11. MILLET ROTI-MAKING MACHINES

Description of the machine

Millet roti making machines are jointly developed by IIMR in association with private entrepreneur to reduce the inconveniences in making rotis with gluten free millet grain.

Features of the Jowar Roti making machines

Version	Version 1	Version 2	Version 3
Operation	Foot operated	Hand operated	Hand operated
Space Requirement	More	Less	Less
Capacity Speed	40 rotis/hr Low (150 rpm)	50-60 rotis/hr Medium (200 rpm)	80-100 rotis/hr High (250 rpm)
Cost	Rs 25 K	Rs 10 K	Rs 8 K

Advantages and Uniqueness of the roti machine

- Used to make gluten-free roti conveniently with higher capacity.
- Removal of inconveniences in preparation of sorghum/millet based rotis.

Please contact for further information:
Dr. B. Dayakar Rao, Principal Scientist,
PI-CoE on Sorghum, ICAR-Indian Institute of Millets Research
Hyderabad, Telangana – 500 030
Email: dayakar@millets.res.in; website: www.millets.res.in

Printed & Published by:
Dr. VA. Tonapi, Director,
ICAR- Indian Institute of Millets Research, Hyderabad.

eatrite™
Eat Jowar - Stay Healthy

AT A GLANCE

NEW TECHNOLOGIES ON MILLET VALUE ADDED FOODS

CENTRE OF EXCELLENCE ON SORGHUM

Sponsored by DAC, Govt. of India

ICAR - INDIAN INSTITUTE OF MILLETS RESEARCH (IIMR)

Hyderabad. www.millets.res.in

EATRITE PRODUCTS TO BE COMMERCIALIZED

1. PUFFS FROM SORGHUM

Description of the technology

Sorghum puffs are RTE (ready to eat) snacks which are developed using puff gun machine where the sorghum grain is loaded into a rotating barrel and fired resulting in an expanded product to a maximum expansion consistent with retention of the grain identity (similar shape of the grain).

Products and by products: Puffs yield – 94%; By-product yield – 6% (small puffs and unpuffed grains)

Advantages and Uniqueness of technology/Product

- They are rich in protein and fibre.
- Variants available masala coated and fried, and also can be coated with other flours (bajra and channa dal) and fried.
- The shelf life is for 4 months when packed in air tight MET pouches at ambient temperatures.
- It can serve as inflight snack or generic evening snack.

Nutrient composition for puffed sorghum (per 100 g)	
Nutrients (100g)	**Value**
Protein (%)	11.9
Fat (%)	3.02
Dietary fibre (g)	13.88

2. EXTRUDED SNACKS

Description of the technology

Extruded Snacks are Ready-To-Eat products prepared using twin-screw hot extruder which combines heating with the act of extrusion to create a shaped cooked product. The formulation of sorghum grits, rice, ragi, wheat and corn flour, is combined and passed through twin screw extruder to produce expanded snacks which can be coated with desired spices to create variations in the taste and flavor.

Products and by products: Snacks yield – 90%; By-product yield – 10% (Extrudate by-product)

Advantages and Uniqueness of technology/Product

- The snacks vary in colour from white to cream and are crispy in nature

B) MILLETS BREAD/ BUN

Description of the technology

Millet Bread is a RTE product which have been prepared at IIMR of replacing 50% wheat by mixing a mixture of millet flour, water, fat, salt and yeast until the mixture gets converted into dough, which is followed by baking the dough into a loaf. The dough is proofed and then baked in oven to get bread. Round balls of the dough is made and baked to get bun.

Advantages and Uniqueness of technology / Product

- Millet bread are fibre rich and beneficial for all age groups.
- Utility as breakfast food
- It is rich in magnesium, zinc, iron, dietary fibre and protein.
- It has a shelf life of 6 days when packed in MET packets.

Nutritional profile of Millets Bread (per 100 g)	
Nutrients (100g)	**Millet Bread**
Protein (%)	7.4
Fat (%)	12.3
Dietary fibre (g)	0.8

C) MILLETS CAKE

Description of the technology

Millet Cake is a RTE product which is prepared at IIMR using 100% of millet flour, sugar, fat, eggs and flavoring ingredients until the mixture gets converted into cake batter, which is followed by baking in an oven.

