

DEVELOPMENT AND EVALUATION OF VALUE ADDED MAIZE DALIA

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ABSTRACT

Value added maize dalia developed along with green gram dal and sweet potato is an energy and protein rich product. The energy and protein content of dalia was 687 kcal and 23.77g per 100 g respectively. The micronutrients such as calcium, riboflavin and niacin were 43.67 mg, 0.32mg and 1.42mg per 100 g respectively. The product being rich in macronutrients and micronutrients is recommended for eradication of protein energy malnutrition among women and children.

INTRODUCTION

Bihar is one of the traditional maize growing states in India. Maize is the third most important food grain crop in Bihar. Presently, Bihar is the third largest producer of maize in India, and it contributes about 8 per cent to the Indian maize production of 22.26 million tones (Mt) in 2012 – 2013 (Pandey, 2016).

Maize has worldwide significance as human food, animal feed and finds diversified uses in large number of industrial products (Kumar and Singh, 2003). But the use of maize in human food is going down day by day. On the other hand the state of malnutrition at global level is alarming.

Bihar, one of the largest maize growing state in India has a very high percentage of malnourished children (NFHS – 3; Mennon *et al.*, 2009 and Grebmer *et al.*, 2011). No doubt, In spite of having very high production of maize in the state it does not find its place in the plate of children. Nutritional limitations especially for protein and niacin in maize have been taken in to consideration and a lot of efforts have been made by scientific community to improve the quality of protein (Bressani *et al.*, 1978; Vivas *et al.*, 1987 and Serna – Saldivar *et al.*, 1987, 1988a, 1988b). The protein quality of maize evaluated for children recovering from protein energy malnutrition have been reported by various researchers (Viteri *et al.*, 1972). Considering the availability of maize and its use after value addition to overcome the problem of malnutrition the present research work has been under taken to develop the value added dalia from maize in combination with other food materials.

MATERIALS AND METHODS

Development of value added maize dalia

The value added maize dalia were developed from maize, green gram dal and sweet potato in combination with different processing methods. It was reported in various study that cereal pulse combination (Bressani and Elias, 1974) and use of different processing methods helps to improve nutrients composition and availability (Bindiya *et al.*, 2015 and Khapre *et al.*, 2016).

Processing methods for cereals and green leafy vegetables

Maize

Processing methods applied were soaking, alkali treatment and drying. At first, the grains of maize were soaked for 5 minutes in double amount of one per cent lime water. Heat treatment was given to it for 30 minutes and kept overnight. Next morning, the grains were washed for three to four times and sun dried (Kumari and Singh, 2013).

Green gram dal

Green gram dal were procured from the market. Pulses were soaked in double amount of water for 2 – 3 hours and then sun dried.

Sweet potato

Sweet potato were washed, peeled, grated and sun dried.

Preparation of value added maize dalia

Ingredients and methods used for the development of the products were as follows

Value added maize dalia

A total of 100 grams properly lime treated maize, 50 grams properly dried sweet potato and 50 grams green gram dal were mixed together and coarsely ground to make improved maize dalia.

Sensory evaluation of value added maize dalia

Sensory quality of product was evaluated using a 9 – point hedonic scale (Manay and Shadaksharaswamy, 2008). Value added maize dalia was evaluated in the form of sweet and salty preparation. The samples were served separately to 30 selected panel members. The sensory parameters used for the evaluation were colour, flavor, texture, taste and general acceptability.

RESULTS AND DISCUSSION

The value added maize dalia had higher macro nutrients (energy, protein) as compared to traditional maize dalia (Table - 1). The calorific value (per 100 gram) of value added maize dalia (687.00 kcal) was higher than traditional maize dalia

Table 1: Comparative analysis of proximate composition of traditional and value added maize dalia (100g)

Nutrients	Traditional maize dalia	Value added maize dalia
Energy (kcal)	342	687
Protein (g)	11.1	23.77
Calcium (mg)	10	43.67
Phosphorus (mg)	348	267.67
Iron (mg)	2	3.77
Carotene (μ g)	90	48.33
Thiamine (mg)	0.42	0.32
Riboflavin (mg)	0.1	0.32
Niacin (mg)	1.8	1.42

Table 2: Comparative analysis of essential amino acid content of traditional and value added maize dalia

