Food Innovation Asia Conference 2025

BITEC, Bangkok, Thailand

12-13 June, 2025

Development and Evaluation of Buckwheat-Fortified Mung Bean Extrudates: Effects on Physicochemical, Textural and Antioxidant Properties.

Girish Ningappa Mathad[1], Mohsen Gavahian[2], Lin Jenshinn[2]

[1]Department of Tropical Agriculture and International Cooperation

[2]Department of Food Science

National Pingtung University of Science and Technology,

Pingtung, Taiwan (R.O.C)

國立屏東科技大學

National Pingtung University of Science and Technology

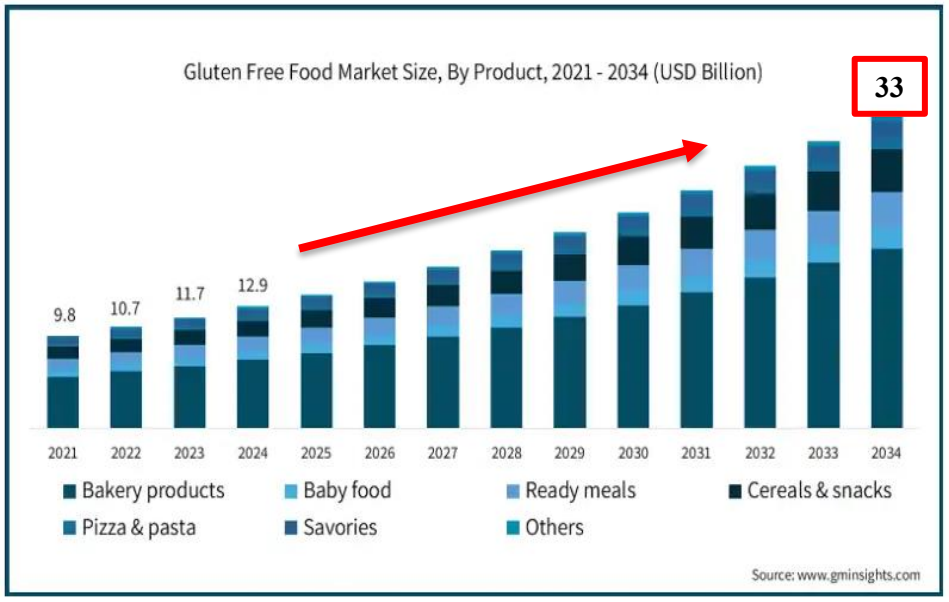
Department of Food Science

Table of contents

Introduction

Global Demand for Gluten-Free and Nutritional snacks

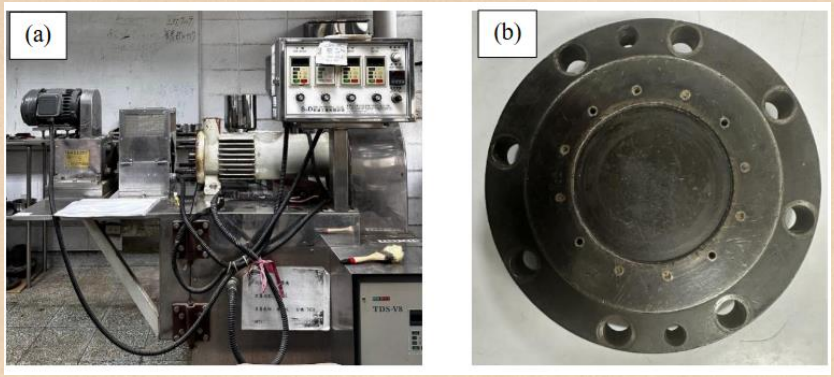
- **Growing prevalence of celiac disease & gluten intolerance.**
- **Rising consumer demand for healthy, gluten-free snacks.**
- **Interest in plant-based protein and sustainable food sources.**



Extrusion Technology & Ingredient Selection

- **Why extrusion?**

- Cost-effective, continuous process.
- Versatile for producing snacks with varied textures.



