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Research Article

Physico-Chemical Properties and Nutritional Factors of Kodo Millets

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ABSTRACT

Kodo millet is one the ancient grains ofthe world, In India different kinds of traditional foods made from small millet grains from staple diet for many rural and urban households. Kodo millet is rich in carbohydrate and crude fiber. Mullets are nutritionally superior than other cereals. Kodo millet grains were evaluated for physico chemical properties employing standard procedure. Kodo millet is light yellow in color, small seeded (1.7mm) with thousand grain weight volume and density of 2.8 g, 1.2ml and 1.84 respectively. The mean hydration capacity of the grains was 0.54% with an index of 24.52. Swelling capacity of the grains was 0.55% with an index of 42.30. Kodo millet grains cooking quality requiring short duration (12minutes) Nutrient composition of kodo millet provide essential macro and micro nutrients, the nutritional analysis is estimated by AOAC method. Nutrient composition of carbohydrate, moisture, fiber, protein and fat is 64.3g, 11.2%, 8.3g, 8.1g and 1.3g respectively, minerals like phosphorus, calcium and Iron is 16mg, 32mg and 0.5mg respectively.

Key words: *Kodo millet, Decortications, Germination, Fermentation*

INTRODUCTION

Kodo millet (*Paspalum scrobiculatum*) is one of the ancient grains of the world, originated (S from Africa and domesticated in India few thousand years ago it is a draught resistant plant. This millet crop is grown in arid and semi-arid grains of African and Asian countries. Traditional technologies such as decortications, germination, fermentation and soaking of cereal and improve protein and starch digestability. The antioxidant activity of kodo millets decreases based foods reduce the level of tannins and phytates, increase the bioavailability of amino acids and mineral elements when the whole grain is dehulled and cooked.

Health benefits of kodo millet, Anti-diabetic, Antioxidant and anti-microbial activity, Anti-obesity, Anti-cholesterol and anti-hypertention:

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MATERIAL AND METHODS

3.1 Procurement of Kodo millet

Bulk samples of Kodo millet grains were collected from local market of Vijayapur district. Samples were cleaned and damaged grains as well as stones and pebbles also removed by manually and stored in air containers till further use.

3.2 Physical properties of Kodo millet

Physical appearance of grain is an important characteristics which determines consumer acceptability, hence the physical characteristics of Kodo millet like, color and shape were visually observed. Thousand grain weight and volume, bulk density, hydration, swelling, cooking and oil absorption characteristics were studied by following procedures.

3.2.1 Thousand grain weight

Weight of randomly selected grains was recorded in grams using electronic balance with a sensitivity of 0.01mg.

3.2.2 Thousand grain volume

Thousand randomly selected grains were dropped in a measuring cylinder containing known volume of distilled water. The difference in volume was recorded in ml.

3.2.3 Bulk density Bulk density was calculated using formula:

$$\text{Bulk density} = \frac{\text{Seed weight(g)}}{\text{Seed volume(ml)}}$$

The bulk density was expressed as g per ml.

3.2.4 Hydration capacity and index

Hydration capacity was calculated as the difference in weight of seeds after soaking for 24hours. It was expressed as weight per gram.

Hydration index was calculated by using the formula given by Kantha *et al*.,

$$Hydrationindex = \frac{Hydrationcapacityper\ 1000\ seeds}{Originaldryweightof\ 1000\ grains} X100$$

3.2.5 Swelling capacity and index

Swelling capacity was calculated as the difference in volume of seeds after soaking for 24hours. It was expressed as weight per gram.

Swelling index of Kodo millet was calculated as described by Kantha *et al*., using the formula.

$$Swellingindex = \frac{swellingcapacityper\ 1000\ seeds}{Seedvolumeper\ 1000\ seed}\ X\ 100$$

3.2.6 Cooking quantity /characteristics

The known quantity of Kodo millet grains were dropped in beakers containing known volume of boiling distilled water and cooked till disappearance of chalky white mass when pressed between two glass slides. The cooked weight, volume and water uptake was recorded. The percent increase in weight and volume of the grains was calculated using the formula:

Increase in

$$Weight\ After\ cooking\ (\%) = \frac{cooked\ weight\ (g) - original\ dry\ seed\ weight\ (g)}{Original\ dry\ seed\ weight\ (g)}\ X\ 100$$

$$Increaseinvolumeaftercooking = \frac{volumeofseeds - originaldryvolume}{volumeofdryseeds}\ X\ 100$$

3.2.7 Swelling power, solubility and solid loss

Swelling power and percent solubility of grains was determined according to the methods used by Schoch.

