.0±1.2 or 10.0 %) and fruits (10.0±0.8 or 33.3 %) was reported as very poor among these adolescents before the supplementation. However, this intake of green leafy vegetables (40.0±2.2 or 40.0 %) and fruits (20.0±1.4 or 66.6 %) increased to normal adequate levels after supplementation period. When the data about food intake pattern of obese adolescents compared between supplemented groups and control group, it revealed that average intake of roots and tubers, milk and milk products were reduced at higher significant level. Whereas non-significant changes were recorded in mean food intake of pulses and legumes, fruits and fat and oil between experiment and control groups of obese adolescents.

The data reported in Table 2 represent the average intake of nutrients by obese adolescents. It indicates that there was significant difference in the nutrient intake of experimental groups when compared with control group before and after supplementation. The average intake of calorie (3600.0 ± 12.3) by experimental group was noted very high (*i.e.* 136.3 %) than their RDA before supplementation. It was reduced significantly after supplementation (*i.e.* 121.2 %). The same picture was observed in protein and fat intake 83.0 ± 4.2 and 64.0 ± 3.3. Excess intake was noted with protein and fat, respectively by these adolescents before the supplementation. This protein and fat intake was found reduced to *i.e.* 106.4 to 88.4 and 290.9 to 240.9 levels, respectively after supplementation. Whereas the intake of other nutrients like vitamin B_1 (0.50±0.01), vitamin B_2 (0.53±0.01),vitamin B_3 (4.5±0.14), beta carotene (800.0±11.6), vitamin C (12.0±1.5),

Table 1 : Average food intake of adolescents

Sr. No.	Food group	Experimental group: Before supplementation (a) Mean ± SD	Experimental group: After supplementation (b) Mean ± SD	'Z' value	Control group: Before supplementation (c) Mean ± SD	Control group: After supplementation (d) Mean ± SD	'Z' value	'Z' value (b) vs. (d)
1.	Cereals (g)	467.0 ± 18.8 (103.7)	389.0 ± 11.6 (86.4)	(2.86)*	472.0 ± 15.6 (104.8)	468.0 ±13.4 (104.0)	(1.12)^{NS}	(2.75)*
2.	Pulses and legumes (g)	60.0 ± 3.2 (120.0)	55.0 ± 2.6 (110.0)	(0.16)*	63.0 ± 4.1 (126.0)	60.0 ± 3.5 (120.0)	(0.03)^{NS}	(1.81)^{NS}
3.	Green leafy vegetables (g)	10.0 ± 1.2 (10.0)	40.0 ± 2.2 (40.0)	(3.11)*	15.0 ± 0.7 (15.0)	21.0 ± 1.1 (21.0)	(1.63)^{NS}	(2.66)*
4.	Other vegetables (g)	90.0 ± 3.1 (120.0)	80.0 ± 3.3 (106.6)	(1.19)^{NS}	93.0 ± 2.9 (124.0)	98.0 ± 2.7 (130.6)	(0.36)^{NS}	(2.59)*
5.	Roots and tubers (g)	140.0 ± 4.6 (140.0)	95.0 ± 4.1 (95.0)	(2.90)*	145.0 ± 5.3 (145.0)	148.0 ± 5.0 (148.0)	(0.02)^{NS}	(3.49)**
6.	Fruits (g)	10.0 ± 0.8 (33.3)	20.0 ± 1.4 (66.6)	(1.98)^{NS}	15.0 ± 1.2 (50.0)	10.0 ± 0.6 (33.3)	(0.65)^{NS}	(1.85)^{NS}
7.	Milk and milk products (ml)	223.0 ± 10.2 (148.6)	185.0 ± 6.6 (123.3)	(3.20)*	230.0 ± 9.3 (153.3)	240.0 ±10.1 (160.0)	(0.84)^{NS}	(3.50)**
8.	Sugar and jaggery (g)	56.0 ± 2.8 (140.0)	41.0 ± 1.3 (102.5)	(1.70)^{NS}	60.0 ± 2.4 (150.0)	66.0 ± 2.8 (165.0)	(0.71)^{NS}	(2.44)*
9.	Fats and oils (g)	63.0 ± 3.4 (126.0)	58.0 ± 2.5 (116.0)	(1.81)^{NS}	60.0 ± 3.1 (120.0)	55.0 ± 2.4 (110.0)	(0.51)^{NS}	(0.21)^{NS}
10.	Egg (g)	47.0 ± 2.8 (156.6)	36.0 ± 2.1 (120.0)	(1.88)^{NS}	50.0 ± 1.9 (166.6)	56.0 ± 1.6 (186.6)	(0.31)^{NS}	(2.38)*
11.	Fish/Meat/Poultry (g)	52.0 ± 2.2 (173.3)	40.0 ±1.9 (133.3)	(1.76)^{NS}	55.0 ± 1.6 (183.3)	60.0 ± 1.8 (200.0)	(0.29)^{NS}	(2.51)*

