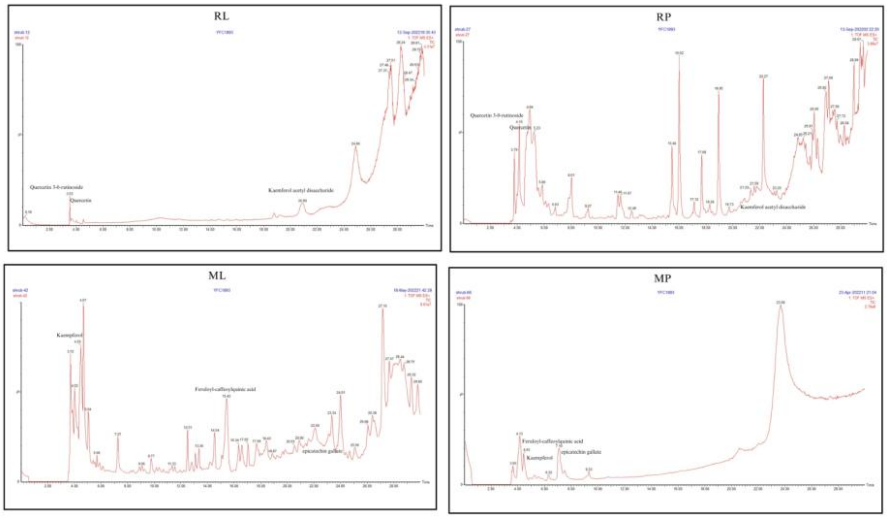
Significant Achievements of Division of Food Science and Postharvest Technology

Flash Vacuum assisted extraction of betalain for enhanced colourant recovery from beetroot

The use of natural food colourants offers dual benefits by imparting a natural hue to food products while also providing bio-functional properties to consumers. Efficient extraction methods enhance the potential for commercial exploitation of this produce. Flash Vacuum Expansion (FVE) is a mild, rapid extraction technology that combines thermal treatment with a sudden pressure drop to enhance the release of intracellular pigments from plant tissues. To optimize this process, a 3-factor, 3-level Box-Behnken Design (BBD) was employed to evaluate the estimation of betalain content. The optimized condition of extraction (time of superheated treatment: 3min), vacuum pressure (250 mm of Hg) and vacuum time (3 minutes) led to an enhanced mass transfer rate and a significantly higher extraction yield—approximately 37% greater than that of the conventional method.

Identification of bioactive compounds in ornamental plant extracts

A total of 126 compounds from rose and marigold were identified through UPLC-ESI-QToF-MS/MS and FTIR imparting antioxidant activity to the rose and marigold leaf and petal extracts. The primary polyphenol compounds identified in rose were quercetin, quercetin 3-O-rutinoside, and kaempferol acetyl disaccharide, while in marigold these were identified as kaempferol, epicatechin gallate, and feruloyl-caffeoylquinic acid.



Chromatograms for rose leaf (RL), rose petal (RP), marigold leaf (ML) and marigold petals (MP)

Testing the efficacy of functionalized edible coating on maintaining the quality of guava fruit

Carboxy methyl cellulose (CMC) and gum arabic (GA) based active edible films activated with rose leaf (RL) and marigold petal (MP) extracts were developed and their impact on the shelf life and postharvest quality of guava fruits when stored under cold condition (10 ± 1 ◦C) was evaluated. When applied to guava fruits, the shelf life was extended up to 18 days for GA + RL, CMC + MP, and CMC + RL coatings. CMC + RL coated fruits retained higher weight retention percentage (91.03 %) and showed lower ethylene production rates along with enhanced biochemical properties. Antioxidant activity (DPPH) was better preserved in coated fruits, with CMC + RL being the most effective. PME and APX enzyme activities were lower in active-coated fruits. CMC + RL coatings outperformed all other coating formulations in maximizing storage life (18 days) and maintaining quality attributes with lowest ripening index (35.93) and total colour difference (82.80).