Essential amino acids	Traditional maize dalia	Value added maize dalia
Approximate Total Nitrogen (g per 100 g)	0.52	0.72
Lysine (g per 100 g)	0.11	0.29
Tryptophan (g per 100 g)	0.02	0.04
Methionine (g per 100 g)	0.06	0.08
Leucine (g per 100 g)	0.37	0.48
Isoleucine (g per 100 g)	0.13	0.24

Table 3: Nutrient adequacy through value added maize dalia

Nutrients	Preschool children (175g)*			Pregnant women (445g)*			Lactating Women (470g)*			Elderly population (460g)*		
	A	B	C(%)	A	B	C(%)	A	B	C(%)	A	B	C(%)
Energy(Kcal)	1240	1013.25	81.71	2175	2576.55	118.46	2425	2721.3	112.21	2425	2663.4	109.83
Protein (g)	22	53.64	243.82	65	136.39	214.45	75	144.06	192.08	60	140.99	234.98
Calcium(mg)	400	76.42	19.11	1000	194.33	19.43	1000	205.25	20.53	400	200.88	50.22
Iron(mg)	12	6.6	55	38	16.78	44.16	30	17.72	59.07	28	17.34	61.93
Carotene (μ g)	1600	84.58	5.28	2400	215.07	8.96	3800	227.15	5.99	2400	222.32	9.26
Thiamine(mg)	0.6	0.56	93.33	1.1	1.42	129.09	1.2	1.5	125	1.2	1.47	122.5
Riboflavin(mg)	0.7	0.21	30	1.3	0.53	40.77	1.4	0.56	40	1.4	0.55	39.29
Niacin(mg)	8	2.49	31.13	14	6.32	45.14	16	6.67	41.69	16	6.53	40.81

A : Recommended dietary allowances of vulnerable groups for different nutrients; B : Nutrient composition of value added maize dalia as per recommended dietary allowances from cereal groups for vulnerable group; C : Nutrient Adequacy (%) of value added maize dalia as per recommended dietary allowances among vulnerable groups

*Amount of cereal recommended for different vulnerable groups (source : Nutritive value of Indian foods, 1981, ICMR Publication)

(343.00 kcal).

Similarly the protein content has been found to be higher in case of value added maize dalia (23.77 g) in comparison with traditional maize dalia (11.10 g).

The calcium and iron content was also high in value added maize dalia (43.67 mg calcium and 3.77 mg iron per 100 g maize dalia) as compare to traditional maize dalia. Only the phosphorus content was low in value added maize dalia (267.67 mg / 100 g) as compared to traditional maize dalia (348 mg / 100 g).

Value added maize dalia was fair source of carotene (48.33 μ g / 100 g), riboflavin (0.32 mg/ 100 g) and niacin (1.42mg / 100 g) as compared to traditional maize dalia.

Value added maize dalia was rich source of protein, calcium and iron, it can be recommended for vulnerable groups. Positive effect of processing and value addition on maize products was observed by many researchers (singh, 2001; Rauf Shah, 2016; Kumari and Singh, 2013 and sule Enyisi *et al.*, 2015)

It can be observed (Table - 2) that the total nitrogen content which determines the protein value of food products is higher in value added maize dalia (0.72g/100g) than traditional maize dalia (0.52g/100g). lysine one of the important limiting amino acid of cereal is very high in value added maize dalia (0.29g/ 100g) than traditional maize dalia (0.11g / 100g).

Again tryptophan a limiting amino acid of maize is higher in value added maize dalia as compared to traditional maize dalia (0.02g/100g). methionine, another important amino acid was higher in value added maize dalia (0.08g/100g) than traditional maize dalia (0.06g/100g). The higher ratio of leucine to isoleucine in maize makes the maize protein unavailable to the body. In case of traditional maize dalia the leucine to isoleucine ratio is 2.85 : 1 whereas it is 2.00 : 1 in case of value added maize dalia.

Since the quality of protein determined by its amino acid composition the higher amount of lysine and tryptophan along with balanced ratio of leucine to isoleucine makes the value added maize dalia more nutritious and hence these are recommended for vulnerable groups.

