The challenges of Post-harvest drying African Cowpeas Leaves and Jute Mallow Vegetables

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1. FOOD SECURITY STATUS IN SUB-SAHARA AFRICA

- Yearly episodes of malnutrition, starvation, droughts and famine in Sub-Saharan Africa
- Food production has improved
- BUT population has increased even more
- AND the post-harvest losses are high, up to 50%.
- Deficiency of important nutrients in the diets of children and women In Africa, 42% of children under the age of 5 years are vitamin A deficient

2. THE ADVANTAGE OF USING ALVS TO ADDRESS FOOD SECURITY

- ALVs are more resistant to diseases, drought tolerant
- Yield highly with high potential for local adaptation
- Well accepted in terms of taste and widely consumed in tropical Africa (good market)
- High in nutrients: Vitamin A, vitamin C, folic acid, riboflavin and minerals: iron and calcium
- High medicinal value and potential for production of phytochemicals.

3. EXAMPLES AFRICAN LEAFY VEGETABLES (ALV)

Cowpea leaves (*Vigna unguiculata*)

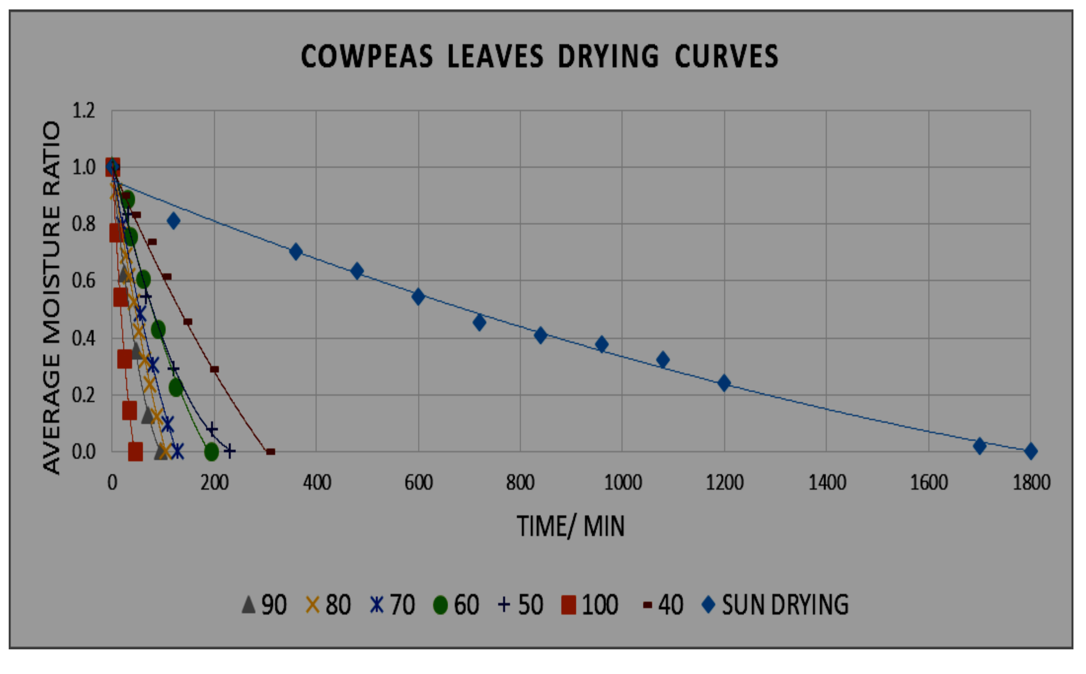
Jute mallow (*Corchurus olitorious L.*)

- Africa leafy vegetables (ALVs) are plants whose leafy parts, succulent stems, flowers and very young fruits, are used as a vegetable
- Are indigenous Africa
- They are multi-functional crops for humans and fodder for livestock
- They mostly sprout naturally after rain

Vegetable amaranth (*Amaranthus spp*)

African nightshades (*Solanum spp*)

