Optimal Drying Conditions for Production of Safe and Nutritious Cassava Leaves

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Introduction

- Cassava leaves are consumed as a vegetable in at least 60% of countries in Sub-Saharan Africa.
- They are rich sources of protein, vitamins B1, B2, zinc and beta carotene.
- They contain high levels of cyanide.
- It is still unclear which processing techniques are optimal to effectively reduce toxicity in cassava leaves without destroying essential nutrients and reducing antioxidant activity.
- Drying temperature and time does not affect beta-carotene, cyanide and antioxidant activity.

Study objective

- To optimize oven drying conditions of cassava leaves for production of safe, nutritious and high antioxidant leaf powder using response surface methodology.

Methods

- Fresh cassava leaves were washed milled, dry blanched and oven dried.
- I-Optimal design with drying temperature (50-80) °C and time (3-8) hours was employed.
- Desirability Function Approach was used to optimize for high antioxidant activity, low cyanide content and high beta carotene content.
- Shelf life of the optimised cassava leaves was determined by evaluating the microbial count for 12 weeks.

Statistical analysis

A numerical multi-response optimization technique of Design Expert®12 statistical software (Stat-Ease, Inc., Minneapolis, USA) was used to determine the optimum conditions for drying cassava leaves.

Results

- The linear model was significant for total hydrogen cyanide ($R^2 = 0.90$, $p < 0.05$) and beta carotene ($R^2 = 0.89$, $p < 0.05$)
- The quadratic model was significant for total antioxidant activity ($R^2 = 0.89$, $p < 0.05$).
- Response surface plots showed that an increase in temperature significantly increased total antioxidant activity (TAA) (Fig 1).
- The increase in temperature significantly increased total cyanide content(fig 2) while total beta carotene reduced (fig 3).
- The optimal drying conditions were: temperature (60 °C) and time (3 hours).
- Total plate count and yeasts and molds of the optimized dried cassava leaves increased during storage for 12 weeks but did not exceed acceptable safety levels.

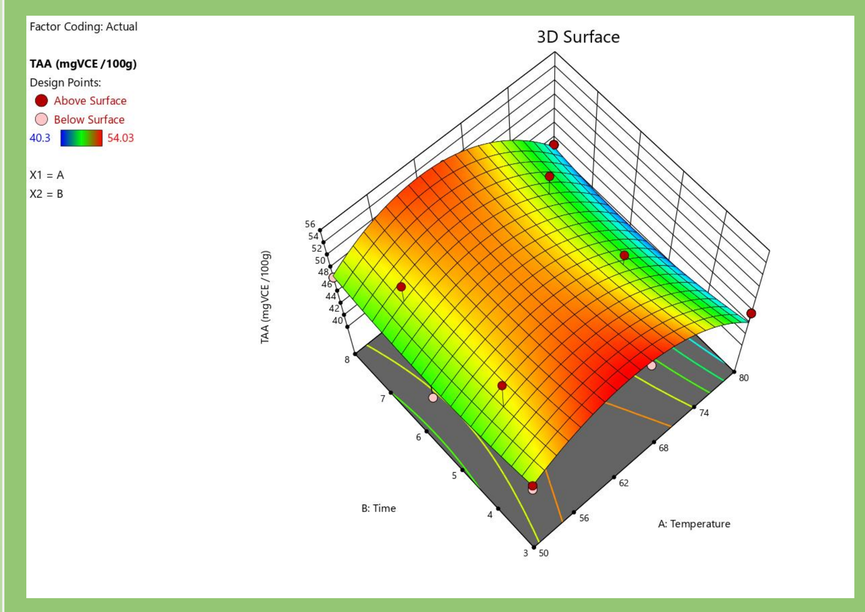

Fig.1. Effect of drying temperature (X_1) and time (X_2) on total antioxidant activity