Advantages and Uniqueness of technology/Product

- Millet cake is fibre rich and beneficial for all age groups.
- Utility as snack food or breakfast food
- It is rich in magnesium, zinc, iron, dietary fibre and protein.
- It has a shelf life of 4 days when packed in MET packets.

Nutritional profile of Millets Cake	
Nutrients (100g)	**Millet Cake**
Protein (%)	9.4
Fat (%)	25.3
Dietary fibre (g)	1.8

Nutrient composition for Millets Pasta (per 100 g)			
	Protein (%)	Fat (%)	D.Fibre (g)
Ragi Pasta	9.39	1.02	1.2
Bajra Pasta	8.39	1.38	1.24
Korra Pasta	1.2	1.88	1.32

10. BAKERY PRODUCTS

Description of the technology (for all millets)

Bakery Products like cookie, bread/bun, cake etc., are preferred and also branded as healthy conventional foods.

Millets were incorporated indifferent variations from 10% to 50% levels to standardize cookies (100%), bread/bun (50%) and cake (100%) by replacing refined wheat flour or using 100% millet flour at IIMR. It is the need of the hour to develop bakery foods as convenience foods and IIMR has carried out research in developing millet based RTE bakery foods described, here under.

A) Millets Cookies

Description of the technology

Millet Cookies are popular ready-to-eat product prepared at IIMR using the formulation of pearl millet/finger millet/foxtail millet flour of superior quality with addition of sugar, milk solids, trans free-fat, salt and nature identical flavoring substances using a planetary mixer, automatic cookie making machine and rotary oven.

Products and by products: Cookie – 92%; By-product yield – 8% (Dough left in the machine, Broken cookies or unbaked)

Advantages and Uniqueness of technology/Product

- Pure Millet biscuits are fibre rich and beneficial for all age groups.
- Low sugar and low fat compared to the market products.
- It is rich in magnesium, zinc, iron, dietary fibre and protein.
- It has a shelf life of 6 months.

Nutritional profile of Millets Biscuits (per 100 g)			
	Protein (%)	Fat (%)	D.Fibre (g)
Ragi Biscuit	7.4	21.3	1.9
Bajra Biscuit	7.39	23.3	22.5
Korra Biscuit	1.9	1.4	1.2

- Utility as evening snacks and inflight snacks.
- They are rich in protein, fibre, iron, zinc and magnesium.
- The shelf life of the product was 6 months and the shelf life analyses are still in progress.
- Variants available masala coated.

Nutritive values of ready-to-eat extruded snack (per 100 g)	
Nutrients (100g)	Value
Protein (%)	12.90
Fat (%)	1.70
Dietary fibre (g)	12.88

3. EXTRUDED FLAKES

Description of the technology

Extruded Flakes are Ready-To-Eat products made with sorghum grits, wheat and corn flour using twin-screw hot extruder to extrude round shaped product which is further flattened in roller flaker machine.

Products and by products: Flakes yield – 88%; By-product yield – 12% (Extrudate by-product, un-flattened flakes)

Advantages and Uniqueness of technology/Product

- Utility as breakfast cereals and can be used instead of corn flakes.
- The shelf life of the product was 5 months and the shelf life analyses are still in progress.
- Variants available masala coated, chocolate or essence based.

Nutritive values of ready-to-eat extruded flakes (per 100 g)	
Nutrients (100g)	Value
Protein (%)	13.90
Fat (%)	1.40
Dietary fibre (g)	14.88

4. INSTANT MIXES

Instant Mixes and ready to reconstitute foods have become well established products in changing scenario of everyday busy life. It is the need of the hour to develop traditional foods as convenience foods and IIMR has carried out research in developing sorghum based instant mixes described, here under.

A) Instant Sorghum Idli Mix

Description of the technology

Idli is an indigenous steamed traditional breakfast food and an attempt has been made at IIMR to prepare instant sorghum idli mix formulated using sorghum fine semolina, powdered blackgram dhal, salt, citric acid and sodium bicarbonate. The formulated mix was packed in a MPET packing material.

Advantages and Uniqueness of technology / Product

- Instantly sorghum idli can be prepared reducing the cumbersome time for fermentation.
- It is rich source of phenolic compounds, causes satiety resulting in slower digestibility and reduces oxidative stress.
- The shelf life of idli mix is 3 months.
- The instant idli mix has high amount of calcium, iron, zinc and riboflavin when compared to control idli.