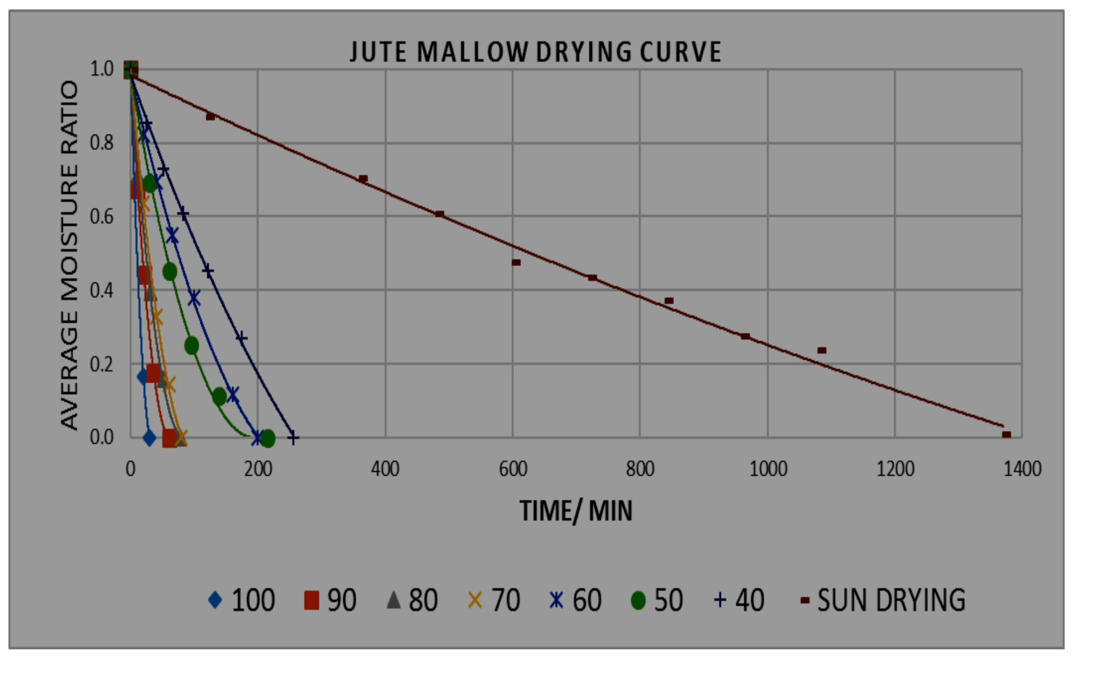
4. DRYING CHARACTIERISTICS OF ALVs



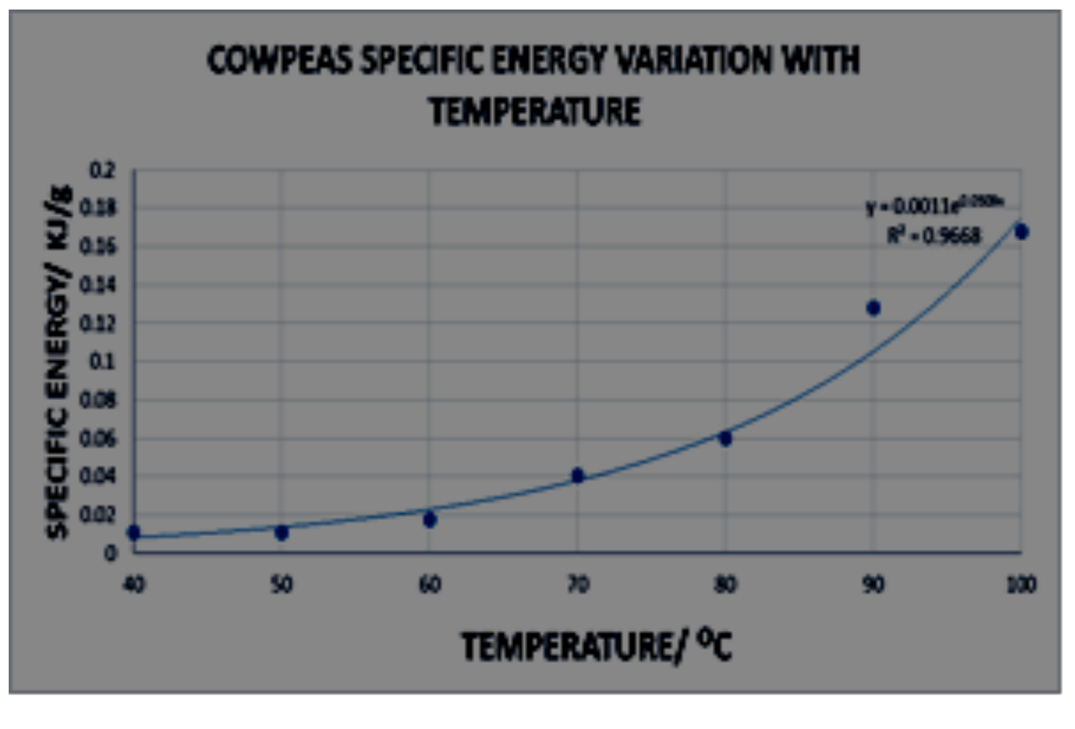
- The drying curves obtained for both vegetables exhibited the falling rate and were devoid of constant rate period of drying
- The Page model adequately explained the drying behavior of the ALVs studied at a temperature range of 40 - 100°C