(a). Single Screw Collet Extruder (b). Die

- **Why mung bean & buckwheat?**

- ***Mung bean:*** high protein, fiber, antioxidants and good digestibility.
- ***Buckwheat:*** gluten-free pseudo-cereal, rich in polyphenols & essential aminoacids

Mung bean

Buckwheat

Research Objectives

Objectives

- To formulate gluten-free extrudates using mung bean and buckwheat.
- To assess the effect of buckwheat incorporation on physicochemical, textural and antioxidant properties.
- To identify optimal formulations based on functional and sensory attributes.

Materials and Methods

Raw Materials

Mung bean | **Buckwheat**

Grinding (Continuous Grinder)

Sieving and Splitting (Halved)

Formulation

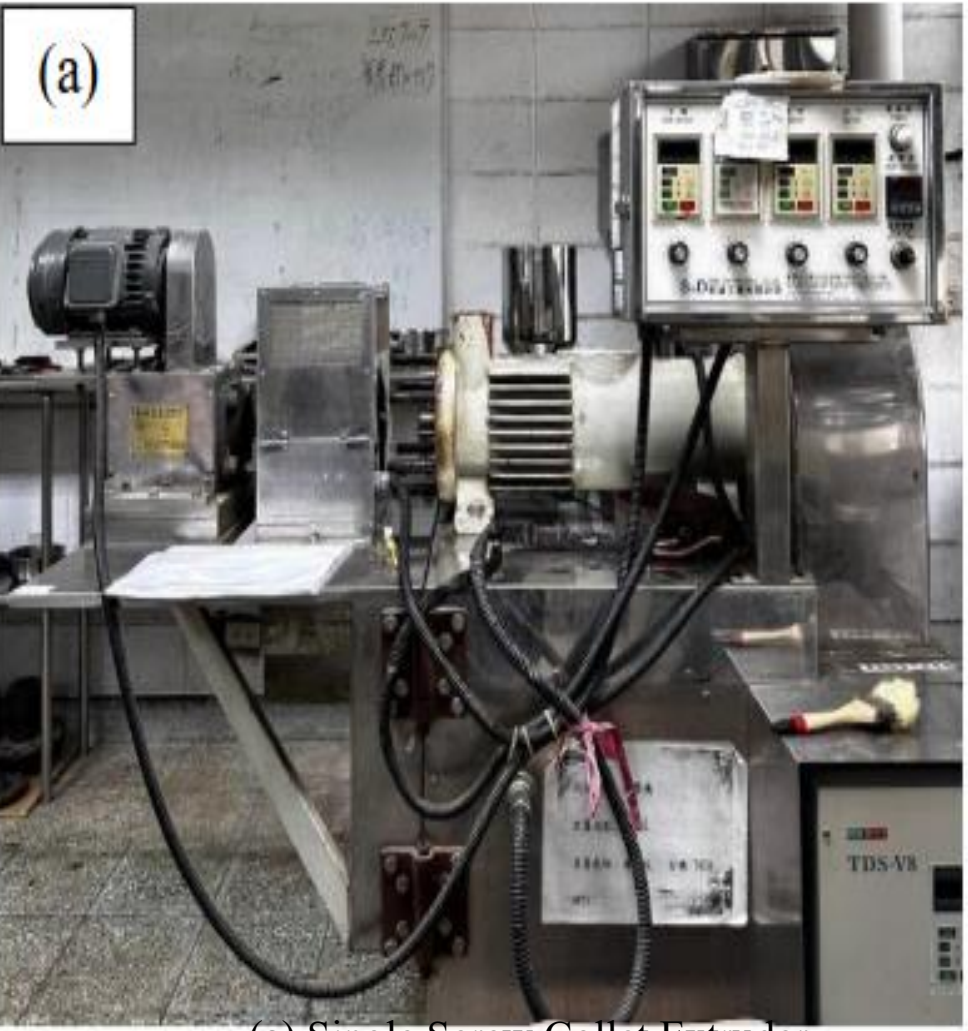
(Based on Experimental Design)