Nutritional Composition of Instant Idli mix (per 100 g)	
Nutrients (100g)	**Value**
Energy (kcal)	364
Folic acid (μg)	45.7
Carbohydrates (g)	71.7
Calcium (mg)	10.2
Protein (g)	12.4
Iron (mg)	7.2
Fat (g)	1.6
Zinc (mg)	0.9
Riboflavin (mg)	1.5
Magnesium (mg)	102.3

B) INSTANT UPMA MIX

Description of the technology

Upma is an indigenous boiled traditional breakfast food and an attempt to prepare instant sorghum upma mix at IIMR formulated

8. MILLETS VERMICELLI

Description of the technology (for all millets)

Vermicelli is prepared using cold extrusion where Finger millet /Foxtail millet /Pearl millet semolina and refined wheat semolina are blended with water for 30 minutes and extruded using a round die, which is allowed to temper in room temperature for 8 hours and then dry in a cabinet drier for 6 hours.

Products and by products: Vermicelli yield – 99%; By-product yield – 1% (negligible)

Advantages and Uniqueness of technology/Product

- Used to make semiya (sweet/spicy) and can be added to milk
- It is rich in protein, calcium, iron and magnesium compared to wheat pasta
- It is Gluten Free, low calorie and rich source of phenolic compounds.
- All millets vermicelli can be stored for six months at ambient temperature

Nutritional Composition of Millet Vermicelli (per 100 g)			
	Protein (%)	**Fat (%)**	**D.Fibre (g)**
Ragi Vermicelli	9.39	1.02	1.2
Bajra Vermicelli	1.02	1.38	1.88
Korra Vermicelli	7.65	1.24	1.32

9. MILLETS PASTA

Description of the technology (for all millets)

Pasta is prepared using cold extrusion where Finger millet /Foxtail millet /Pearl millet semolina and refined wheat semolina are blended with water for 30 minutes and extruded using a round die, which is allowed to temper in room temperature for 8 hours and then dry in a cabinet drier for 6 hours.

Products and by products: Pasta yield – 99%; By-product yield – 1% (negligible)

Advantages and Uniqueness of technology/Product

- Utility as breakfast food
- Can be stored for six months at ambient temperature; Finger millet /Foxtail millet /Pearl millet vermicelli shelf life studies are still in progress.

Advantages and Uniqueness of technology/Product

- Utility can be used to make upma, khichidi, rawa laddu, idli, dosa, kesari etc.
- They are rich in protein, fibre, iron, and zinc.
- It is Gluten Free, low calorie and rich source of phenolic compounds.
- All two rawa have shelf life of 3 months for pearl millet, foxtail millet and finger millet.

Nutritional Composition of Millet Rawa (per 100 g)			
	Protein(g)	Fat (g)	Fibre (g)
Bajra Idli Rawa	16.1	3.2	1.6
Bajra Upma Rawa	16.3	3.1	1.7
Ragi Idli Rawa	13.1	3.4	1.2
Ragi Upma Rawa	14.1	3.6	1.4
Korra Idli Rawa	11.1	2.5	1.6
Korra Upma Rawa	12.1	2.7	1.7

7. MILLETS FLOUR

Description of the technology (for all millets)

Flour is used as a main ingredient for various recipes. Millet grains (Pearl Millet/Bajra, Finger Millet/Ragi and Foxtail Millet/Korra) are processed by dry milling where the grain are cleaned and milled using hammer mills to separate the endosperm, germ and bran from each other to get fine flour. Ragi flour, Bajra flour and foxtail millet flour have been developed.

Products and by products: Flour yield – 89%; By-product yield – 11% (Bran)

Advantages and Uniqueness of technology/Product

- It is rich in magnesium, zinc, iron, dietary fibre and protein.
- Used to make rotis and bakery foods (cakes and biscuits).
- It is Gluten Free, low calorie and rich source of phenolic compounds.
- Korra flour, Ragi flour and Bajra can be stored for two months at ambient temperature

Nutritional Composition of Millet Rawa (per 100 g)			
	Protein(g)	Fat (g)	Fibre (g)
Bajra Flour	6.1	2.2	1.5
Ragi Flour	7.1	2.4	1.2
Korra Flour	5.1	2.5	1.4

using roasted sorghum semolina, Bengal gram dal, mustard seeds, curry leaves, dried green chillies, salt and oil. The formulated mix was packed in a MPET packing material.

