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Valorization of Dairy Whey in Black Wheat Idli: A Functional Food Approach to Enhance Health Markers in Albino Rats Ankur Aggarwal, Tarun Verma*

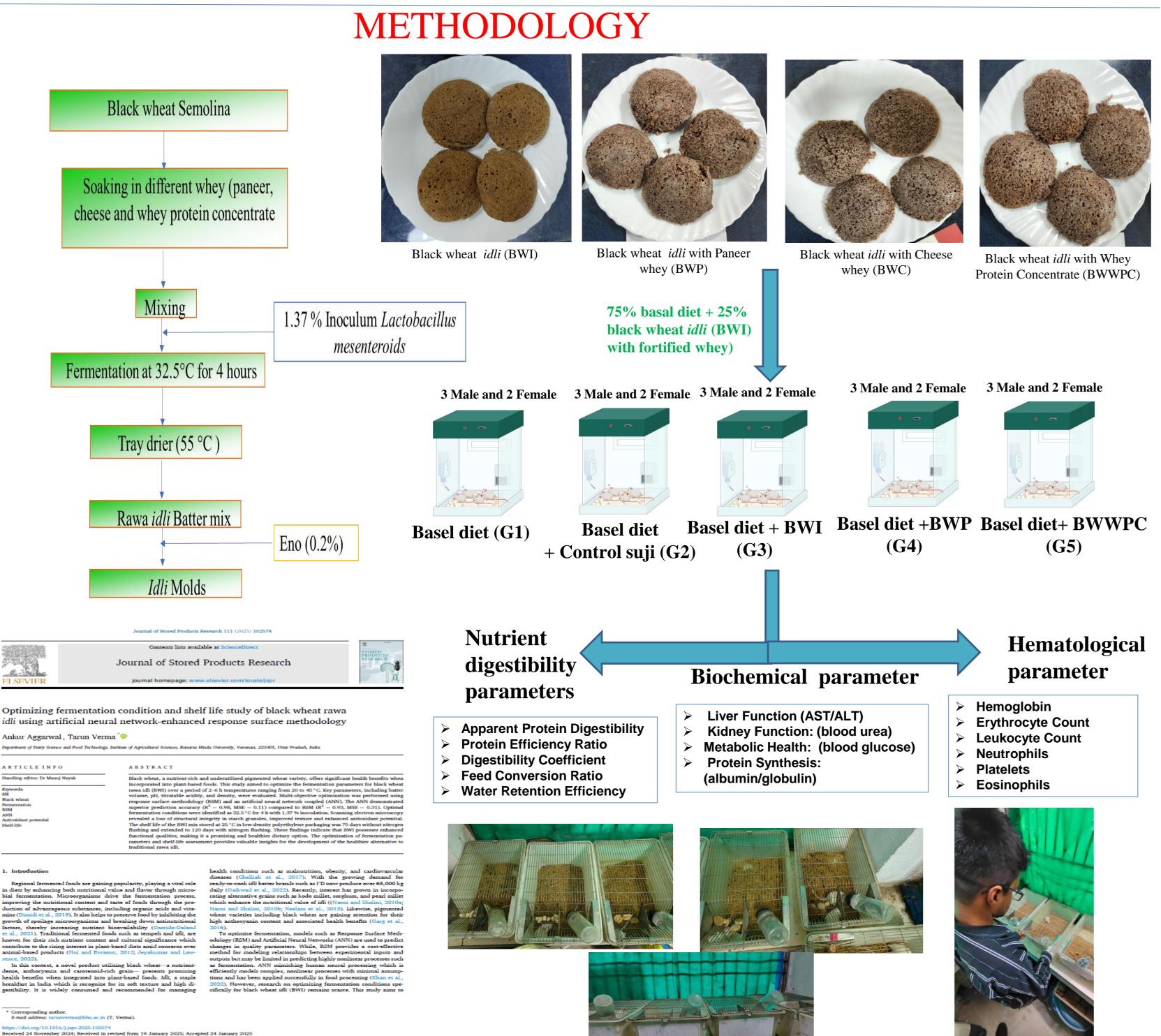
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INTRODUCTION

- Problem Food industry struggles with waste management and rising demand for functional foods (Gaikwad et al. 2022).
- Scale Indian dairy generates ~180–190 million tons of whey yearly, causing environmental concerns (Ahmad et al., 2019).
- Opportunity Whey is nutrient-rich and can be upcycled into valueadded products.
- Innovation Developed nutrient-dense black wheat idli fortified with paneer whey (BWP), cheese whey (BWC), and Whey protein concentrate (BWWPC).
- Health Benefits Combines black wheat (fiber, anthocyanins) + whey (protein, bioactives) for a sustainable functional food.