Utilization of grape pomace for development of extruded snack

Grape pomace incorporated puffed snack was developed with good organoleptic acceptability, high fiber and antioxidant activity. Optimal extrusion conditions were identified as 7.5% grape

pomace inclusion, 11% feed moisture, a screw speed of 300 rpm, and a barrel temperature of 117–121°C. Under these conditions, the optimized product demonstrated desirable characteristics, including an expansion ratio of 1.92, porosity of 0.72, total phenolic content of 784.69 mg GAE/100 g, antioxidant activity (FRAP) of 182.47 μmol TE/g, and a sensory acceptability score of 6.54. In addition to improved textural and sensory attributes, the incorporation of grape pomace significantly enhanced the nutritional and functional quality of the product.

The huge nutritional potential of processed little millet

Little millet (LM) is a nutrient dense and climate resilient grain. The effect of different processing treatments (roasting, pressure cooking, soaking, germination) was studied on nutritional, anti-nutritional, structural (XRD), thermal (TGA) and bioactive (NMR) profile of LM. The findings revealed varying effects of the processing treatments on the LM characteristics. Notable inferences include that *in-vitro* digestion of LM showed significantly ($p<0.05$) higher DPPH radical scavenging activity and FRAP activity post digestion in pressure cooked LM, while CUPRAC activity, total phenolic content and total flavonoid content were significantly ($p<0.05$) higher in germinated LM. All the treatments significantly reduced the phytic acid content, an anti-nutritional component. Germination and roasting treatments significantly enhanced the α-amylase and α-glucosidase inhibition activity which suggests a retarding effect of these processing treatments on post prandial blood glucose increase by millet-based foods. Amongst different processing treatments, germination and pressure cooking resulted in various useful bioactive compounds such as amino acids, mono unsaturated and poly unsaturated fatty acids and polyphenolic compounds that play an important role in functioning of human body. XRD revealed enhanced crystallinity in soaked and germinated LM. The suitable processing treatments can positively alter the nutritional, structural and bioactive profile of the LM while reducing the anti-nutritional factors. Thereby, the study provides meaningful insights on the impact of processing treatments towards improving functionality of treated millets and their utility in future functional food applications.