10% Buckwheat : 90% Mung Bean

20% Buckwheat : 80% Mung Bean

30% Buckwheat : 70% Mung Bean

(Continued to next page)



(a) Single Screw Collet Extruder

(b) Die

Results and Discussions

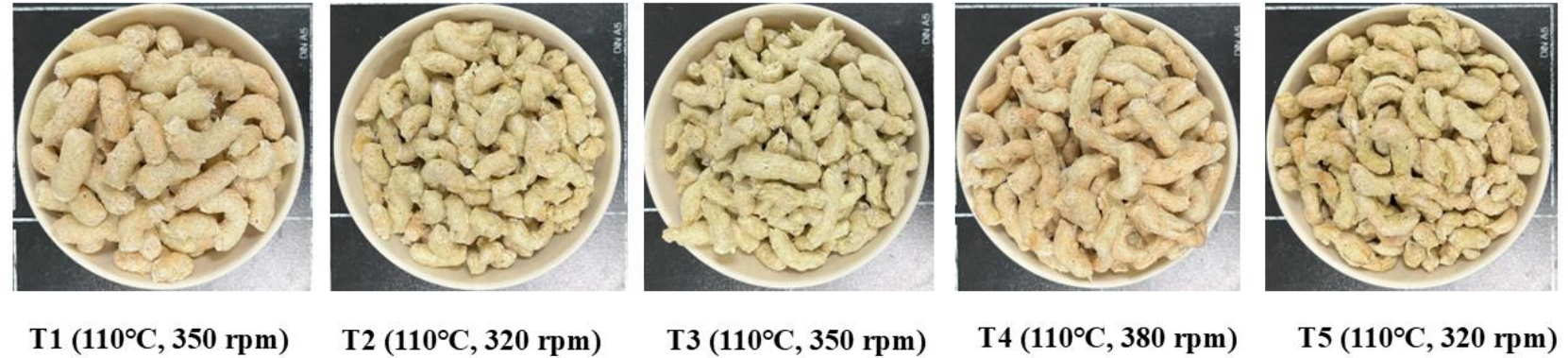
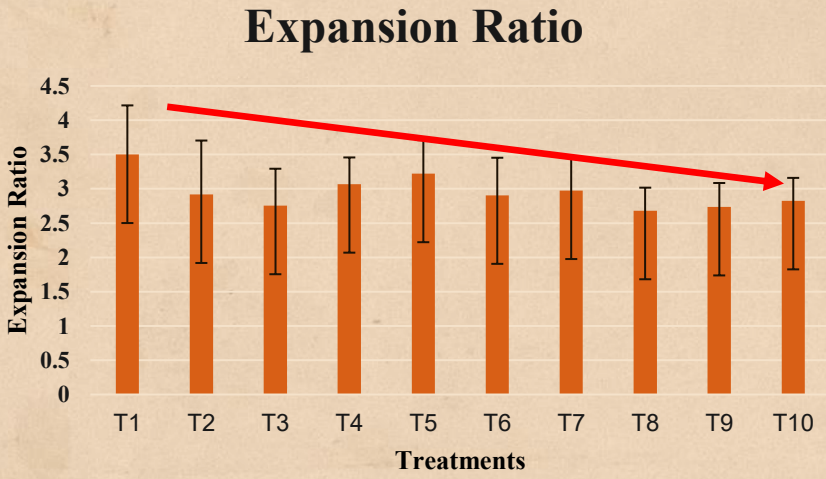
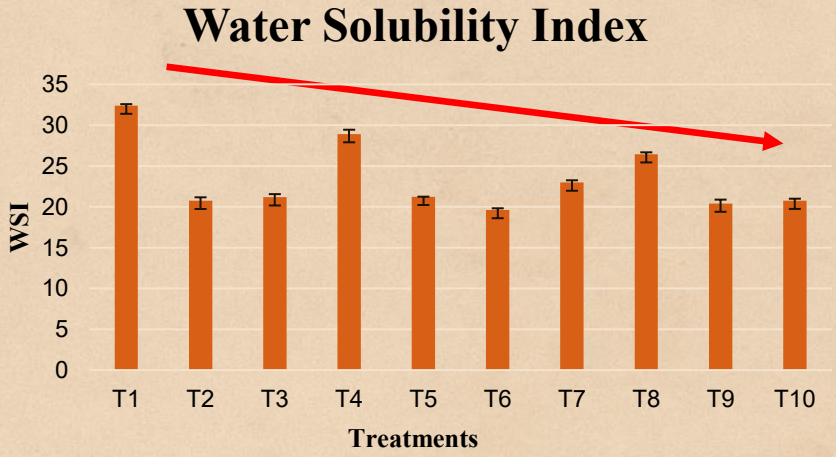