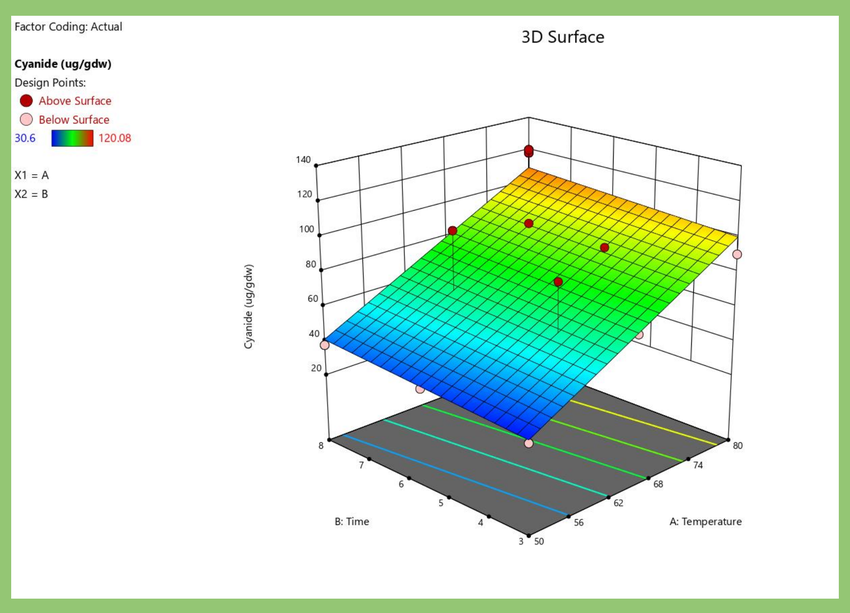

Fig. 2. Effect of drying temperature(X_1) and time (X_2) on total cyanide content

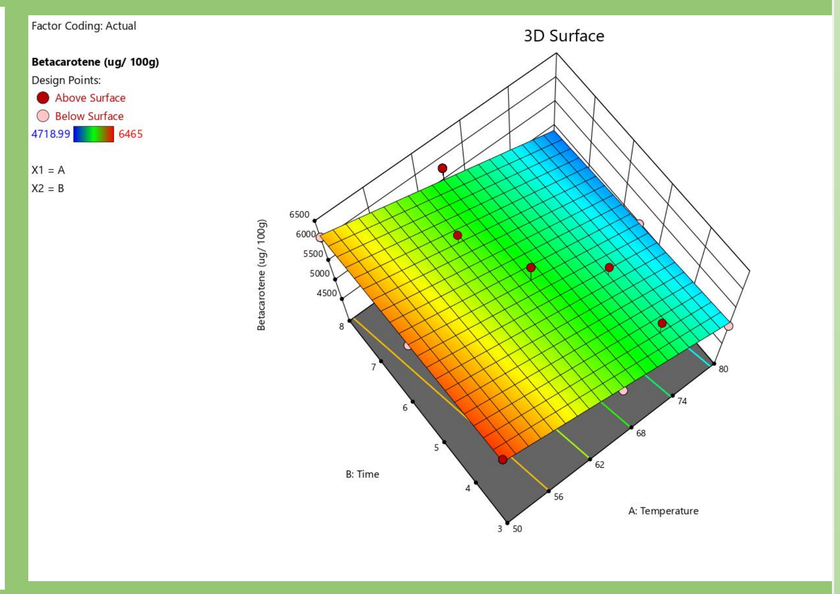

Fig 3: Effect of drying (X_1) and time (X_2) on drying temperature and time on beta carotene

Discussion

- The increase in total antioxidant activity may be attributed to formation of novel compounds such as Maillard reaction products which contribute to antioxidant activity[1].
- Decrease in beta carotene is due to transformation of all trans beta carotene to Cis form that is not biologically active[2].
- Total plate count and yeasts and molds of the optimized dried cassava leaves during storage period of 12 weeks did not exceed maximum acceptable safety values for molds.

Conclusion

- Oven drying affects the beta carotene content, antioxidant activity and cyanide content of the cassava leaves.
- Optimal drying conditions can be applied in the production of a safe, shelf stable, nutritious, high antioxidant product in the nutraceutical and food industries.

References

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