$$MR = ke^{-wt}$$

- Where, **MR** represents the average moisture ratio; **k** is the decay constant coefficient; **w** is the drying time coefficient; **t** is the drying time.



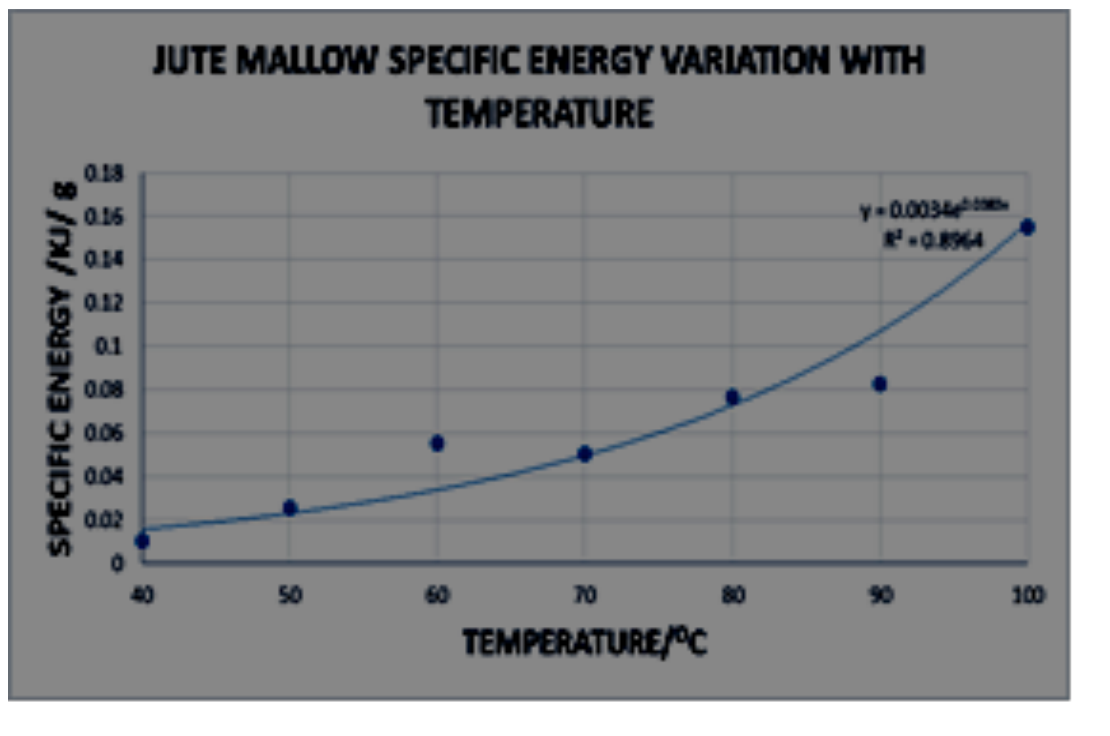
5. ENERGY CONSUMPTION FOR DRYING ALVs



- The energy consumption in vegetable drying was a function temperature and time.
- The thermal efficiency diminishes as drying air temperature increases, resulting in an increase of energy consumption in function of increasing drying air temperature.
- A relationship between specific energy, the drying time and temperature was developed using multiple regression analysis.

