



# INFOGRAPHIC

## TỐI ƯU HOÁ QUÁ TRÌNH THU NHẬN TINH BỘT KHÁNG LOẠI V (RS5) TỪ ĐẬU XANH (VIGNA RADIATA) BẰNG PHƯƠNG PHÁP NHIỆT ẨM KẾT HỢP DẦU DỪA THỦY PHÂN

Tác giả:

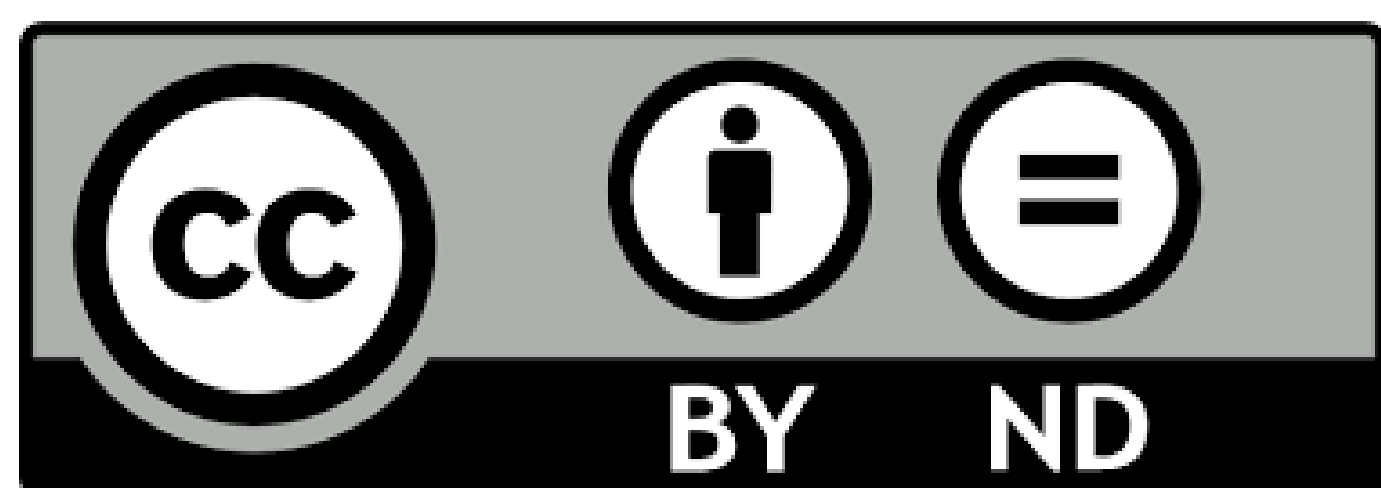
Nguyễn Ngọc Hân

Đơn vị:

Khoa Khoa học Ứng dụng & Công nghệ

Năm xuất bản:

2026



Tối ưu hoá quá trình thu nhận tinh bột kháng loại V (RS5) từ đậu xanh (Vigna radiata) bằng phương pháp nhiệt ẩm kết hợp dầu dừa thủy phân © 2026 bởi **Nguyễn Ngọc Hân** được cấp phép theo **CC BY-ND 4.0**.

## OPTIMIZATION OF RESISTANT STARCH TYPE V (RS5) FORMATION FROM MUNG BEAN (*VIGNA RADIATA* L.) STARCH USING HEAT TREATMENT COMBINED WITH HYDROLYZED COCONUT OIL



### ABSTRACT

This study investigated the effects of processing time, processing temperature, and hydrolyzed coconut oil (HCO) ratio on the formation of type V resistant starch (RS5) from mung bean starch (*Vigna radiata* L.) using heat treatment combined with HCO. The process was optimized using response surface methodology based on a Box-Behnken design (RSM-BBD), and the obtained RS5 was characterized for its physicochemical and structural properties. The optimal conditions were 46.0 min, 109.1°C, and 7.5% HCO, yielding  $16.27 \pm 0.06\%$  resistant starch, close to the predicted value of 16.93%. SEM and XRD analyses confirmed significant morphological and structural changes associated with amylose-lipid complex formation. Compared with native starch, the obtained RS5 showed lower moisture content and higher WAC, OAC, and lightness ( $L^*$ ). Overall, heat treatment combined with HCO effectively promoted RS5 formation and improved its physicochemical properties, demonstrating its potential as a functional starch ingredient for low-GI foods.

