



UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE

ICAR-ALL INDIA CO-ORDINATED RESEARCH PROJECT ON POST-HARVEST ENGINEERING AND TECHNOLOGY

POST-HARVEST RESEARCH ON NUTRI-CEREALS: *A TWO DECADE COMPENDIUM*

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List of Millet Projects Handled in ICAR- AICRP (PHET) UAS, Bangalore (1999-2021)

Sl. No.	Title of the Project	Year of Start	Year of Completion
1.	Development of small millets popping/puffing machine for cottage industry use	2019	2021
2.	Formulation of Avocado-Milk-Brown top millet diabetic health drink	2019	2021
3.	Development of Probiotic drink/beverage from foxtail millet (<i>Setaria italica</i>)	2018	2020
4.	Hermetic storage of small millet rice for management of insects	2018	2021
5.	Development of a dehuller for Browntop millet (<i>Urochloa ramosa</i>)	2017	2021
6.	Developing active packaging system for small millet rice and its products to prevent insect infestation and development of rancidity	2017	2019
7.	Development of ready-to-serve small millet one dish meal and its production line	2015	2017
8.	Management of storage insects in small millets and their milled rice grains	2014	2016
9.	Development of white ragi (finger millet) based dairy food product	2013	2015
10.	Development of nutri-rich energy foods using small millets	2010	2013
11.	Development of probiotic low fat dahi fortified with small millet flours	2010	2013
12.	Development of techniques for the control of stored grain insects of milled rice and milled pulses	2009	2012
13.	Development of value added nutri-rich products from small millets	2006	2008
14.	Development of value added products from Little, Foxtail and Proso millets	2006	2009
15.	Development of a dehulling and polishing/pearling machines for small millets	2004	2006
16.	Quality evaluation of ragi flour (Finger millet) packaged and marketed as a ready to cook consumer product in Karnataka	2003	2006
17.	Adoption of Thresher – pearler for ragi (Finger millet)	1999	2003

Development of small millets popping/puffing machine for cottage industry use (2019-2021)

Sl.
No.s

Name of the project

Outcome of the project

- 1 Development of small millets popping/puffing machine for cottage industry use (2019-2021)



Among the UAS released ragi varieties, GPU 66, KMR 630, GPU 67 and KMR 340 were found to be best for popping.

Initial grain moisture content of 19% wb with salt water treatment @ 2% w/w) were found to be best to obtain good quality popped ragi product.

An electrically operated Hot-Air Puffing Machine (capacity about 3-5 kg/h) suitable for small millets especially finger millet was successfully designed, developed and tested for its performance. The machine was simple and easy to operate with little training and could be used by SHGs who make value added products from millet puffs.

Formulation of Avocado-Milk-Browntop millet diabetic health drink (2019-2021)

2 Formulation of Avocado-Milk-Browntop millet diabetic health drink (2019-2021)



Composite Beverage .Among the blend ratios of Browntop millet: Avocado: SMP tested, the blend ratio 3:5:5 was most acceptable based on sensory acceptability studies.

Masala blends were prepared by adding the Butter milk masala blend at specified level and adding salt. The prepared blends were highly acceptable.

Storage stability study of the above pasteurized drink revealed that the product was acceptable up to 7 days at refrigerated condition

Development of Probiotic drink/beverage from foxtail millet (*Setaria italica*) (2018-2020)

3 Development of Probiotic drink/beverage from foxtail millet (*Setaria italica*) (2018-2020)



Foxtail millet malt slurry supplemented with liquid whey only and supplemented with 2% honey and 10% liquid whey fermented by lactic acid bacteria showed better results in terms of pH (4.25 & 4.15) TSS (14 & 14.5 brix) with highest titrable acidity (90.45 & 0.59%), LAB counts respectively. Compared to other treatments.

There was a significant difference in supplemented and non-supplemented foxtail millet probiotic beverages with respect to pH, TSS, titrable acidity and total LAB population

Hermetic storage of small millet rice for management of insects (2018-2021)

4 Hermetic storage of small millet rice for management of insects (2018-2021)



For prolonged storage of millet rice grains & management of insects and rancidity Foxtail, little and kodo millet rice grains packaged in 80 micron EVOH multi-layered film package (*ProHarvest*) and sealed hermetically could be stored at ambient conditions for 60 days maintaining shelf-life quality i.e., without appreciable rise in rancidity and insect infestation.