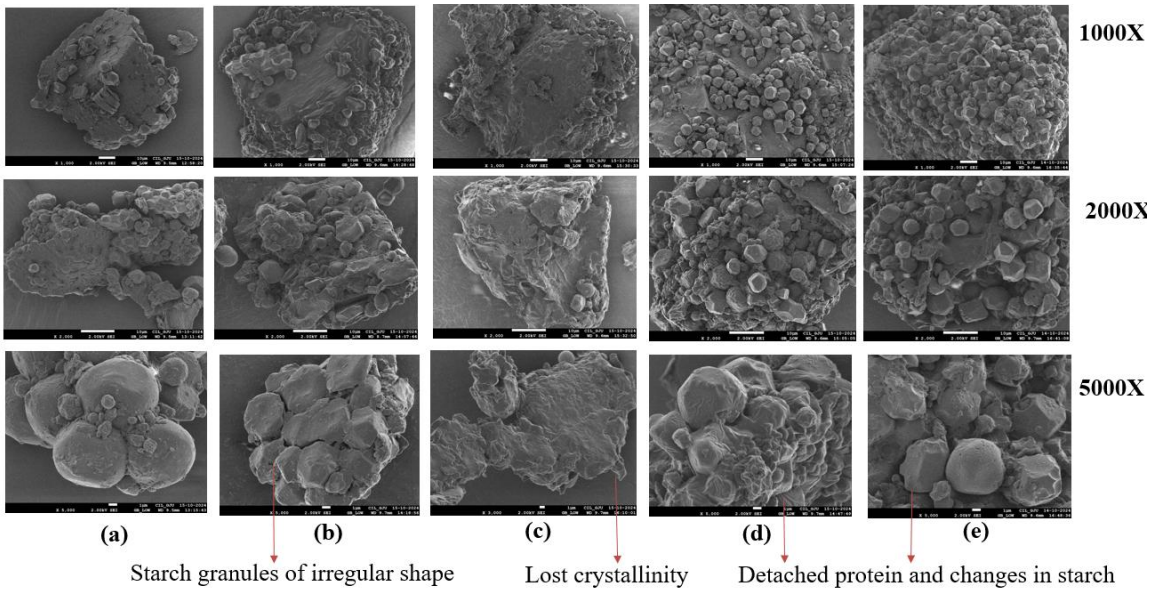


Fig. Effect of processing treatments on the little millet flour as studied under Scanning Electron

Microscopy [(a) control/ native; (b) roasted; (c) pressure cooked; (d) soaked; (e) germinated]

b. Technical Publications (English)

c. Regular Publications (Hindi)

d. Technical Publications (Hindi)

e. PUBLICATIONS AT A GLANCE

(i) Number of Publications (to be supplied by the All Divisions/ Centres/ Stations/ Units) as per the proforma given:

(a) Research papers (With international impact factor or NAAS rating 6 and above) published in National/ International journals (Numbers must be based on first authorship only)

(b) Research

(ii) Similarly, where authorship is given to one or more authors from IARI in a paper published by other organization (e.g. DU, JNU, PAU, MoA, NPL, etc.) the first author amongst all from IARI, mentioned in the paper may be considered by reporting the number.

(i) Publication of popular articles (in Number only)

S. No.	Popular Articles	
	Hindi	English
	6	28

(ii) Papers Published in Journals, Conference, Symposia and Other (in Numbers only)

S. No.	Journals (With international impact factor or NAAS rating 6 and above)				Conference, Symposia and Other	
	National Journal		International Journal		National	International
	English	Hindi	English	Other Language		
	4		18			2

(iii) Books & Book Chapters (in Numbers Only)

S. No.	Books		Book Chapters	
	English	Hindi	English	Hindi
1.	1	1	12	2

(iii) Bibliographic details of publications of NAAS rating >10 as per NAAS score 2024.

S. No.	Bibliography of Publication (As per Journal of Indian Journal of Agricultural Sciences)	NAAS rating	Impact Factor (Thompson Reuters)	Journal is UGC Approved or not	Journal is in SCOPUS or not
1.	Ranjani M, Rudra S G, Sharma R M, Arun T, Chawla G, Dash S, Kumar D. 2025. Ultrasonication-assisted polyol-osmosed persimmon candies: effect of ultrasonication and drying techniques on product quality. *Sustainable Food Technology* **3 (1)**: 322-332.	11.3 (not listed)	5.3	Yes	Yes
2.	Ahamad S, Asrey R, Vinod B R, Menaka M, Vargheese E, Prasad K, Chawla G, Balubhai T P, Kumar D 2025. Exogenous Melatonin Application Retains Bioactive Compounds,	13.3	7.2	No	Yes