It can be observed (Table - 3) if value added maize dalia is taken as soul food out of cereal groups, 175g of the maize product recommended for preschool children provides 1013.25 kcal energy, 53.64g protein, 76.42mg calcium,

Table 4: Per cent adequacy of nutrients with respect to 100 kcal in value added maize dalia

Vulnerable groups		Protein (g)	Calcium (mg)	Iron (mg)	Carotene (μ g)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)
Preschool children	RDA (100 kcal)	1.77	32.26	0.97	129.03	0.05	0.06	0.65
	Value added maize dalia	4.02	30.19	1.74	39.79	0.1	0.04	0.67
	Adequacy (%) per 100 kcal	227.12	93.58	179.38	30.79	200	66.6	103.07
Pregnant women	RDA (100 kcal)	2.99	45.97	1.74	110.34	0.05	0.06	0.64
	Value added maize dalia	4.02	30.19	1.74	39.79	0.1	0.04	0.67
	Adequacy (%) per 100 kcal	134.45	65.67	100	36.02	200	66.6	104.69
Lactating women	RDA (100 kcal)	3.09	41.23	1.24	156.7	0.05	0.06	0.66
	Value added maize dalia	4.02	30.19	1.74	39.79	0.1	0.04	0.67
	Adequacy (%) per 100 kcal	130.09	73.22	140.32	25.36	200	66.6	101.52
Elderly people	RDA (100 kcal)	2.45	16.49	1.15	98.97	0.05	0.06	0.66
	Value added maize dalia	4.02	30.19	1.74	39.79	0.1	0.04	0.67
	Adequacy (%) per 100 kcal	164.08	183.08	151.3	40.15	204.08	60.6	101.52

6.60mg iron, 84.58 μ g carotene, 0.56mg thiamine, 0.21mg riboflavin and 2.49mg niacin. When its contribution to the total recommended dietary allowances is calculated the nutrient adequacy of maize out of cereal groups has been found to be 81.71 per cent in case of energy, 243.82 per cent for protein, 55.00 per cent for thiamine, 31.13 per cent for niacin and 30.00 per cent for riboflavin. It was low in calcium (19.11%) and very low in carotene (5.28%).

In case of pregnant women if maize is taken in a recommended dose that is 445g for cereal it provides 2576.55 kcal energy, 136.39g protein, 194.33mg calcium, 16.78mg iron, 215.07 μ g carotene, 1.42mg thiamine, 0.53mg riboflavin and 6.32mg niacin. Nutrient adequacy of maize diets in case of pregnant women is 118.46 per cent for energy, 214.45 per cent for protein, 44.16 per cent for iron, 129.09 per cent for thiamine, 40.77 per cent for riboflavin and 45.14 per cent for niacin. The recommended dose (460g) of cereals in case of lactating women if consumed in forms of maize diets provides 2721.30 kcal energy, 144.06g protein, 205.25mg calcium, 17.72mg iron, 227.15 μ g carotene, 1.50mg thiamine, 0.56mg riboflavin and 6.67mg niacin. Nutrient adequacy of maize diets in case of lactating women 112.21 per cent for energy, 192.08 per cent for protein, 59.07 per cent for iron, 125.00 per cent for thiamine, 40.00 per cent for riboflavin and 41.69 per cent for niacin. The recommended dose (470g) of cereal in case of elderly population if consumed in forms of maize diets provides 2663.40 kcal, 140.99g protein, 200.88mg calcium, 17.34mg iron, 222.32 μ g carotene, 1.47mg thiamine, 0.55mg riboflavin and 6.53mg niacin. Nutrient adequacy of maize diets in case of elderly population is 109.83 per cent for energy, 234.98 per cent for protein, 50.22 per cent for calcium, 51.93 per cent for iron, 122.50 per cent for thiamine, 39.29 per cent for riboflavin and 40.81 per cent for niacin. It was very low in carotene (9.26%).

It can be observed (Table – 4) that the total protein content in value added maize dalia taken by preschool children, pregnant women, lactating women and elderly population surplus by 243.82, 214.45, 192.08 and 234.98 per cent respectively. Energy value of value added maize dalia was surplus by 81.71 per cent for preschool children, 118.46 per cent for pregnant women, 112.21 per cent for lactating women and 109.83 per cent for elderly population. Similarly the percentage of thiamine content is surplus by 93.33 per cent for preschool children, 129.09 per cent for pregnant women, 125.00 per cent for lactating women and 122.50 per cent for elderly population

and the percentage of niacin was surplus by 31.13, 45.14, 41.69 and 40.81 per cent for preschool children, pregnant women, lactating women and elderly population. Other important nutrients like calcium, iron and riboflavin was also in improved state in value added maize dalia.

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