Dehulled foxtail millet rice grains treated with gamma irradiation @ 0.5- 1.0 kGy and packed in 80 micron EVOH multi-layered film package (*ProHarvest*) could be stored under ambient conditions for at least 6 months without insect infestation and significant rise in rancidity of stored grains. The microbial load (bacterial & yeast) also significantly was lowered in the treated grain improving the quality of grain.

Development of a dehuller for Browntop millet (*Urochloa ramosa*) (2017-2021)

5 Development of a dehuller for Browntop millet (*Urochloa ramosa*) (2017-2021)



The prototype *Small Millet Dehuller* consists of a hopper, dehusking chamber and a hull aspiration unit, all mounted on a sturdy angular frame work. The machine is operated by 5 hp electric motor. The heart of the unit is the dehusking chamber where the millets get dehusked mainly by abrasive mechanism. An emery coated cylinder (slightly tapered) rub the millets against the ribbed concave to separate the outer hull (husk) from the endosperm of grain. The gap between the cylinder and concave slightly reduced from feed to discharge end in order to create sufficient grain pressure in the dehusking chamber. The dehusked grain along with husk come out of dehusking chamber and fall by gravity into the husk aspiration unit where the hull is separated out and carried away by the air stream. The hull laden air is passed to a cyclone separator to separate hull from the air. The dehusking efficiency of >95% was observed for most small millets except for brown-top millet for which it was about 75% (2 passes). The prototype is still fine-tuned to achieve higher dehusking efficiency and lesser millet rice grain breakage. Capacity of the Machine 100 kg/h

Developing active packaging system for small millet rice and its products to prevent insect infestation and development of rancidity (2017-2019)

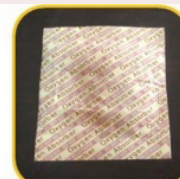
- 6 Developing active packaging system for small millet rice and its products to prevent insect infestation and development of rancidity (2017-2019)



Foxtail millet rice with insects



Red Flour Beetle
(*Tribolium castaneum* Herbst)



Oxygen Absorber



Foxtail millet rice packed in Ecotact, HDPE and LDPE covers

Supply sources of multilayer pouches with gas barrier properties and Oxygen Absorbers of known volume were identified.

Samples of both the multilayer pouches and oxygen absorbers were procured to conduct preliminary trials.

Availability of GCMS support from other Central Institutes was explored.

Development of ready-to-serve small millet one dish meal and its production line (2015-2017)

- 7 Development of ready-to-serve small millet one dish meal and its production line (2015-2017)



Developed Foxtail Millet ODM Instant Mix containing small millet, green gram dal and dehydrated vegetables that gives 744 kcals per serving after preparation, meeting 1/3rd Recommended Dietary Allowance of the target group; Product can be stored up to 3 months.

Management of storage insects in small millets and their milled rice grains (2014-2016)

8 Management of storage insects in small millets and their milled rice grains (2014-2016)



Insect control studies were initiated in both husked rice and unhusked grains of foxtail millet against Lesser Grain Borer (*Rhyzopertha dominica*).

Four treatments comprising Aluminium phosphide @ 9g per tonne, Boric acid 2% w/w, Spinosad 45 SC @ 0.1mg/kg and *Acorus calamus* rhizome powder 0.2% w/w were tried against an untreated control.

In unhusked grains, both Aluminium Phosphide and Spinosad resulted in complete mortality of adults by the first week of treatment, followed by Boric acid (in two weeks).

In treatments with foxtail millet milled rice, Spinosad, Aluminium Phosphide and *A. calamus* performed superiorly compared to Boric acid and the Control, showing a quick knock-down effect with over 88 per cent mortality by first week itself.

Confirmatory trial has been initiated to reconfirm the mortality trends effected by different treatments.

Development of white ragi based dairy food product (2013-2015)

- 9 Development of white ragi based dairy food product (2013-2015)
- The best quality Ready to-Cook malted white ragi based dairy food was formulated by blending malted white ragi flour (70%), SMP (11.5%), sugar (18.5%), multivitamins and minerals with a shelf life of 2 months.
- Honey (5%) and freeze dried probiotic organisms at specified level could be dry blended to the prepared cooled porridge to prepared honey blended probiotic malted food.
- Ready-to-Reconstitute white ragi malted food was developed using vacuum drying (50°C for 8 hrs) and spray drying (160°C inlet and 90°C out let temperatures) which resulted in an enhanced shelf life of 6 months.
- The acceptability of sorghum and white ragi flakes as masala snack were the adjudged as best, even though all were equally acceptable. Shelf life of the Sorghum flakes and White ragi flakes was up to 6 months.