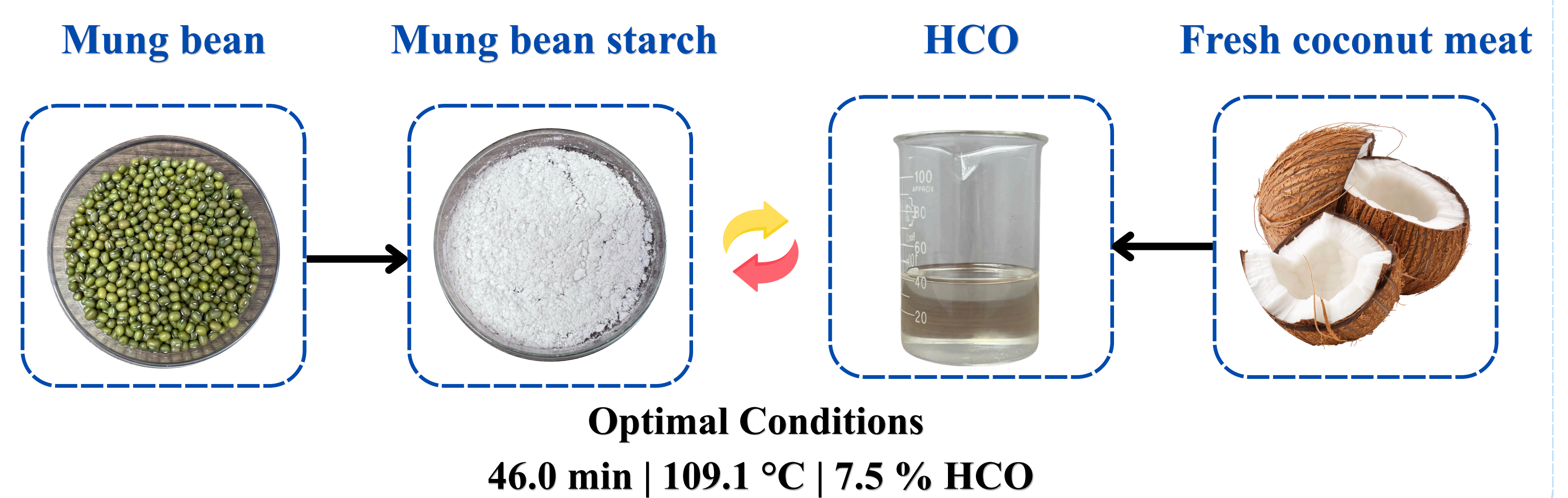


### RESEARCH OBJECTIVES

- Characterization of the raw materials, including native mung bean starch derived from the ĐXBĐ07 variety and hydrolyzed coconut oil.
- Optimization of the production conditions for type V resistant starch (RS5) from mung bean starch using hydrolyzed coconut oil.
- Characterization of the physicochemical properties of the obtained RS5 and comparison with native mung bean starch.