$$E_t = A + B_1 t + B_2 T$$

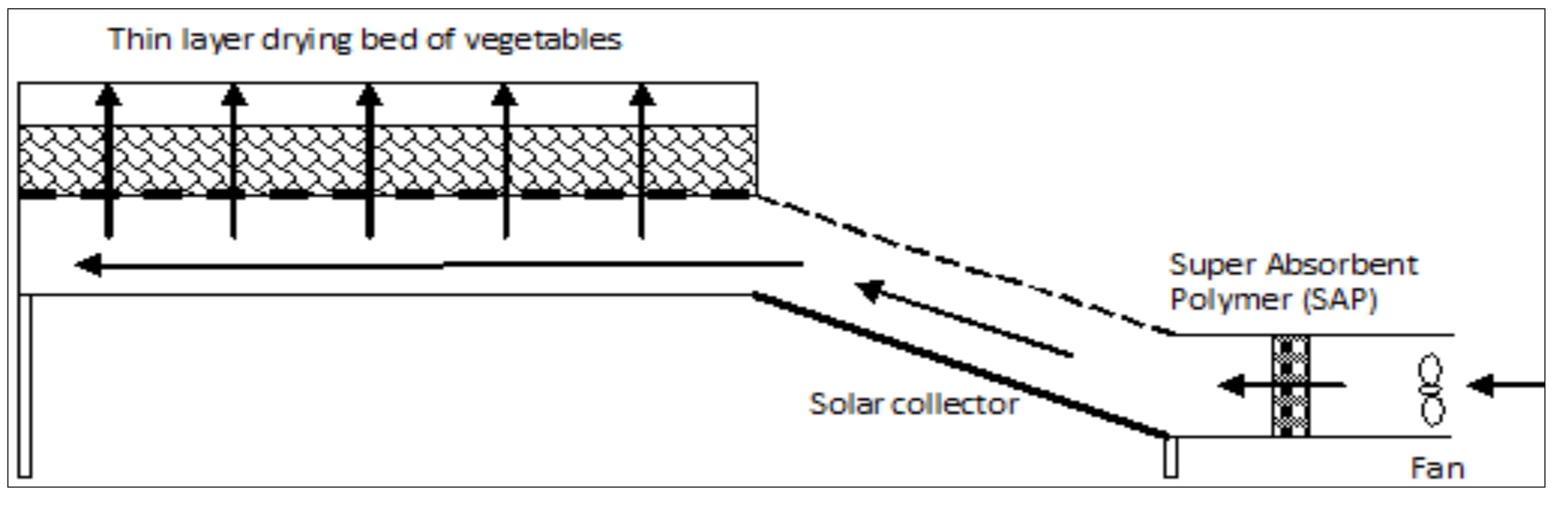
- A is the constant B_1, B_2 are time and temperature coefficients respectively X_1, X_2 are time and temperature variables



6. OBJECTIVES OF PROPOSED STUDY

- Fabrication of a Super Absorbent Polymer (SAP) / Solar hybrid drying system
- To optimize the drier for minimum energy use as well as optimum taste, nutrient, phytochemical and colour retention.
- Soft matter characterization of the vegetables during the drying process to explain nutrient, phytochemical and colour loss
- To determine sorption isotherms of the dried vegetables and best packaging options

7. PROPOSED VEGETABLE DRIER DESIGN



REFERENCES

1. Duncan O. Mbuge, Renata Negrini, Livine O. Nyakundi, Serge P. Kuate, Ranajit Bandyopadhyay, William M. Muiru, Baldwyn Torto, Raffaele Mezzenga. 2016. Application of superabsorbent polymers (SAP) as desiccants to dry maize and reduce aflatoxin contamination, J Food Sci Technol (August 2016) 53(8):3157–3165.
2.Mutuli, G. P., and D. O. Mbuge. 2015. Drying characteristics and energy requirement of drying cowpea leaves and jute mallow vegetables. Agric Eng Int: CIGR Journal, 17(4):265-272.
3.Wang, W., G. Chen, and A. S. Mujumdar. 2007. Physical interpretation of solids drying: an overview on mathematical modeling research. *Drying Technology, 25*(4):659-668
4.Kiremire, B., E. Musinguzi, and F. Lukwago. 2010. Effects of vegetables drying techniques on Nutrient Content: A case study of South Western Uganda. African. Journal for Food Agriculture, Nutrition and Development, 10(5): 2587-2600
5.Román, F., and O. Hensel. 2011. Effect of air temperature and relative humidity on the thin-layer drying of celery leaves (Apium graveolens var. secalinum). Agric Eng. Int: CIGR Journal, 13(2).

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