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Strategic approaches for reducing toxic components in plum kernels (*Prunus domestica L.*): A sustainable valorization approach

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INTRODUCTION & AIM

- Valorization of agri-food wastes offers a sustainable approach to produce value-added products for the food sector, reducing waste and environmental pollution.
- Plums (Prunus domestica L.) are globally significant fruits with a production of approximately 12.1 million metric tons per year (2022), valued for their taste and nutritional properties.
- Plum kernels are rich in nutrients, providing high-quality oils (45.95 - 50.00%), dietary proteins (35.9 - 40.0%), and bioactive compounds, which are often lost during processing.
- A major challenge to utilizing plum kernels is the presence of amygdalin (0.1 - 17.5 mg/g), an anti-nutritional cyanogenic glycoside responsible for bitterness and potential toxicity.
- The recovery of these underexploited proteins could be eminently vital for human nutrition.
- Detoxification of plum kernels by some innovative method is essential to prevent cyanide toxicity a
- This research aimed to investigate the effects of microwave, hydrothermal, and combined treatments on plum kernels' composition, antioxidant activity, anti-nutritional factors, and bioactive compounds.
- Response Surface Methodology was used to optimize these treatments, enhancing the safety and stability of underutilized plum kernels..

METHOD

- **Microwave Heating**:

Power: 100 - 600 W for 2 - 8 minutes.
Optimized using RSM to reduce cyanogenic glycosides

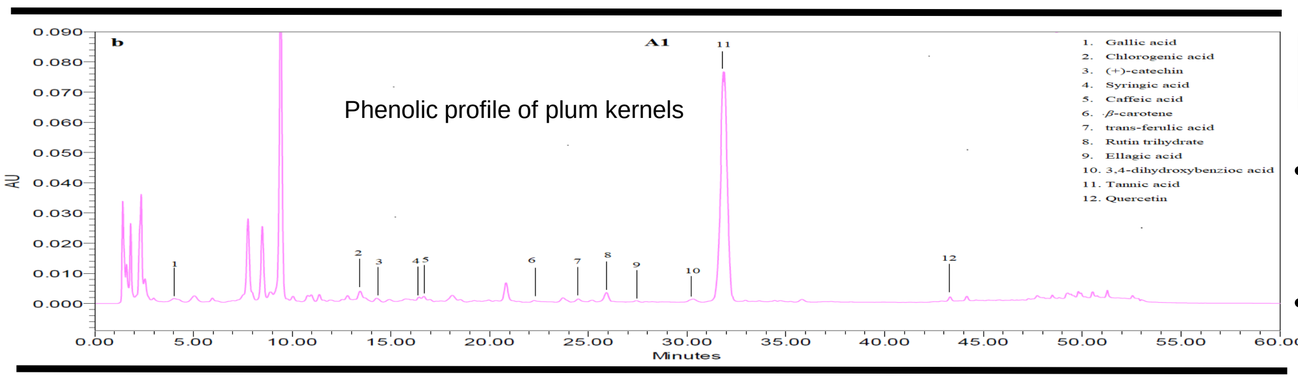
- **Hydrothermal Treatment**:

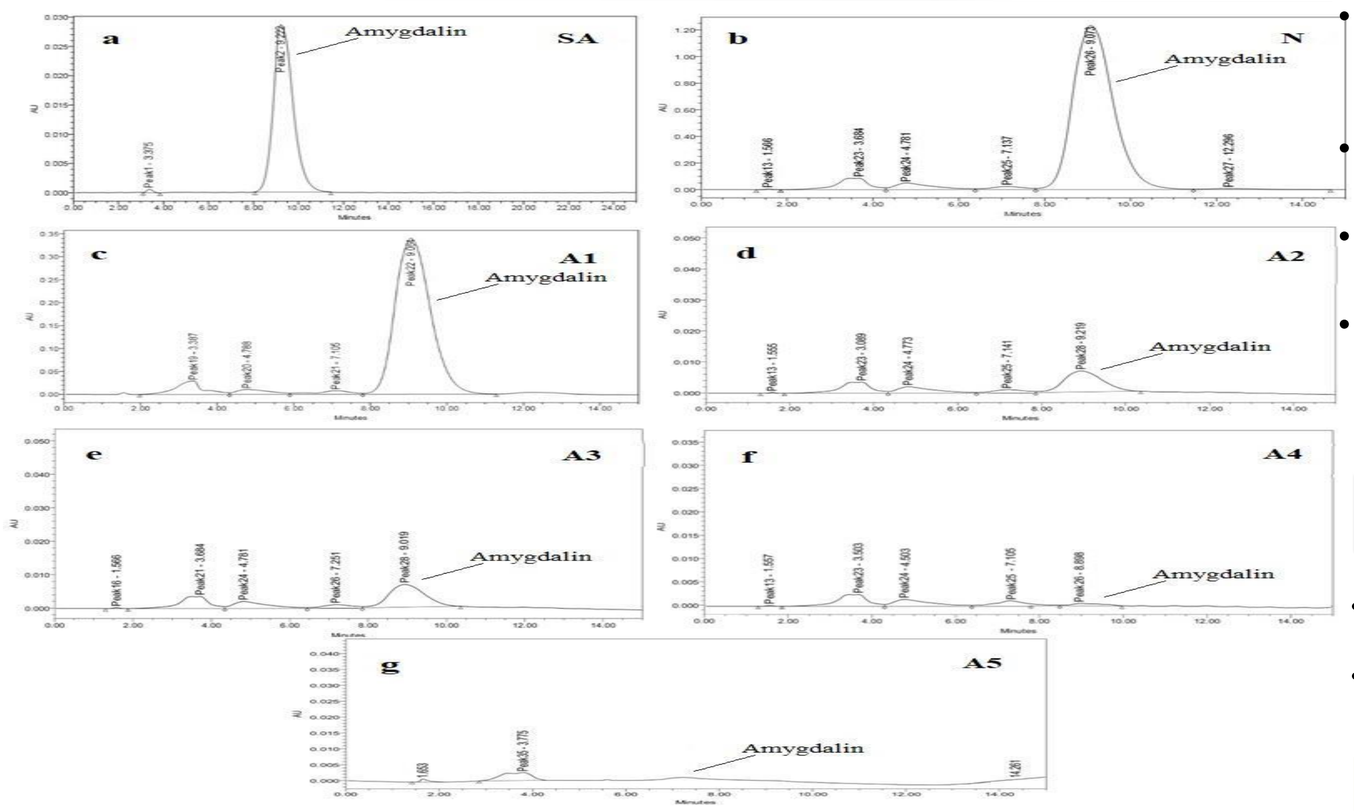
Soaking temperatures: 25–45 °C.
Soaking times: 6–18 hours.
Optimized using RSM to reduce cyanogenic glycosides

- **Combined Microwave & Hydrothermal Treatment**:

Microwave: 450 W for 6 minutes.
Hydrothermal: 45 °C for 6 - 12 hours
Optimized using RSM to eliminate cyanogenic glycosides

- **Anti-nutritional Factors**
- **Antioxidant Potential**
- **Proximate Analysis**
- **Polyphenol analysis**
- **Optical Characteristics**
- **FTIR Analysis**
- **GC-MS Analysis**
- **HPLC Analysis**
- **Statistical Analysis**





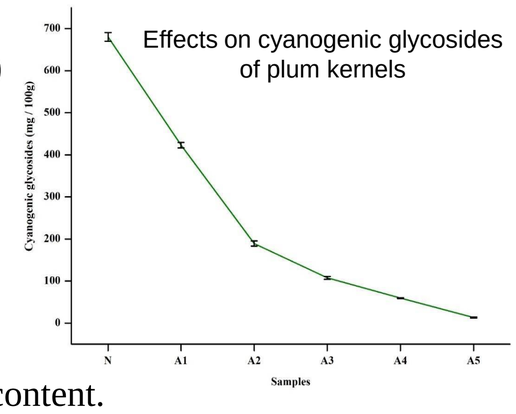
Effects of different processing conditions on amygdalin content of plum kernels