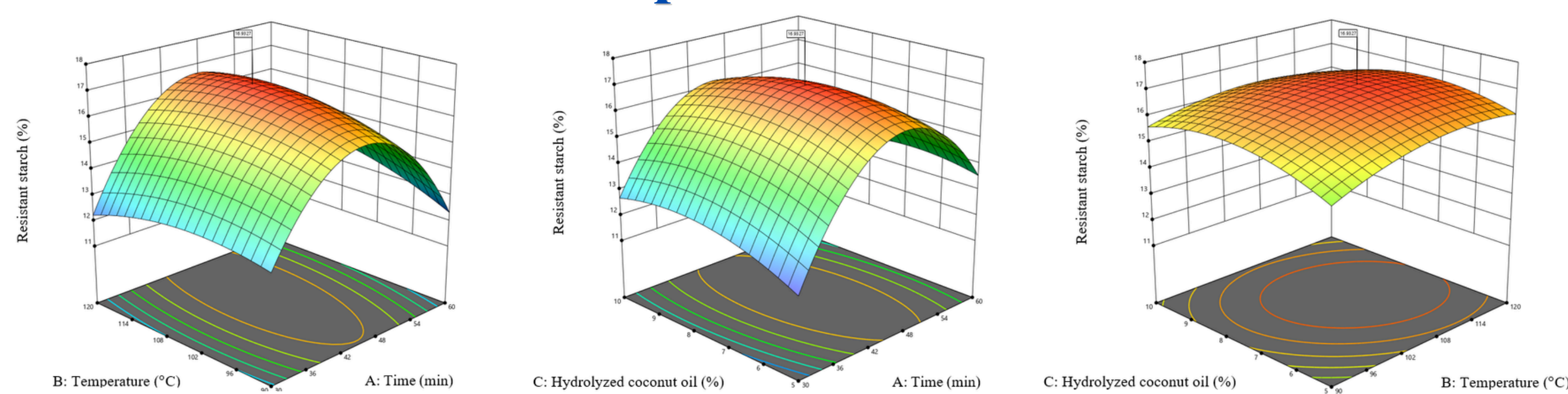


### MATERIALS & METHODS



### RESULT AND DISCUSSION

#### RSM - Box-Behnken optimization



**R<sup>2</sup>: 0.9821**

**Adjusted R<sup>2</sup>: 0.9591**

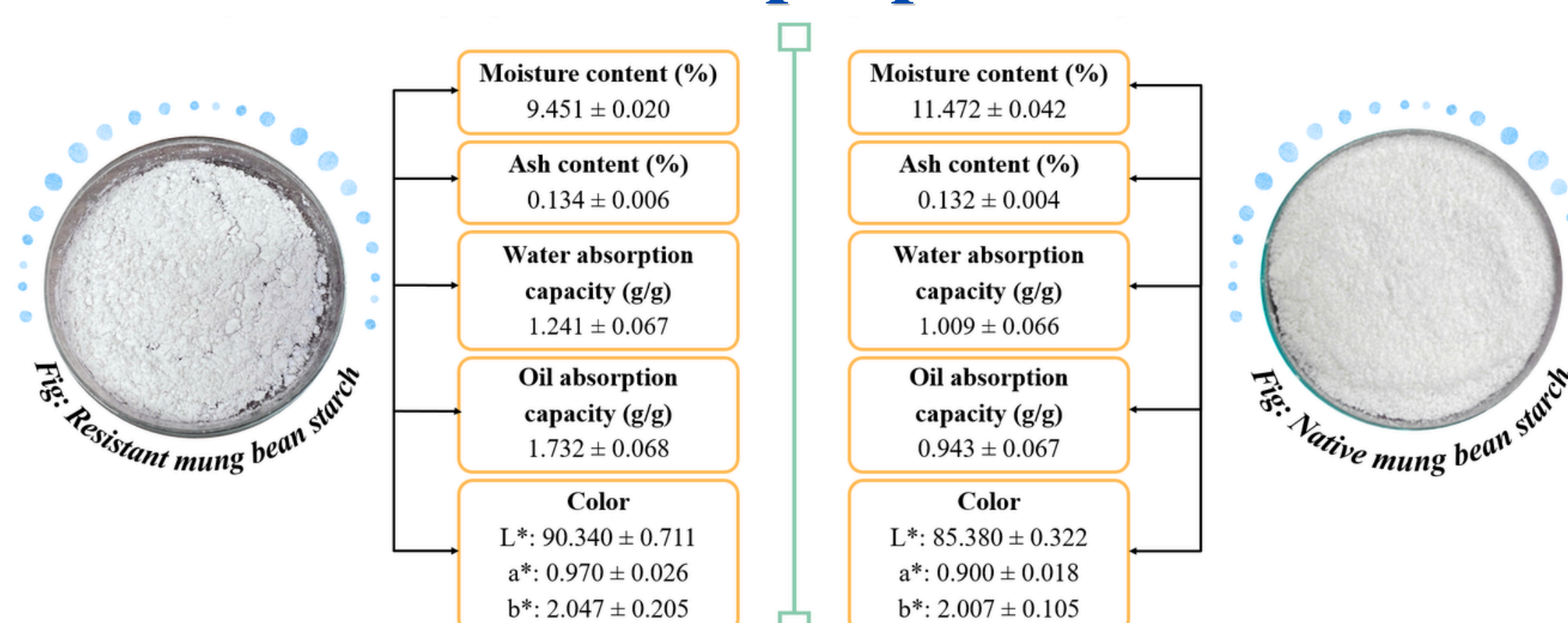
**Adeq Precision: 16.4695**

Table: Optimization results

| Optimal conditions |                  |               | RS5 estimated content (%) |                 |
|--------------------|------------------|---------------|---------------------------|-----------------|
| Time (min)         | Temperature (°C) | HCO ratio (%) | Experimental value        | Predicted value |
| 46.0               | 109.1            | 7.5           | $16.27 \pm 0.06$          | 16.9327         |

Note: HCO ratio (%) = Hydrolyzed coconut oil ratio (%); RS5 estimated content (%) = Resistant starch type V estimated content (%).