A known quantity of sample was added to a centrifuge tube. Weight of the centrifuge tube containing test sample was noted. A known volume of distilled water was added and cooked in water bath at 100°C for 20 minutes. The cooked samples were centrifuged at 4000 rpm for 10 minutes. The supernatant was transferred to a test tube and inner sides of the centrifuge tube dried well and weighed. The swelling power of the sample per gram was calculated using the formula:

$$\text{Swelling power (g/g)} = \frac{W3 - W2}{W1} \times 100$$

Where, W1 = sample weight
W2 = tube + sample weight before cooking
W3 = tube + sample weight after cooking

For per cent solubility of the sample, weight of empty Petri dish was noted and after pouring 10 ml of supernatant in a dish, dried at 110°C for 4-5 hours. The Petri dish was cooled and weighed. Per cent solubility was calculated as:

$$\text{Solubility (\%)} = \frac{(W5 - W4)\, VE}{VA} \times \frac{100}{W1}$$

Where,
W1 = sample weight
W4 = weight of empty Petri dish
W5 = weight of petridish after drying the aliquot
VA = amount of supernatant added
VE = amount of water added while cooking

Solid loss was determined by cooking sample in boiling water bath for 20 mins. After this, cooked material is strained in a beaker and the whole filterate is transferred quantitatively to a Petri dish and evaporated over a water bath, followed by drying in an oven at 105°C for 1 hour and weighing the solids.

Nutrient composition of kodo millet

The proximate composition of the Kodo millet was assayed as follows

3.3.1 Estimation of Moisture

A known sample was weighed into a previously weighed moisture cup and dried in an oven at 60C to a constant weight and moisture content calculated as follows:

$$\text{Moisture content \%} = \frac{\text{Initial weight (g)} - \text{final weight (g)} \times 100}{\text{Weight of sample}}$$

3.3.2 Estimation of protein

The nitrogen content of the grains was assessed by Kjeldahl method using Pelican Kelplus equipment. Crude protein was calculated by multiplying with a factor 6.25.

$$\text{Protein (\%)} = \frac{\text{Titre value-Blank x N. of HCl x 14.007 x 6.25}}{\text{Sample weight (g)}} \times 100$$

3.3.3 Estimation of Fat

Moisture free flour samples were weighed in moisture free thimbles and crude fat was extracted by refluxing with petroleum ether in a Soxhlet apparatus. Per cent crude fat was calculated as follows:

$$\text{Fat (\%)} = \frac{\text{Weight of sample before extraction} - \text{Weight of sample after extraction (g)}}{\text{Sample weight (g)}} \times 100$$

3.3.4 Estimation of Carbohydrate

Carbohydrate content was calculated by differential method.

Carbohydrate (g/100g) = 100-(protein + fat + fibre + ash + moisture)

3.3.5 Estimation of fibre

The sample of the fibre was estimated by using moisture and fat free samples and expressed as gram/100 g of the sample.

$$\text{Fibre (g/100g)} = \frac{100 - (\text{moisture} + \text{fat})\text{X (We} - \text{Wa)}}{\text{Weight of sample taken (moisture and fat free)}}$$

3.3.6 Estimation of Iron

The iron in the mineral extract was estimated by Wong's method given by Raghu Ramulu,

Reagents:

- Dissolve 1 grams of potassium persulphate in 100 ml of distilled water
- H2So4(30%): to 70 ml of distilled water 30 ml of H2So4 was added
- Potassium thiocyanate solution (40%): dissolve 40 grams of potassium thiocyanate in 90ml of distilled water and 4 ml of acetone was added to it and he volume was made up to 100ml.
- Standard iro solution: Stock standard solution was made up to 1 liter to give final concentration of 0.1 mg/ml.
- Working standard: 10ml of stock solution was made up to 100 ml to give final concentration of 0.01mg/ml.

Procedure

Working standard solution was taken in the values of 1.0, 1.5, 2.0,2.5 and 3.0ml which correspond to 0.01,0.015,0.02, 0.025 and 0.03mg of iron respectively in different test tubes. To all the test tubes 1.0ml 40% potassium were added. Distilled water was added to make up the volume to 10ml in each test tube and was allowed to stand for 20minutes. The intensity of the color developed was read in the colorimeter at 540nm. 2ml of ash solution was taken an added all other reagents same as in standard. The readings were plotted against different concentration standard and the concentration of unknown was intercepted from the graph.

3.3.7 Estimation of Calcium

Reagents:

- H2so4 (1N): to 97.215 ml of distilled water 2.785 ml of concentrated H2So4 was added.
- Ammonium oxalate solution (4%) : Dissolve 4gms of ammonium oxalate in 100 ml distilled water.
- Dilute ammonia solution: Two ml of liquor ammonia was added to 98 ml of distilled water.
- KMnO4 solution (0.01N) : Dissolved 0.316gms of KMnO4 in 100ml of Distilled water.
- Oxalic acid (0.01N) : Dissolve 0.06303gms of oxalic. In 100 ml distilled water.
- H2SO4 (6N) : To 83.29 ml of distilled water 16.7 of concentrated H2SO4 added.
- Methyl red indicator.