OBJECTIVE

- Analyze the nutritional content, texture, antioxidant potential, antinutritional of the whey fortified *idli* formulations
- To access the effects of the fortified *idli* diet on growth performance, nutrient digestibility, and blood-biochemical markers in albino rats



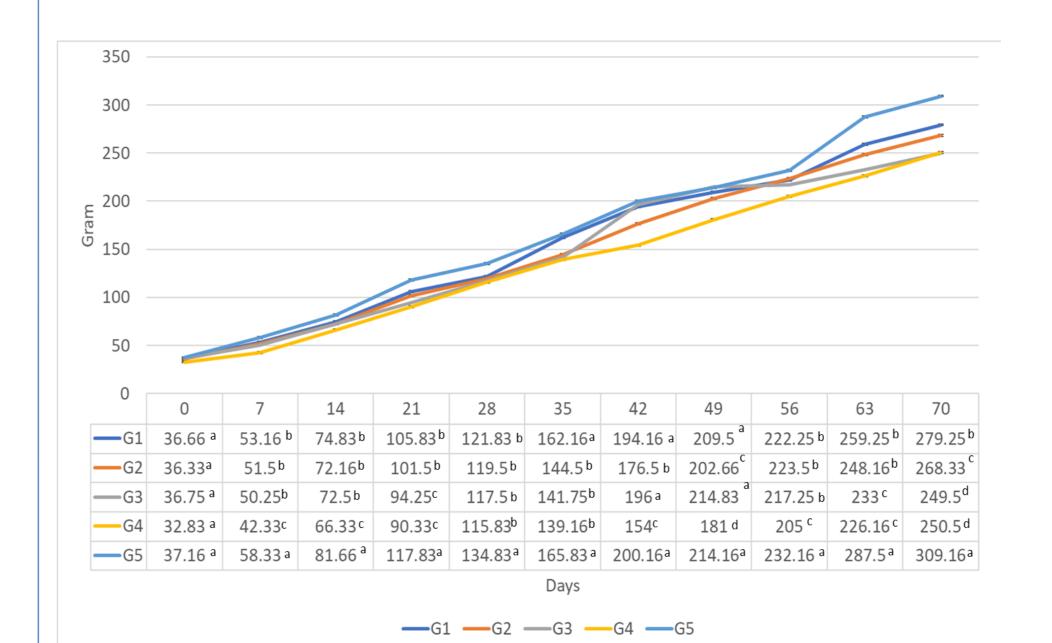
NUTRITIONAL

Physio-chemical properties Antioxidant Potential and antinutritional of black wheat *idli* with different whey

Group	Dietary Description	Moisture (%)	Protein (%)	Fat (%	(6)	Crude Fib	er (%)	Ash (%)	Tannin (mg/100 g)
G1	Basal diet (Control)	10	21	36		5		_	— (g
G2	Traditional wheat rawa idli mix	4	13.12	2.81		2.65	5	1.98	480
G3	Black wheat rawa idli (BWI) mix	5	18.71	1.85	, 	4.76	5	2.37	350.85
G4	Black wheat rawa idli + Acid Whey (BWP) mix	5	20.34	1.82	•	4.75	5	2.64	192.28
	Black wheat rawa idli + Whey Protein Concentrate								
G5	(BWWPC) mix	5	24.76	2.04	•	4.79)	2.61	196.57
Antioxidant properties		WS	BW	/I		BWP	B	WC	BWWPC
DPPH	(% Inhibition)	8.20 ± 0.6^{c}	72.20 ±	72.20 ± 5.6^{a}		4.72 ± 2.6^{b} 64		5 ± 2.3^{b}	64.73 ± 2.8^{b}
FRAP (mmol/100 g)		4.19 ± 0.5^{c}	55.84 ±	55.84 ± 4.5^{a}		$27.90 \pm 1.1^{\text{b}}$ 27.8		4 ± 1.9^{b}	27.65 ± 1.7^{b}
ABTS ((mg AAE/100g)	0.48 ± 0.07^{c}	8.81 ±	1.07 ^a	5.3	37 ± 1.5^{b}	5.23	± 1.3 ^b	5.07 ± 1.2^{b}
TPC (n	ng GAE/100g)	21 ± 1.85^{c}	210.54 ±	- 7.85 ^b	224.	$4.77 \pm 4.85^{\mathrm{a}}$	224.11	± 3.92a	225.90 ± 4.85^{a}
TFC (mg QE/100g)		20.6 ± 1.12^{c}	$205.6 \pm$	205.6 ± 5.11^{a}		5.6 ± 3.11^{a} 196.0		$\pm 4.87^{b}$	148.8 ± 4.32^{c}