#### Native vs. Modified Starch properties



#### Crystal surface morphology - SEM

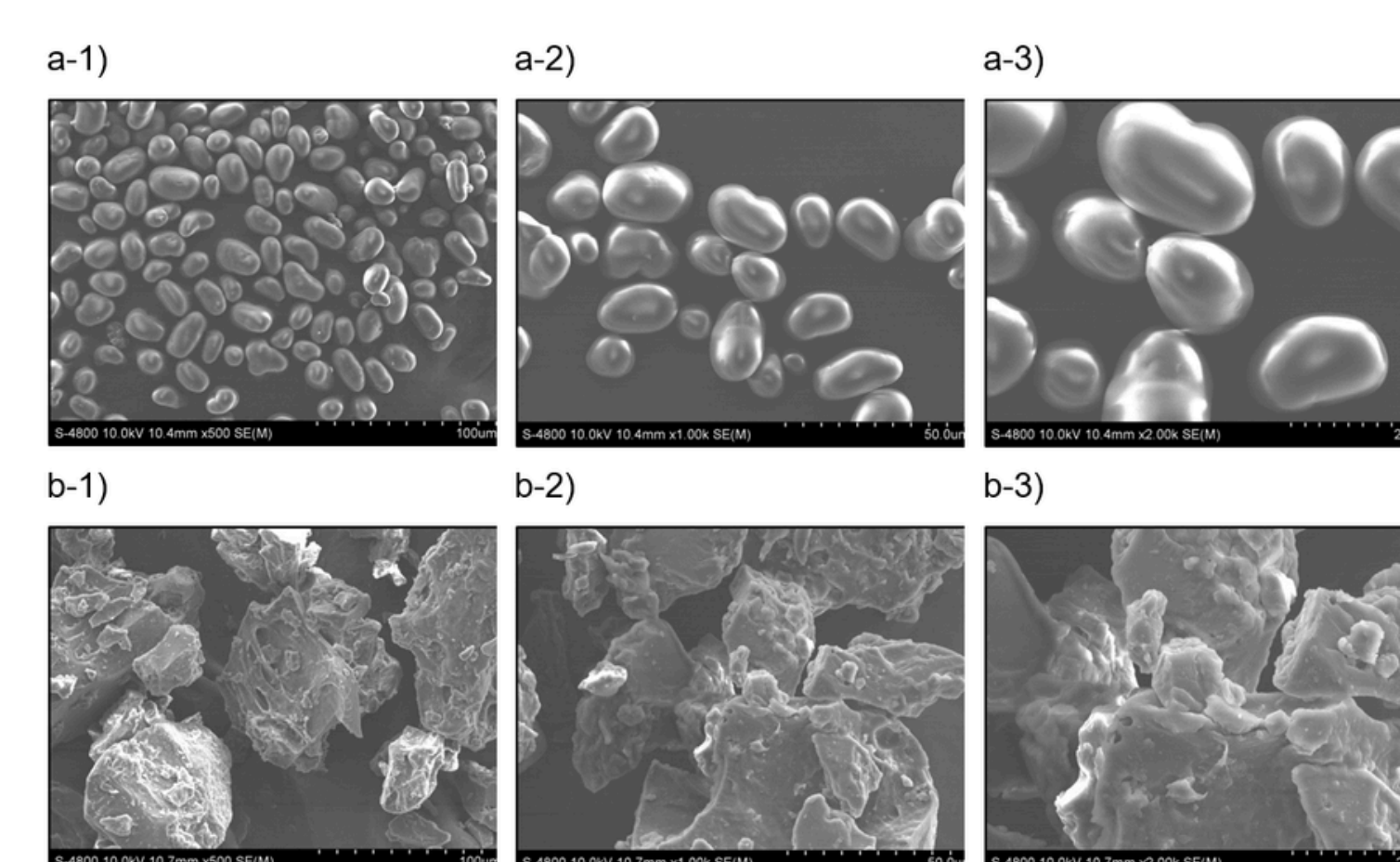


Figure: Scanning electron microscopy (SEM) micrographs of native mung bean starch (a1–a3) and RS5 resistant starch (b1–b3) prepared under the optimum conditions predicted by the Box–Behnken design (BBD). Images a1 and b1 were captured at ×500 magnification, a2 and b2 at ×1000, and a3 and b3 at ×2000.

“Loss of the original granule structure and formation of irregular polyhedral aggregates with rough surfaces, cracks, and fracture-like features.”