Fig. 1 Visual appearance of mung bean and buckwheat-based extrudates.

Results and Discussions

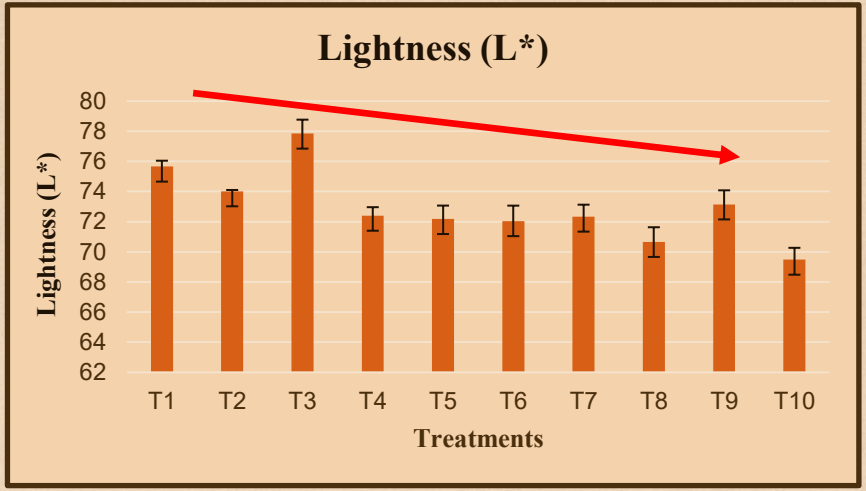


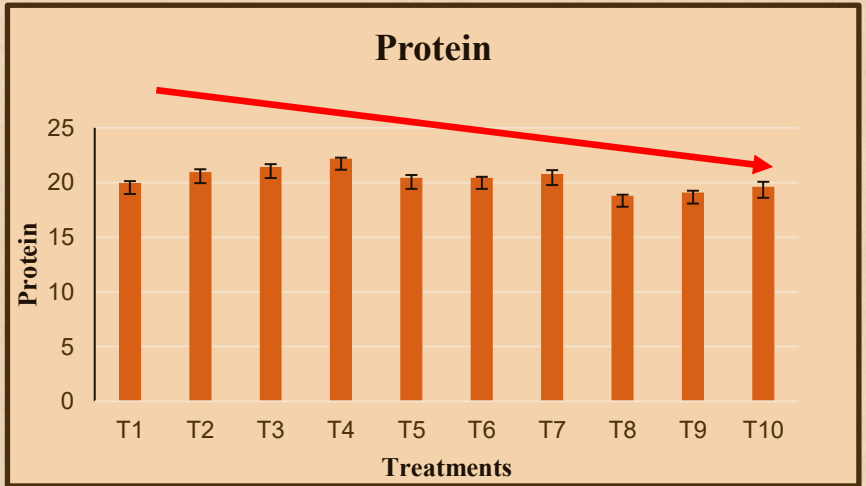


- **Expansion ratio**: Likely due to the **high protein and fiber contents** affecting starch gelatinization. **Dietary fiber** in extrudates **disrupts cell wall integrity, thereby hindering air cell formation** and reducing the Expansion Ratio.
- **WSI**: This could be related to the **hydrophilic component** and variation in the **constituents of buckwheat.**