HEALTH MARKERS IN ALBINO RATS

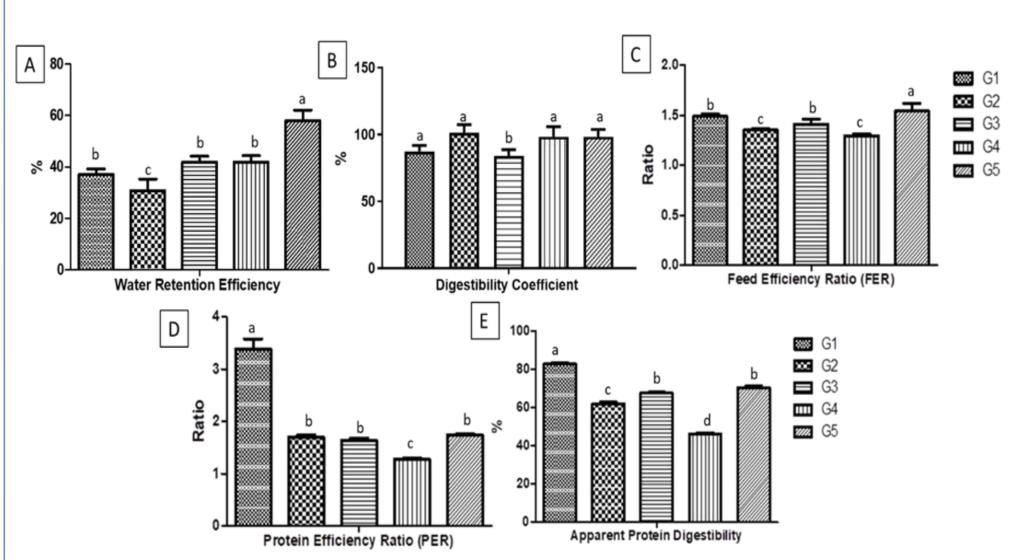
Growth Performance



•Body Weight Gain: G5 (WPC-fortified) ↑ final body weight (309.17 g) & total gain (272 g); G3 (Black Wheat) ↓ gain (212.75 g).

•Feed Intake: G5 (WPC-fortified) ↑ total feed intake among all groups.