Advantages and Uniqueness of technology / Product

- Instantly sorghum upma can be prepared with added flavor and taste.
- It is Gluten free, low calorie, rich in protein, iron and fibre.
- Rich source of phenolic compounds and causes satiety resulting in slower digestibility.
- The shelf life of upma mix is 6 months.

Nutritional Composition of Instant Upma mix (per 100 g)	
Nutrients (100g)	Value
Energy (kcal)	374
Carbohydrates (g)	78.7
Protein (g)	13.4
Fat (g)	1.8
Fibre (g)	1.5

C) INSTANT DOSA MIX

Description of the technology

Dosa is an indigenous traditional breakfast food like pan cake. An attempt to prepare instant sorghum dosa mix was done at IIMR formulated using sorghum flour, blackgram dhal (2:1), salt, citric acid and sodium bicarbonate which were mixed uniformly in a blender. The formulated mix was packed in a MPET packing material.

Advantages and Uniqueness of technology / Product

- Instantly sorghum dosa can be prepared with added flavor and taste.
- It is Gluten Free, low calorie, rich in fibre and iron.
- Rich source of phenolic compounds and causes satiety resulting in slower digestibility.
- The shelf life of dosa mix is 6 months.

Nutritional Composition of Instant Dosa mix (per 100 g)	
Nutrients (100g)	**Value**
Energy (kcal)	364
Folic acid (μg)	45.7
Carbohydrates (g)	71.7
Calcium (mg)	10.2
Protein (g)	12.4
Iron (mg)	7.2
Fat (g)	1.9
Zinc (mg)	0.9
Riboflavin (mg)	1.5
Magnesium (mg)	102.3

D) INSTANT PONGAL MIX

Description of the technology

Pongal is a traditional breakfast recipe and an attempt has been made at IIMR to prepare instant pongal mix formulated using processed sorghum, green gram dhal, spices and condiments. The formulated mix was packed in a MPET packing material.

Advantages and Uniqueness of technology/Product

- Instantly Pongal can be prepared with added flavor and taste.
- It is Gluten free, low calorie and safe for Celiac Patients.
- Rich source of phenolic compounds, causes satiety resulting in slower digestibility and reduces oxidative stress (Antioxidant)
- Shelf life is or a period of one year.

Nutritional Composition of Instant Pongal mix (per 100 g)	
Nutrients (100g)	**Value**
Energy (kcal)	242.4
Fat (g)	3.1
Carbohydrates (g)	142.4
Fibre (g)	15.4
Protein (g)	29.1
Amylose (mg %)	12.65

5. SORGHUM MUESLI

Description of the technology

Muesli is a product made by mixing of honey and dry fruits to sorghum flakes. We have made an attempt to prepare sorghum muesli mix where, thick flakes were dry roasted and then coated with honey. Cashew nuts, almonds, pista, raisins were roasted and added to this.

Advantages and Uniqueness of technology/Product

- Utility as snack item or along with milk.
- It is Gluten Free, low calorie and rich source of phenolic compounds.
- It causes satiety resulting in slower digestibility and reduces oxidative stress (Antioxidant)
- Shelf life for a period of one year.

Nutritional Composition of Muesli (per 100 g)	
Nutrients (100g)	**Value**
Energy (kcal)	342.4
Carbohydrates (g)	75.4
Protein (g)	17.1
Fat (g)	2.1
Fibre (g)	1.7

6. MILLETS SEMOLINA (RAWA/SUJI)

Description of the technology (for all millets)

Semolina are ready to cook foods where millet grains (Pearl Millet, Finger Millet and Foxtail Millet) are processed by dry milling. Here the grain are cleaned and milled using hammer mills to separate the endosperm, germ and bran from each other to get semolina of two variants (medium and fine semolina).

Products and by products (for all millets)

- Medium Semolina (Upma Rawa) yield – 71-76% ; By-product yield – 29-24% (contains coarse/fine semolina, flour and bran)
- Fine Semolina (Idli rawa) yield – 74-80%; By product yield – 26-20% (contains coarse/medium semolina, flour and bran)