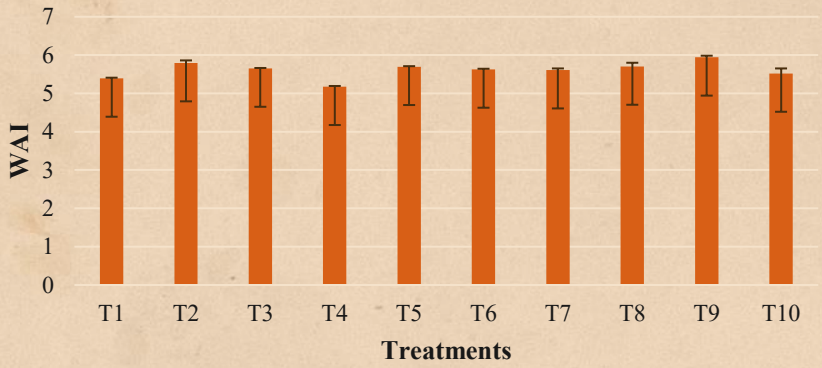
Results and Discussions

- **Lightness**: **Colour of the buck wheat** and, **Millard reaction**, a non-enzymatic interaction between reducing sugars and amino acids or peptides, resulting in complex mixtures.
- **Protein:** Reduction in protein content, likely due to the **loss of thermostability and reduced protein enthalpy during extrusion.**

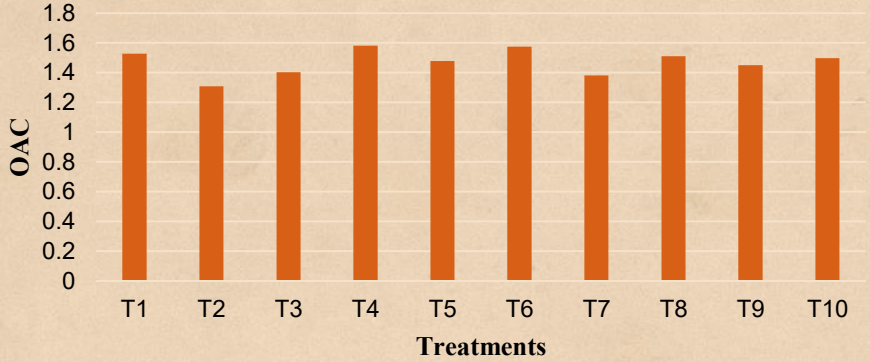




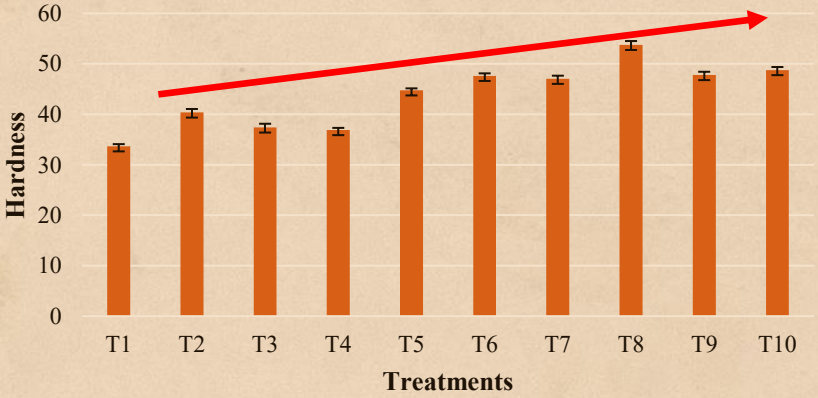
Water absorption Index (WAI)



Oil Absorption Capacity



Hardness



- **Water absorption Index (WAI):** WAI decreased with the increase in buckwheat levels due to the non-starch components affecting the gelatinization process.