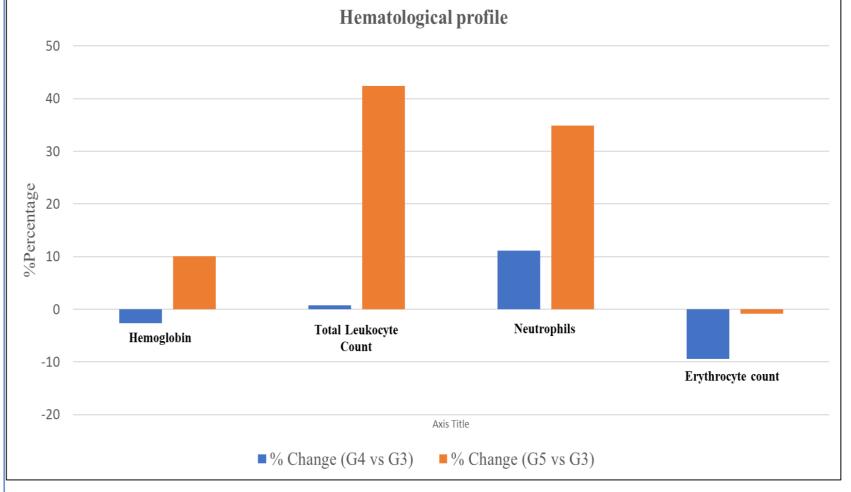
Nutrient Digestibility

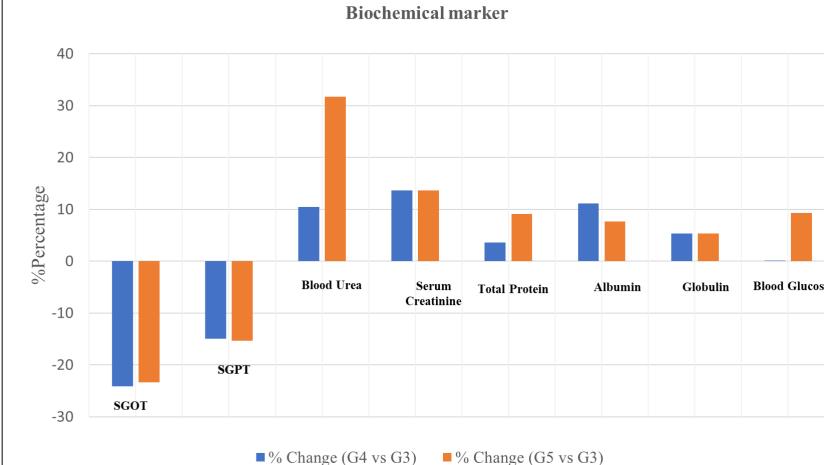


- Protein Efficiency & Digestibility: G5 (WPC-fortified) ↑ PER & APD (68%); G4 (Whey-fortified) ↓ PER & APD (47%).
- **Feed Efficiency:** G5 ↑ FER → best feed-tomass conversion.
- Water Retention: G4 & G5 ↑ Water Retention Efficiency (WRE)

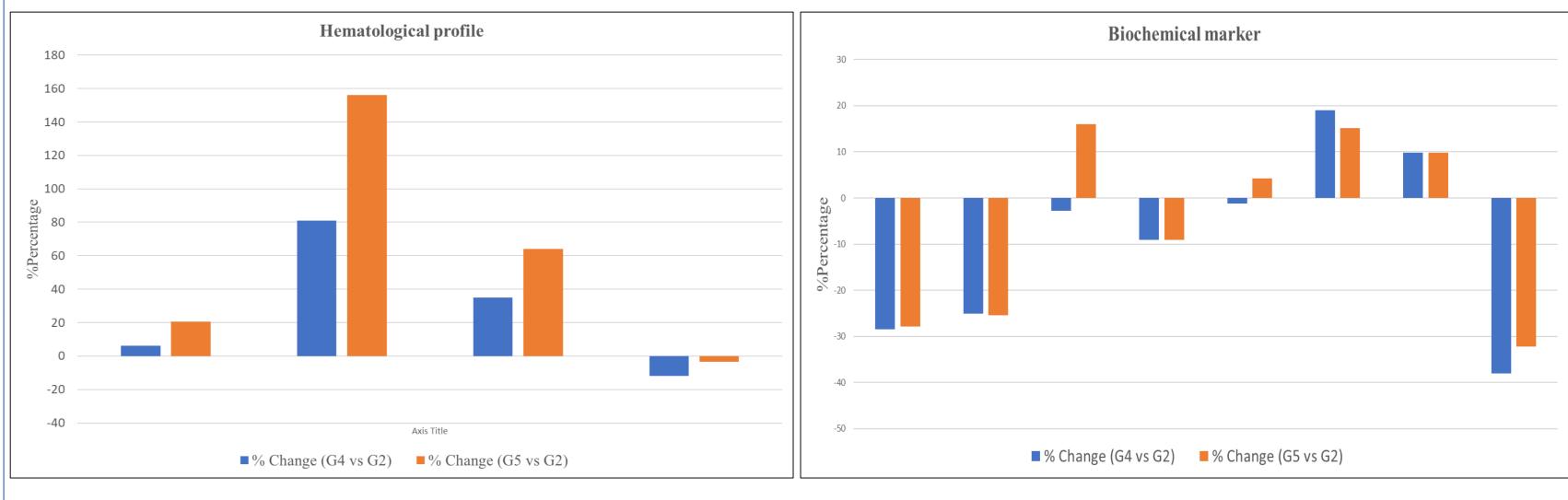
Haematological profile and Blood-Biochemical Markers

a) Impact of Whey Fortification to Black Wheat Diet





b) Comparative Effects of Fortified Black Wheat Diets vs. Control Wheat Diet



CONCLUSION

- Enhanced Nutritional & Textural Quality: Whey fortification notably increased protein († 24.76% in WPC) and while simultaneously reducing anti-nutritional compounds.
- Improved Growth & Digestibility: WPC-fortified diet (G5) showed maximum body weight († 309.17 g) and highest protein digestibility († 68%); unfortified G3 had lowest gain (\downarrow 212.75 g).
- Positive Effects on Health Benefits: G5 improved hemoglobin and immunity; G3 supported kidney function and blood glucose regulation.
- Sustainable Valorization of Dairy Waste: Effective valorization of dairy whey into nutrient-rich, functional black wheat *idli* — aligning with global sustainability goals.

REFERENCE (Published)

Aggarwal, A., & Verma, T. (2025). Optimizing fermentation condition and shelf life study of black wheat rawa idli using artificial neural networkenhanced response surface methodology. Journal of Stored Products Research, 111, 102574.

Aggarwal, A., Verma, T., Ghadei, K., Maiti, P., Sharma, R., Yadav, S. S., ... & Chen, K. T. (2025). Valorization of under-utilized whey: its effect on rheological and functional properties in black wheat idli. LWT, 118637.