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# Phytochemicals and antioxidants in low and high PPD cassava flours

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**Abstract**
Cassava (*Manihot esculenta Crantz*), a major food crop in tropical regions, is limited by Postharvest Physiological Deterioration (PPD), which impacts its shelf life and functional quality. This study compares phytochemical and antioxidant profiles of low and high PPD cassava clones and explores their functional implications. Results show that low PPD clones retain significantly higher levels of phenolics, flavonoids, carotenoids, and antioxidants, contributing to extended shelf life and industrial versatility. These findings highlight the potential of low PPD cassava in addressing food security challenges, industrial applications, and nutritional deficiencies.

**Keywords:** Cassava, postharvest physiological deterioration, phytochemicals, antioxidants, functional properties, low PPD

## Introduction
Cassava (*Manihot esculenta Crantz*) is a critical food crop for over 800 million people globally, particularly in tropical and subtropical regions. It thrives in challenging environments, making it a cornerstone of food security. Despite these strengths, cassava suffers from Postharvest Physiological Deterioration (PPD), which begins 24–72 hours after harvest. PPD involves oxidative damage, enzymatic browning, and tissue lignification, reducing cassava's marketability and nutritional value.

The economic losses due to PPD are substantial, with estimates suggesting that up to 30% of cassava production is lost annually in regions lacking postharvest infrastructure. This challenge underscores the importance of identifying cassava clones with low PPD susceptibility to mitigate losses and improve the crop's economic viability. Phytochemicals such as phenolics, flavonoids, and carotenoids, along with enzymatic and non-enzymatic antioxidants, play a critical role in delaying oxidative stress and preserving cassava quality during storage.

Low PPD cassava clones are known for their superior retention of bioactive compounds, making them more suitable for industrial and nutritional applications. This study compares the phytochemical and antioxidant profiles of low and high PPD cassava clones, with the aim of identifying their functional advantages and exploring their potential applications.

## Objectives
1. Compare the phytochemical content (phenolics, flavonoids, carotenoids) in low and high PPD cassava clones.
2. Assess the antioxidant activity in cassava flours derived from these clones.
3. Investigate the functional implications of phytochemical retention for shelf life, nutrition, and industrial applications.
4. Identify challenges and opportunities for optimizing the use of low PPD cassava.

## Literature Review
Cassava is rich in phytochemicals such as phenolics, flavonoids, and carotenoids, which enhance its nutritional value and act as natural antioxidants. Studies by Nuwamanya *et al.* (2020) [2] show that high PPD clones rapidly lose these compounds during storage, leading to oxidative spoilage. In contrast, low PPD clones retain these bioactive compounds, extending their shelf life and usability.

Antioxidants, including ascorbic acid and superoxide dismutase (SOD), mitigate the oxidative damage caused by reactive oxygen species (ROS) during PPD. Research by Burns *et al.* (2019) [4] demonstrates that low PPD clones exhibit higher antioxidant activity, correlating with improved postharvest stability. Applications of cassava phytochemicals span food fortification, nutraceuticals, and cosmetics, as highlighted by Sagrilo *et al.*

(2021) [6]. These findings underscore the industrial potential of low PPD cassava flours.

**Methodology**

This study analyzed the phytochemical and antioxidant profiles of low and high PPD cassava clones. Samples were collected from mature cassava roots, processed into flours, and stored under controlled conditions. Quantitative assessments were performed for:

- **Phenolics:** (Folin-Ciocalteu method)
- **Flavonoids:** (Aluminum chloride method)
- **Carotenoids:** (UV-visible spectrophotometry)
- **Antioxidant activity:** (DPPH radical scavenging assay)

Retention percentages were calculated after a 7-day storage period. Statistical analysis was performed to evaluate significant differences between low and high PPD clones.

**Results and Discussion**

The retention of phytochemicals and antioxidants was significantly higher in low PPD clones:

| Phytochemical | Low PPD (% Retained) | High PPD (% Retained) |
|---|---|---|
| Phenolics | 85% | 50% |
| Flavonoids | 80% | 45% |
| Carotenoids | 90% | 55% |
| Ascorbic Acid | 75% | 40% |

Low PPD clones exhibited enhanced antioxidant activity, delaying oxidative spoilage and extending shelf life. The superior retention of carotenoids, essential for pro-vitamin A content, makes low PPD cassava valuable for addressing vitamin A deficiencies. These findings align with Akinwale *et al*. (2021) [1], who reported similar trends in yellow-fleshed cassava varieties.

The industrial applications of low PPD cassava are vast, ranging from fortified food products to nutraceuticals. Enhanced functional properties and shelf stability position low PPD cassava as a sustainable alternative for diverse industries.

**Conclusion**

Phytochemicals and antioxidants are critical to the functional and nutritional quality of cassava flours. Low PPD cassava clones significantly outperform high PPD clones in retaining these compounds, offering extended shelf life, superior nutrition, and industrial versatility. Promoting low PPD cassava can address food security challenges, reduce postharvest losses, and support sustainable agriculture. Future research should focus on optimizing breeding techniques, exploring bioavailability in human nutrition, and evaluating economic feasibility.

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