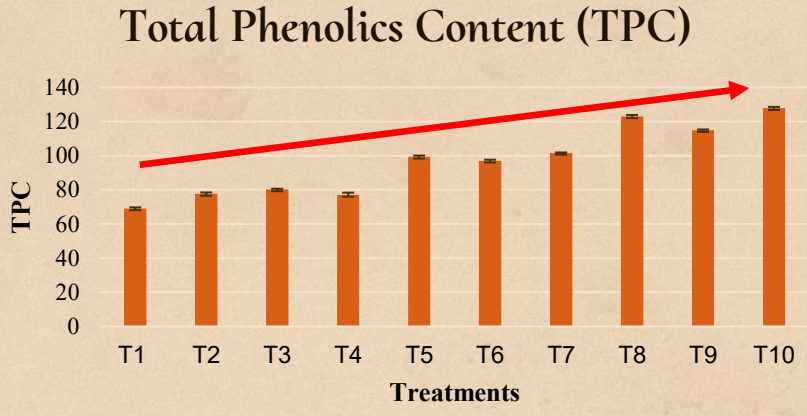
- **Oil Absorption Capacity:** Due to their protein structures, degree of denaturation, and the porous matrix formed during the extrusion process.

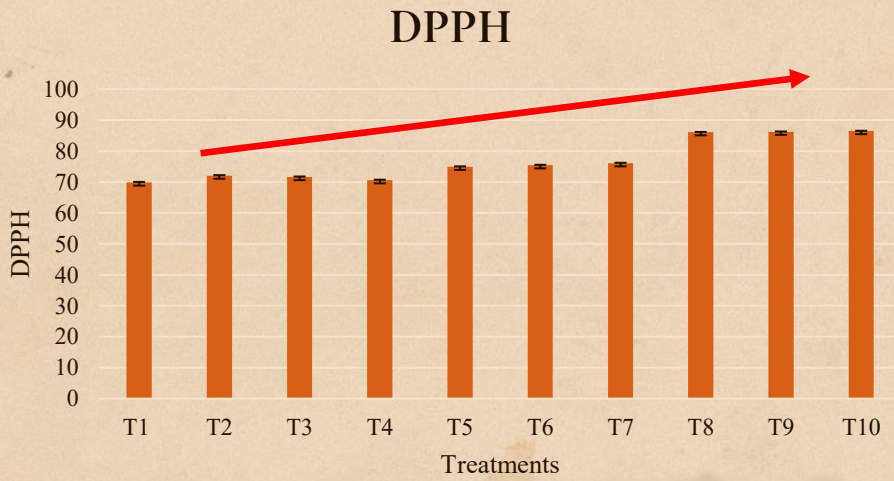
- **Hardness:** Lower at 10% buckwheat, whereas it increased at 20 to 30% levels. Similar results were observed in corn grit extrudates with buckwheat, likely due to protein content variations.