* and ** indicate significance of values at P=0.05 and 0.01, respectively NS=Non-significant
Figures in parantheses indicate percentage

Table 2 : Average nutrient intake of adolescents

Sr. No.	Food group	Experimental group			Control group			
		Before supplementation (a)	After supplementation (b)	'Z' value	Before supplementation (c)	After supplementation (d)	'Z' value	'Z' value (d) VS (a)
		Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD		
1.	Energy (kcal)	3600±12.3 (136.3)	3200±11.9 (121.2)	(3.56)**	3615±13.4 (136.9)	3264±12.1 (123.6)	(3.66)**	(2.68)*
2.	Protein (g)	83±4.2 (106.4)	69±3.4 (88.4)	(3.19)*	85±4.5 (108.5)	65±3.8 (83.3)	(3.54)**	(0.21) NS
3.	Fat (g)	64±3.3 (290.0)	53±2.8 (240.9)	(3.64)*	68±3.5 (309)	61±3.1 (277.2)	(2.40)*	(2.60)*
4.	Vitamin B_1 (mg)	0.50±0.01 (33.1)	0.63± 0.01 (48.4)	(1.16) NS	0.45±0.01 (34.6)	0.50±0.01 (38.4)	(1.09) NS	(2.53)*
5.	Vitamin B_2 (mg)	0.53±0.01 (33.1)	0.66±0.01 (41.25)	(0.97) NS	0.51±0.01 (31.8)	0.60±0.01 (37.5)	(0.81) NS	(1.27) NS
6.	Vitamin B_3 (mg)	4.5±0.14 (26.4)	11.7±0.23 (68.8)	(2.61)*	4.1±0.11 (24.11)	12.1±0.30 (71.1)	(2.59)*	(1.06) NS
7.	β carotene (μ g)	800±11.6 (33.3)	1200±16.2 (50)	(3.81)**	809±12.2 (33.7)	1230±11.8 (51.2)	(3.90)**	(2.50)*
8.	Vitamin –C (mg)	12±1.5 (30)	20±1.8 (50)	(1.60) NS	12±1.5 (30)	15±1.6 (37.5)	(0.63) NS	(1.35) NS
9.	Calcium (mg)	515±9.8 (103)	560±11.4 (112)	(2.70)*	530±10.3 (106)	560±11.4 (112)	(1.22) NS	(1.22) NS
10.	Iron (mg)	8.5±1.6 (17)	10.2±0.8 (20.4)	(0.48) NS	9.3±1.2 (18.6)	10.6±0.9 (21.2)	(0.64) NS	(0.08) NS
11.	Dietary fibre (g)	11±0.8 (36.6)	13±0.6 (43.3)	(0.41) NS	9±0.6 (30)	12±0.5 (40)	(0.53) NS	(0.16) NS