Procedure

Two ml of mineral extract was pipette out into centrifuge tubes. A drop methyl red indicator was added to the tubes and the solution turned light pink in color. Liquor ammonia was added till it turns into light yellow color. This showed that solution was too alkaline. A drop of glacial acitic acid was added to give a salmon pink color indicating the correct PH

for the precipitation calcium. This was mixed well 1ml of ammonium oxalate solution was added.

The tubes were kept overnight and centrifuged at 2000 rpm the following day. The supernatant was thrown off by inverting the tubes carefully on a clear filter paper and drained. Care was taken to prevent the precipitate running along the sides of the tubes. 4ml of liquor ammonia was added to the precipitate along the sides of the test tube and was centrifuged again. The supernatant was thrown off and process was repeated 2 to 3 times. 10ml of 1N sulphuric acid was and the contents were made to dissolve. The tubes were kept in a water bath til the contents started simmering and titrated against 0.01N potassium permanganate when still hot. The end point was definite pink color, which persisted for atleast 1 minute.

RESULTS AND DISCUSSION

Table 1. Physico - chemical characteristics of Kodo millet

parameter Parameter	Characteristics/quantity Characteristics/quantity
Shape	Spherical
Whole grain color	Light yellow color
Color (dehulled)	Creamish white
Size (mm)	1.7
Thousand grain weight(g)	2.8
Thousand grain volume(ml)	1.2
Bulk density	1.84
Hydration capacity (g/1000 seeds)	0.54
Hydration index (%)	24.52
Swelling capacity(ml/1000 seeds)	0.55
Swelling index (%)	42.30
Cooked weight (g)	473
Gain in weight after cooking (%)	373
Cooking time (min)	12
Swelling power g /g	9.73

Table 2. Nutrient composition of Kodo millet

Nutrient	Quantity
Moisture	11.2%
Protein	8.1g
Fat	1.3g
Carbohydrate	64.3g
Fiber	8.3mg
Iron	0.5mg
Calcium	32mg
Phosphorus	169mg

All values are for 100g of sample

Kodo millet has good source of carbohydrate (64.3 g), moisture (11.2%), fiber (8.3g) protein (8.1g) and fat (1.3g). In minerals it is the good source of calcium (32mg), iron (0.5mg) and phosphorus (169mg).

Kodo millet although considered as one of the minor millet, forms a staple food. Kodo millet owing to its superior nutrient composition and nutritional quality in terms of digestibility of both proteins and carbohydrates. The present investigation was under taken to assess the physico chemical characteristics, value addition and storage quality. The results of the present study are discussed in this chapter.

Kodo millet is a small seeded grain exhibiting minute variation in gram color, thousand grain weight, volume and density. Kodo millet is light yellow in color small seed prior to dehulling (Table1). After dehulling, the seed size is further reduced, with thousand grain weight, volume and density of 2.8g, 1.2ml and 1.84 respectively. The dehulled grain color is light yellow to very creamish white is acceptable by common consumer.

Nutritive value of kodo millet provide essential macro and micro nutrients, the nutrient composition of carbohydrate, moisture, fiber, protein and fat is 64.3g, 11.2%, 8.3g, 8.1g and 1.3g respectively, minerals like phosphorus, calcium and Iron is 16mg, 32mg and 0.5mg respectively.

Kodo millet is a grain of excellent nutritional quality ideal for inclusion in the daily diet for health benefits. Kodo millet blends with common food ingredients without affecting sensory qualities in common recipes at specified levels of incorporation.

CONCLUSION

Kodo millet is one the ancient grains of the world, In India different kinds of traditional foods made from small millet grains from staple diet for many rural and urban households. Kodo millet is rich in carbohydrate and crude fiber. Mullets are nutritionally superior than other cereals. Kodo millet grains were evaluated for physico chemical properties employing standard procedure. Kodo millet is light yellow in color, small seeded (1.7mm) with thousand grain weight volume and density of 2.8 g, 1.2ml and 1.84 respectively. The mean hydration capacity of the grains was 0.54% with an index of 24.52. Swelling capacity of the grains was 0.55% with an index of 42.30. Kodo millet grains cooking quality requiring short duration (12minutes)

Nutrient composition of kodo millet provide essential macro and micro nutrients, the nutritional analysis is estimated by AOAC method. Nutrient composition of carbohydrate, moisture, fiber, protein and fat is 64.3g, 11.2%, 8.3g, 8.1g and 1.3g respectively, minerals like phosphorus, calcium and Iron is 16mg, 32mg and 0.5mg respectively.

It can be concluded that sensory evaluation done on all the recipes revealed that Kodo millet significantaly improved their organoleptic and storage quality. Organoleptic evaluation of sev during storage gradually decreases from 5^{th} day and it was not acceptable on 15^{th} day similarly the organoleptic evaluation of thattai during storage decreases from 5^{th} day and it was moderately not acceptable on 15^{th} day. All products revealed that kodo millet significantly improved their organoleptic and storage quality and also contributed to their high acceptance. The fact that there are inexpensive, locally available and nutritious make them potentially effective in solving diabetes, cardiovascular disease, constipation and obesity.

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