Results and Discussions

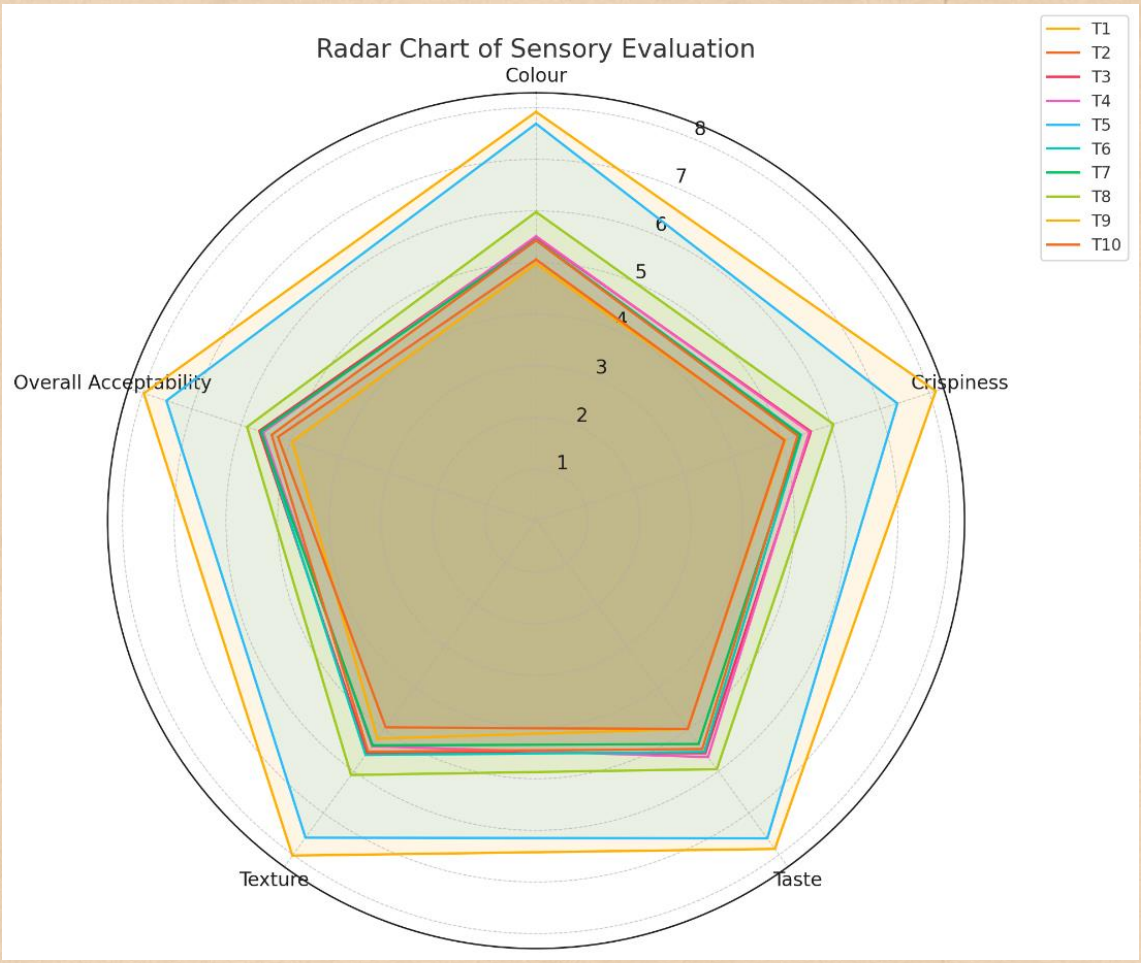
Total Phenolics Content (TPC): TPC was observed with increasing the proportion of buckwheat, likely due to the presence of polyphenols.

DPPH: The observed increase in antioxidant activity in this study suggests that the polyphenolic compounds present in buckwheat either remained stable or were released and transformed into more bioavailable forms during the extrusion process.





Results and Discussions



- The highest sensory scores were noticed in **T8 and T9.**
- **20% and 30% of buck wheat incorporation** showing that these were the most preferred by the panellists.

Fig.2 Radar chart of sensory characteristics of mung bean and buckwheat-based extrudates.