* and ** indicate significance of values at P=0.05 and 0.01, respectively NS=Non-significant
Figures in parantheses indicate percentage

calcium (515.0±9.8), iron (8.5±1.6) and dietary fibre (11.0±0.8) was inadequately taken by these obese adolescents before supplementation period. However, the average intake level of b carotene (1200.0±16.2), vitamin B_3 (11.7±0.23) and calcium (560.0±11.4) was observed increased significantly after their supplementation period. Moreover, a non-significant increase was noticed in the average intake of vitamin B_1, vitamin B_2, vitamin C, iron and dietary fibres. Higher significant increase was noticed in the average intake of energy, protein and fat which was significantly reduced as 3615.0 ± 13.4 to 3264.0 ± 12.1 (kcal), 85.0 ± 4.5 to 65.0 ± 3.8 (g) and 68.0 ± 3.5 to 61.0 ± 3.1(g), respectively after six months in control group of adolescents. Whereas the average intake of β carotene 809.0±12.2 to 1230.0±11.8 μg, and vitamin B_3 (4.1 ±0.11 to 12.1 ±0.30 mg) was found significantly increased after six months of period in control group. A non-significant change was seen in the per cent intake of vitamin B_1 (34.6 to 38.4), vitamin B_2 (31.8 to 37.5), vitamin- C (30.0 to 37.5), calcium (106.0 to 112.0), iron (18.6 to12.2) and dietary fibres (30.0 to 40.0) among control group.

Table 3 depicts the average mean values of anthropometric indices of adolescents. It describes the constant height after six months period *i.e.* index of these adolescents was abnormal before the supplementation period *i.e.* 80.1 ± 2.4 kg or 133.0 per cent and 31.6 ± 1.7 or 160. 0 per cent, respectively. Body weight and body mass index reduced significantly after supplementation period *i.e.* 80.1 to 72.3 and 31.6 to 28.0, respectively. The control group of adolescents showed a non-significant difference in their anthropometric measurements after six months of period. When the data of experimental group is compared with control groups, it showed reduction in body weight and body mass index at higher

Table 3 : Average anthropometric measurements of adolescents

Sr. No.	Anthropometric measurements	Experimental group			Control group			'Z' value (b)vs (d)
		Before supplementation (a)	After supplementation (b)	'Z' value	Before supplementation (c)	After supplementation (d)	'Z' value	
		Mean ± SD	Mean ± SD		Mean ± SD	Mean ±SD		
1.	Height (cm)	160.8±11.6 (93.6)	160.8±11.6 (93.6)	(0.01) NS	163.1±11.2 (94.7)	163.1±11.2 (94.7)	(0.01) NS	(0.22) NS
2.	Body weight (kg)	80.1±2.4 (133.0)	72.3±2.1 (120.0)	(2.68)*	83±2.4 (138.3)	85±2.6 (141.6)	(1.29) NS	(3.71)**
3.	Body mass index	31.6±1.7 (160.0)	28.0±1.2 (140.0)	(2.61)*	31.2±1.1 (155.0)	34.2±1.1 (171.0)	(0.92) NS	(3.74)**

* and ** indicate significance of values at P=0.05 and 0.01, respectively NS=Non-significant
Figures in parantheses indicate percentage

Table 4 : Average lipid profile of adolescents

Sr. No.	Lipid profile	Experimental group			Control group			'Z' value (b)vs (d)
		Before supplementation (a)	After supplementation (b)	'Z' value	Before supplementation (c)	After supplementation (d)	'Z' value	
		Mean ±SD	Mean ±SD		Mean ±SD	Mean ±SD		
1.	Blood cholesterol (mg/100ml)	260.0±5.5 (130.0)	180.0±3.8 (30.0)	(3.75)**	265.0±4.1 (141.0)	281.0±4.1 (141.0)	(2.40)*	(3.82)**
2.	LDL level (mg/100ml)	160.0±3.1 (160.0)	131.0±2.4 (131.0)	(3.70)**	165.0±2.9 (165.0)	195.0±3.3 (145.0)	(2.64)*	(3.91)**
3.	HDL level (mg/100ml)	25.0±1.1 (52.0)	45.0±1.6 (93.7)	(3.61)**	30.0±1.4 (63.0)	22.0±1.1 (4.6)	(2.38)*	(3.79)**
4.	Triglycerides (mg/100ml)	173.0±2.9 (157.2)	140.0±1.8 (127.2)	(3.88)**	180.0±1.6 (164.0)	220.0±2.3 (220.0)	(3.60)**	(4.11)**