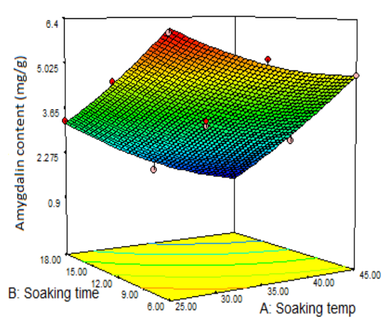
RESULTS & DISCUSSION

1. Microwave Treatment

(At optimized condition of 450 W for 6 min)

- **Improved Composition:**
  - Oil content: ↑ **4.03%**
  - Crude fiber: ↑ **3.62%**
  - Carbohydrates: ↑ **14.92%**
  - Crude protein: ↓ **7.61%**
- **Enhanced Antioxidant Activity**:
  - Increased total phenolic and flavonoid content.
  - Increased bioavailability of phenolic compounds
- **Reduced Anti-nutritional Factors**:
  - Amygdalin: ↓ **87.1%**
  - Hydrocyanic acid: ↓ **84.7%**
  - Phytic acid: ↓ **20.9%**
  - Tannins: ↓ **46.2%**
- **Damaging Effects**:
  - Prolonged heating (8 min) caused burning spots and degraded phenolic compounds.





Effects on amygdalin content of plum kernels

2. Hydrothermal Treatment Optimization:

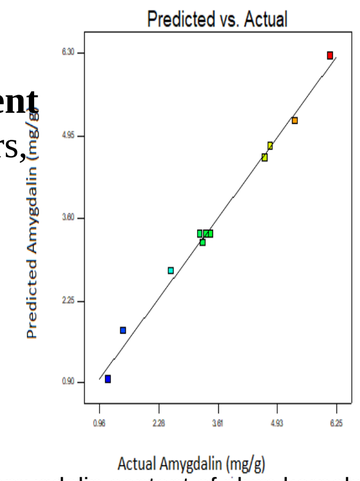
(At optimized condition of soaking at 45 °C for 12 hrs)

- Reduced amygdalin: ↓ **68.72%,**
- HCN: ↓ **79.59%,**
- Tannins: ↓ **72.64%.**

3. Combined Microwave & Hydrothermal Treatment

(At optimized condition of soaking at 45 °C for 12 hrs, followed by microwave heating at 450 W for 6 min)

- **Synergistic Effects**:
  - Reduced cyanogenic glycosides: ↓ **98.02%,**
  - Phytic acid: ↓ **89.50%,**
  - Tannins: ↓ **84.71%.**
  - **Amygdalin was undetectable.**



Effects on amygdalin content of plum kernels

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CONCLUSION

- **Microwave Heating (450 W for 6 min)** enhances plum kernel composition, increasing oil, fiber, ash, carbohydrates, and bioactive compounds while reducing amygdalin, HCN, phytic acid, and tannins.
- **Hydrothermal Treatment (45°C for 9 hours)** reduces anti-nutritional factors but does not lower amygdalin to safe levels.
- **Combined Microwave & Hydrothermal Treatment** effectively reduces cyanogenic glycosides to undetectable levels and preserves key phenolics, improving antioxidant potential.
- Controlled treatments offer a **cost-effective detoxification method** for safe, sustainable use of plum kernels in food and bioactive compound production.
- Further refinement is needed to meet **safety standards** for amygdalin reduction
- Future work will focus on optimizing extraction processes for biopolymers (oil, protein), their characterization, and their potential utilization in various food and drug applications.

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