Results and Discussions

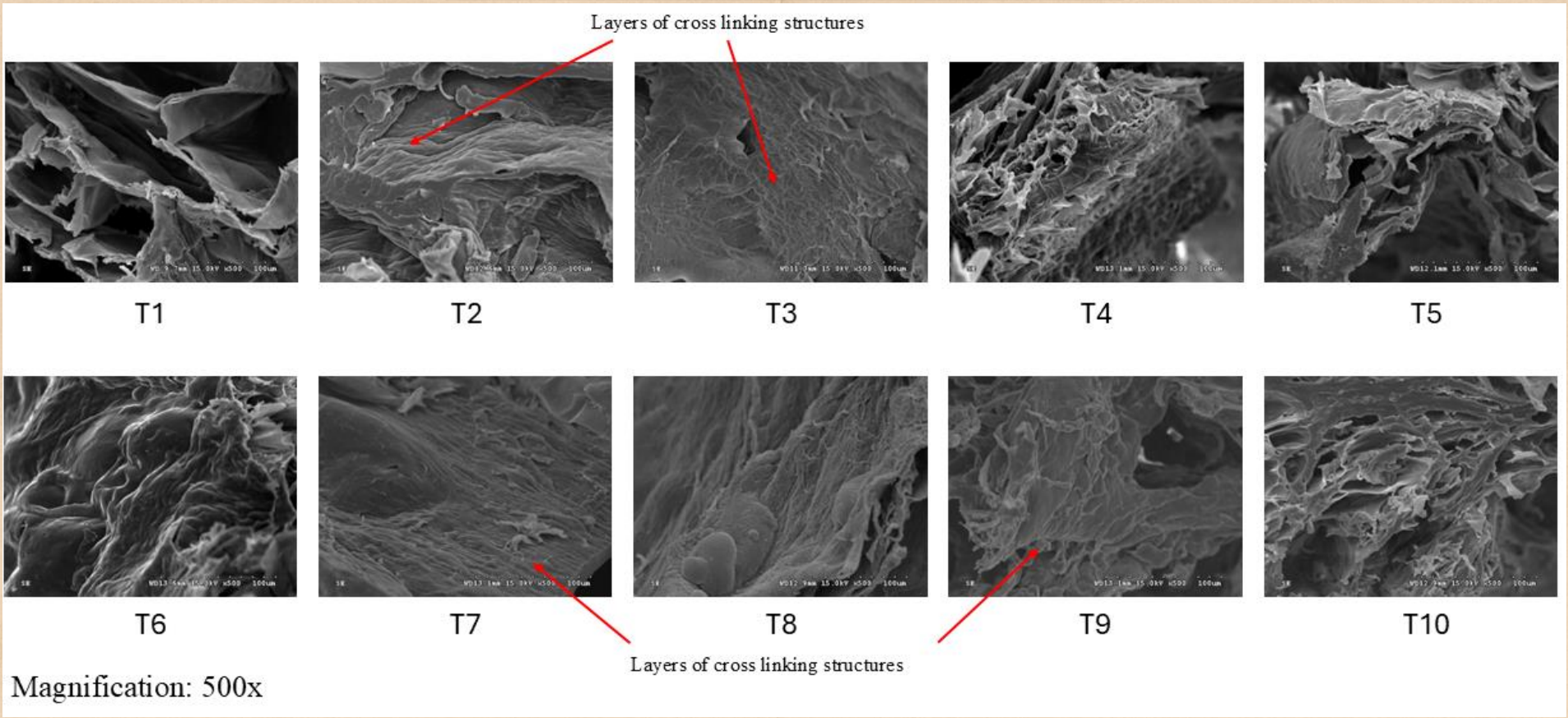


Fig.3 Scanning electron micrographs of native and extruded mung bean and buckwheat-based extrudate at 500 × magnification.

Conclusion

•**Buckwheat fortification** in mung bean-based extrudates significantly improves their **nutritional and functional properties**.

•**Higher buckwheat levels** enhance **antioxidant activity**, **TPC**, and **oil absorption capacity**, but reduce lightness, expansion ratio, and WSI.

•**Optimal sensory acceptance** was observed in extrudates with **20–30% buckwheat**, offering a balance between nutrition and consumer preference.

•**Microstructural analysis (SEM)** confirmed changes in matrix integrity due to **protein–starch interactions**, reflecting altered texture and structure.

•These findings demonstrate the potential of **buckwheat–mung bean formulations** in developing **gluten-free, health-oriented extruded snacks**

Thank you for your attention.

Girish Ningappa Mathad
Ph.D. Scholar
Department of Tropical Agriculture and International Cooperation
National Pingtung University of Science and Technology, Pingtung, Taiwan (R.O.C)
girishmathad007@gmail.com

國立屏東科技大學
National Pingtung University of Science and Technology
Department of Food Science