* and ** indicate significance of values at P=0.05 and 0.01, respectively NS=Non-significant
Figures in parantheses indicate percentage

Table 5 : Correlation of ~ -hydroxy citric acid supplementation with the nutritional profile of adolescents

Sr. No	Nutritional profile	Correlation of α-hydroxy citric acid supplementation		
		I (0.5 mg /100 ml)	II (1 mg /100 ml)	III (1.5 mg/100 ml)
1.	Body weight (kg)	(1.41) ^{NS}	(2.65)*	(3.82)**
2.	BMI	(1.59)^{NS}	(2.78)*	(3.91)**
3.	Blood cholesterol (mg/100 ml)	(1.30)^{NS}	(2.48)*	(3.88)**
4.	LDL level (mg/100 ml)	(1.36)^{NS}	(2.66)*	(4.21)**
5.	HDL level (mg/100 ml)	(1.21)^{NS}	(1.39)^{NS}	(3.91)**
6.	Triglycerides (mg/100 ml)	(1.78)^{NS}	(3.72)**	(4.40)**

* and ** indicate significance of values at P=0.05 and 0.01, respectively NS=Non-significant
Figures in parantheses indicate percentage

significant level.

The lipid profile of selected adolescents is presented in Table 4. It indicates that before supplementation blood cholesterol (260.0±5.5 mg), LDL (160.0 ± 3.1 mg) and triglycerides (173.0±12.9 mg) showed above their normal values. However, the values of lipid profile *i.e.* blood cholesterol (180.0 ±3.8 mg), LDL level (131.0 ± 2.4 mg), triglyceride level (140.0 ±1.8 mg) were reduced significantly after the supplementation period. However, HDL level in these experimental group was found increased significantly from 25.0±1.1 to 45.0±1.6 mg after supplementation period, which indicated a normal per cent (93.7). The level of blood cholesterol (mg), LDL (mg) and triglyceride (mg) was found increased significantly *i.e.* 265.0±4.1 to 281.0±4.1, 165.0±2.9 to 195.0±3.3 and 180.0±1.6 to 220.0±2.3, respectively in control group after six months of period. Whereas the level of HDL (mg) noted decreased from 30.0±1.4 to 22.0±1.1 in this control group after six months.

Table 5 gives an idea about the data regarding correlation of α-hydroxycitric acid supplementation with the nutritional profile of obese adolescents. It indicates that the body weight, BMI, blood cholesterol, LDL level, HDL level and triglycerides of adolescents who were supplemented with 0.5 mg/100 ml α-hydroxycitric acid for six months showed a non-significant difference. The supplementation of 1mg/100 ml of α-hydroxycitric acid to these adolescents showed significant difference in body weight kg (2.65), BMI (2.78), blood cholesterol, LDL level. The difference in HDL level only was found non-significant. The experimental group who were supplemented 1.5 mg/100ml α-hydroxycitric acid noted more significant correlation in decrease of BMI, blood cholesterol, LDL level and triglycerides and increase in HDL level.

Conclusion:

On the whole it can be concluded that, the excess intake of energy (kcal), protein (g) and fat(g) found decreased, whereas intake of other nutrients like vitamin B_1, B_2, B_3 vitamin C and β carotene was noted increased after supplementation. Supplementation of 1.5 mg/100ml of α-hydroxyl citric acid with Kokam health was found directly correlated in the reduction of body weight (kg), BMI, lipid profile of the experimental obese adolescents.

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