	Enhances Antioxidant Activity, Reduces Softening and Prolongs Shelf Life of Cherry Tomato (*Solanum lycopersicon* var. Cerasiformaeae) During Cold Storage. *Journal of Future Foods* https://doi.org/10.1016/j.jfutfo.2025.03.008				
3.	Vinod B R, Asrey R, Varghese E, Meena N K, Patel V B, Ahamad S 2025. Ozonised Water Treatment Delays Ripening and Senescence of Stored Papaya Fruit via Eliciting Antioxidant Defence System. *Journal of Future Foods* https://doi.org/10.1016/j.jfutfo.2024.10.006	13.2	7.2	No	Yes
4.	Ahamad S, Asrey R, Menaka M, Vinod B R, Kumar D, Balubhai T P. 2025. 24-Epibrassinolide treatment boosts bioactive compound preservation, delays softening and extends shelf life of cherry tomatoes during storage. Food Chemistry https://doi.org/10.1016/j.foodchem.2025.145051	15.8	9.8	No	Yes
5.	Balubhai Tandel Prakrutiben, Ram Asrey, M Menaka, BR Vinod, Eldho Vargheese, Aashish Khandelwal, Shruti Sethi, OP Awasthi, VB Patel, Sajeel Ahamad, Gautam Chawla, K Varsha (2025). Enhancing the antioxidant system and preserving nutritional quality of Indian Ber (Ziziphus mauritiana L.) fruit following melatonin application. *Food Research International* https://doi.org/10.1016/j.foodres.2025.116251	14.0	8.0	N	Y
6.	Menaka, M., Asrey, R., Singh, D., Patel, V. B., Meena, N. K., Vinod, B. R., & Ahamad, S. (2024). Preserving functional properties and inhibiting postharvest peel browning in guava during cold storage via 24-epibrassinolide application. *Postharvest Biology and Technology*, *216*, 113033. https://doi.org/10.1016/j.postharvbio.2024.113033	14.8	6.8	No	Yes
7.	Lekshmi, SG, Sethi, S., Asrey, R., Singh, KP., Kumar R, Sindhu, PM, Singh, Ajit Kumar, Gunjan, P., Goswami, A.K. (2025) Comprehensive characterization of biodegradable edible films activated with rose and marigold extracts and application of active edible coatings to extend the postharvest storage life of guava *Food Research International*, 203:115895. doi: 10.1016/j.foodres.2025.115895	13.00	7.00	Yes	Yes
8.	Jain Akshat, Sethi, S. Chopra, S., Joshi, A., Grover, M., Khandelwal, A., Sharma, R. M., Lekshmi SG, Sindhu PM (2025)	12.80	6.80	Yes	Yes

	Comparative evaluation of ohmic and conventional heat treatment on process time, microbial quality and bioactive retention of citrus beverages *Innovative Food Science and Emerging Technologies.* https://doi.org/10.1016/j.ifset.2025.104034				
9.	Yadav, U., Yadav, A., Arora, B., Yadav, N., Nandana, S., & Singh, P. (2025). Microbial Derived Flavoring Compounds in Meat, Fish, and Poultry-Based Products: Application and Health Benefits. Food Reviews International, 1–26. https://doi.org/10.1080/87559129.2025.2557559	12	6	Yes	Yes
10.	Upadhyay N, Akasapu K, Kumari R, Perinban S, Yawale P, Chintha P, Singh A, Mahendra R, Meena S, Deewan A, Jaiswal P, Kumar D. 2025. Impact of processing treatments induced changes on little millet: Insights in nutritional, structural and metabolite profile. *Food Chemistry*, 146234.	15.80	9.8	Yes	Yes
11.	Jadaun S, Upadhyay N, Siddiqui S. 2025. Isolation and characterization of cellulose nanofibers from rice straw using ultrasonication-assisted extraction technique coupled with high shear dispersion. *Biomass Conversion and Biorefinery*, 1-17.	10.10	4.1	Yes	Yes

11. IP Management , Patents, Technology Commercialization, IPR Activities and Agribusiness Incubation Activities (to be supplied by the ZTM&BPU) as per following head:-

11.1 Technology commercialization

01 (Pusa Black Garlic) INR 100000/-

11.2 Intellectual property rights

IPRs	Application No./ Registration No./ Grant No.	Name of Innovation/ Technology/ Product/ Variety	Date of Filing/ Registration/ Grant	Application Filed/Granted/ Registered**
Patents	CBR no. 55126	Low calories ultrasonicated aonla candy and method of preparation thereof	24.10.2025 (filed)	Filed

11.4 MoUs/ Agreements Signed

- MoU of Contract Research Project signed with M/s GOOD & HAPPY Botanics Pvt. Ltd. EcoParadizONEarth, Ernakulam - 682313, Kerala

13. Awards and Recognitions

- 3rd Prize for Oral Presentation during International Conference on "The Future of Food Science & Technology: Innovations, Sustainability, and Health" AMIFOST 2025 for the presentation titled "Texture Modified Protein Extrudates Prepared by Reactive Supercritical Fluid

Extrusion".