#### Crystal structure - XRD

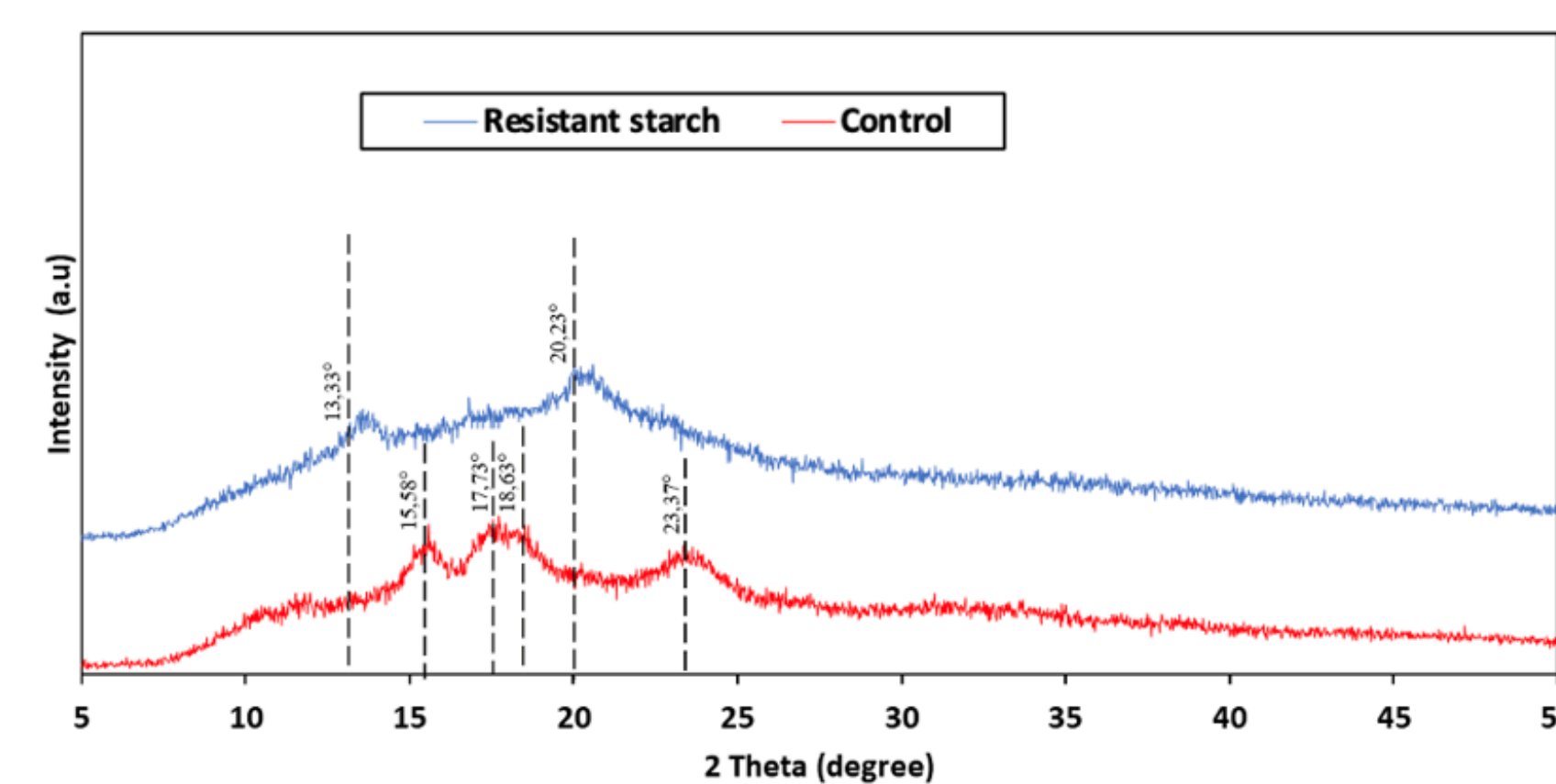


Figure: X-ray diffraction (XRD) patterns of native mung bean starch (red line) and RS5 resistant starch (blue line) prepared using a Box–Behnken design (BBD), with main diffraction peaks indicated by 2θ values.

**A - type** → **V- type**  
**Amylose - lipid complex formation**  
**2θ = 13.33° & 20.23°**



### REFEFENCES

1. Ali, A., Wani, T. A., Wani, I. A., & Masoodi, F. A. (2016). Comparative study of the physico-chemical properties of rice and corn starches grown in Indian temperate climate. *Journal of the Saudi Society of Agricultural Sciences*, 15(1), 75–82.
2. Andriani, I., Faridah, D. N., Talitha, Z. A., & Budi, F. S. (2021). Physicochemical characterization of resistant starch type V (RSV) from manggu cassava starch (*Manihot esculenta*).



### CONCLUSION

RSM - Box-Behnken optimized RS5 production from mung bean starch at 46.0 min, 109.1°C and 7.5% HCO, achieving  $16.27 \pm 0.06\%$  RS5, close to the predicted value of 16.93%. SEM showed that starch granules lost their original structure and formed irregular, polyhedral aggregates with rough surfaces, cracks, and fracture-like features, while XRD confirmed an A-type → V-type transition, indicating amylose-lipid complex formation. Compared with native starch, RS5 exhibited lower moisture but higher WAC, OAC, and  $L^*$ , indicating that heat treatment combined with HCO promoted RS5 formation and improved its physicochemical properties, supporting its potential application in low-GI foods.