Development of nutri-rich energy foods using small millets (2010-2013)

- 10 Development of nutri-rich energy foods using small millets (2010-2013)
- Three type of nutritious food products were developed: *Ready-to-Use* Beverage Powder Mix, *Ready-to-Eat* Nutri-Mix powder and Calcium & iron enriched Papads from five small millets namely, Little, Barnyard, Proso, Foxtail and Kodo millets.

Development of probiotic low fat dahi fortified with small millet flours (2010-2013)

- 11 Development of probiotic low fat dahi fortified with small millet flours (2010-2013) Process technology for preparation of *Probiotic Low Fat Dahi* products enriched with Whey Protein Concentrate using foxtail, little and proso millets (individually) was developed, which can be commercially exploited. Addition of 1% whey protein concentrate was optimum for millet blended dahi products.

Development of techniques for the control of stored grain insects of milled rice and milled pulses (2009-2012)

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|---|---|
| 12 Development of techniques for the control of stored grain insects of milled rice and milled pulses (2009-2012) | Status and species of insects infesting milled pulses in Karnataka was found out Boric Acid (2%), Zandu Parad tablets (1%) were found to be very effective in controlling Lesser Grain Borer (<i>Rhizopertha</i>) and Rice Weevil (<i>Sitophilus</i>) in milled Bengal gram dal. |
| | Both the Lesser Grain Borer (<i>Rhizopertha</i>) and Rice Weevil (<i>Sitophilus</i>) failed to develop in all the treatments including control in trials with Black gram dal.
The Pulse beetle that was recorded infesting green gram dal in some of field collected samples, failed to develop in all the treatment, including control. |

Development of value added nutri-rich products from small millets (2006-2008)

- 13 Development of value added nutri-rich products from small millets (2006-2008)
- Parboiling has improved the quality of small millet rice grains with respect to cooking qualities and nutrient composition. Nutritious value added bakery products like *chakkuli* and vermicelli have been successfully made incorporating various small millet rice flours and are ready for commercial exploitation.

Development of value added products from Little, Foxtail and Proso millets (2006-2009)

- 14 Development of value added products from Little, Foxtail and Proso millets (2006-2009)
- The evaluation of different pre-treatments for dehusking of small millets using different mills was studied. Attempts were made to dehusk different types of small millets. Small millets were given different pre-treatments prior to dehusking viz., soaking in water, lime water treatment and edible oil treatment. The treated small millets and raw millets were subjected to dehusking using different machines. Laboratory model rubber roll shellar, Ragi pearler, Burr mill and provinder mill (stone) were tried for dehusking. Provinder mill and among treatments limewater pretreatment performed better compared to others and resulted better recovery and good quality rice grains of small millets.

Development of a dehulling and polishing/pearling machines for small millets (2004-2006)

15 Development of a dehulling and polishing/pearling machines for small millets (2004-2006)

The Scheme successfully developed a pearler for foxtail millet by modifying the ragi pearler developed by the scheme and the efficiency was more than 99 percent. Both Burr mill and friction type rice pearler were used for milling studies. Milling of hydrothermally pre-treated little and foxtail millet grains indicated that the dehulling and milling efficiencies and head rice yield improved significantly due to hydrothermal pre-treatments of grains.

Quality evaluation of ragi flour (Finger millet) packaged and marketed as a ready to cook consumer product in Karnataka (2003-2006)

- 16 Quality evaluation of ragi flour (*Finger millet*) packaged and marketed as a ready to cook consumer product in Karnataka (2003-2006)
- The project was taken up to assess the keeping quality or shelf-life of ragi flour which is available as already to cook commodity like wheat flour from fresh ragi was stored in the LDPE- 200G covers and assessed for its safe storage period without any infestation by the insects. The studies revealed that no infestation and off-flavour was observed in the flours stored in LDPE-200G covers and air tight plastic boxes upto 8 months. Rice moth infestation was observed during the 9th month of storage in some containers. There was no reduction in the moisture content of flour upto 6 months of storage. But however decreased thereafter. Soluble carbohydrate content of the flours started decreasing after 3 months of storage. Amount of water soluble proteins started decreasing after 2 months of storage.

Adoption of Thresher – pearler for ragi (Finger millet) (1999-2003)

- 17 Adoption of Thresher – pearler for ragi (*Finger millet*) (1999-2003)
- It was observed that there was no complete removal of glumes converging the ragi grain. This was found to be due to the polishing drum coming in contact with the grain. By further modification of the pearling drum with a slight increase in the frictional area there is a definite improvement in the pearling efficiency was seen.