- 3rd Prize in Oral presentation to Ahale, A., Upadhyay, N.*, Sarkar, T., Hussain, A., Singh, A.K., Kapila, S. for 'Functional processed cheese spread containing Moringa oleifera: Insights in physico-chemical….. consumer acceptability' during International conference on Recent Advances in Food Science and Technology: A way forward organized during 22-24 Jan, 2025 organized by DSLD CHEFT, Devihosur- Haveri & Karnataka Science and Technology Academy, DST, Govt. of Karnataka
- 1st Prize to Neelam Upadhyay for oral presentation on 'Moringa oleifera containing functional processed cheese spread: Insights during shelf life study' during National Conference on Advances in food based technologies for food and nutrition security- AN AAU- ICSSR initiative for vision viksit Bharat @2047 during 1-2 Mar, 2025 organized by Assam Agricultural Univeristy, Jorhat and NSI, Jorhat Chapter
- 3rd Prize for Oral presentation to Alka Joshi for Antioxidant Determinant of Beetroot: As a function of maturity stages during 11-12 March, 2025
- First Prize for Oral Presentation to Alka Joshi for beetroot pomace utilization during 27-28 March, 2025

18. Transfer of technology (to be supplied by Coordinators/All Divisions/Centres/Stations/Units)

i. NEH

ii. SC-SP

Sl. No.	Name of the training programme	Date	Number of trainee(s) participated
1.	Two days training programme cum seed and inputs distribution programme in Processing Techniques for Horticultural and Arable Produce (off campus-Uttarakhand)	13.10.2025 to 14.10.2025	100 farmers

vii. Trainings

S. No.	Name of training programme	Date	Number of trainee(s)
1.	ICAR sponsored winter school on Recent Advances in Food Processing Technologies for Agri-Horti Produce	21 days (15 Jan - 4 Feb 2025)	19
2.	ADP on Recent avenues in Food Processing Technology for Agritech Startups	6 days (8-13 sept 2025)	33

20. Miscellany (for the period January 1 to December 31, 2025)

I. Number of on-going projects at IARI as on December 31, 2025 (School-wise, to be supplied by the PME Section)

II. Number of scientific meeting organized at the Institute (to be supplied by the All Divisions/ Centres/ Stations/ Units) as per the proforma given:

S. No.	Detail	No.
1.	Workshops	
2.	Seminars	
3.	Summer/ Winter school	
4.	Farmer's day (s)	1 training and 6 seed cum input distribution programme in Uttrakhand
5.	Any other	

III Number of scientists who participated in scientific meetings, etc (to be supplied by the All Divisions/ Centres/ Stations/ Units) as per proforma given:-

S. No.	Detail	No.
(i)	In India	
	Seminars	1
	Scientific meetings	2
	Workshops	
	Symposia	
	Any other	3 (Conference)
(ii)	Abroad	
	Seminars	
	Scientific meetings	
	Workshops	
	Symposia	
	Any other	1 (Conference)

IV (a) Honours and Awards (please provide the information in respect of prestigious Awards and Awards of Professional Societies recognized by NAAS) (to be supplied by the All Divisions/Centres/Stations/Units) as per proforma given:-

S. No.	Period	Name of the Scientist(s)/ Staff	Designation	Name of the Awards/ Recognition(s)	Contributions
1.	2025	Alka Joshi	Senior Scientist	Selected by *Agrinnovate India (AgIn) and Kerala Startup Mission (KSUM)* under the Branding Challenge 2.0 and screened under top two as a technology having commercial potential	Antioxidant Rich Papaya Candy
2.	2025	Alka Joshi	Senior Scientist	Pusa Vishist Pravakta Award (hindi)	To deliver talk in hindi in various events specially for farmers