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"Resilience of agricultural systems against crises"

Improving of Thermal Uniformity of Mango During Radio Frequency Heat Treatment for Insect Control

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1. INTRODUCTION

Hypothesis in this study was to improve the distribution of electromagnetic energy from radio frequency (RF) heating of mango fruit (*Magnifera indica* L.). Therefore, a rotating container was developed and filled with a medium (water) to support a homogeneous movement and uniformity of electromagnetic energy.

Fig 1. *Radio frequency applicator*

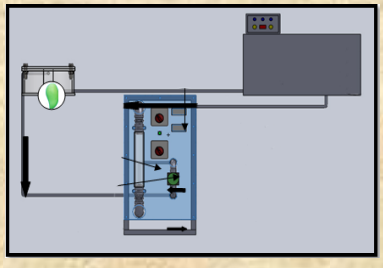

Fig 2. *Schematic diagram of fruit chamber*

2. MATERIALS & METHODS

The experiment was to compare the uniformity of heat inside mango fruit treated by several thermal methods based on U.S (USDA-APHIS-PPQ, 2002) regulation for control fruit fly in mango. Design of rotating container combined with RF applicator (Fig 1) was done (Fig 2). The indicator affected on movement of mango fruit then was investigated by using three different weights (360, 330 and 250g) of mango (*Magnifera indica* L.) to determine the flow rate as well as the velocity of the movement of fruit around the container per time was also measured. Comparison of heating method between radio frequency, hot water and hot air on mango fruit (Fig 3.)were evaluated by infrared camera for the uniformity of heat in treated mango fruit.

Table 1 Velocity of different mango weight in rotating chamber filled with water

Weight of mango (g)	Water flow rate (Liter/min)	Mango rotation (rpm)
366	11.5	32±1.47 a*
330	11.5	35±1.49 b
250	11.5	41±1.48 c

Different letters within row indicate that means are significantly different (P≤0.05)

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3. RESULT & DISCUSSION

The result was found that 1000 watt RF heating energy applied to container of fruit-roll could provide a consistent distribution of thermal treatment in mango with exposure period for 5-10 minutes (Fig 4 A & B) which was equivalent to the result from dipping in hot water for a period o

Fig 3. *Mango sample cut in half lengthwise before treating*

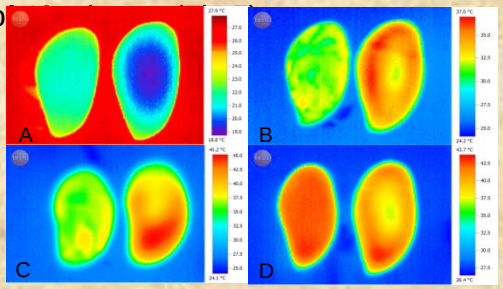

Fig 4.*Thermal image with temperature legend showing heat distributions in untrated mngoes (A) and treated mango with radio frequency 1000 watt for 5 minute (B) 10 minutes (C) and exposed with temperature of 48C for 8 min (D)*

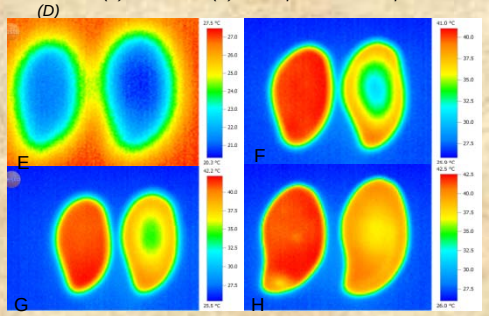

Fig 5. *Thermal image with temperature legend showing heat distributions in treated mango with hot water for 10 min(E), 20 min (F), 30 min (G) 40 min (H)*

Besides that the thermal distribution in mango treated with hot air showed non-uniform heat distribution inside flesh fruit (Fig 6).

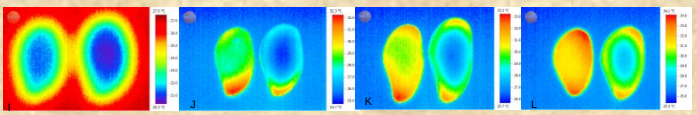

Fig 6. *Thermal image with temperature legend showing heat distributions in treated mango with hot air for 10 minutes (I) 20 minutes (J) 30 minutes (K) 40 minutes (L)*

4. CONCLUSION

The RF heating operation process required shorter time than immersion into hot water and exposure to hot air. The results recorded also that there were no contact damages observed since the mango fruit moved freely in water filled chambers.

5. REFERENCE

USDA-APHIS-PPQ, 2002. Treatment manual: interim edition. In: Agric., U.S.D. (Ed.). Animal Plant Health Inspection Service, Plant protection Quarantine, Riverdale, MD.