

# Study of radio frequency on disinfestation and pasteurization of rice flour

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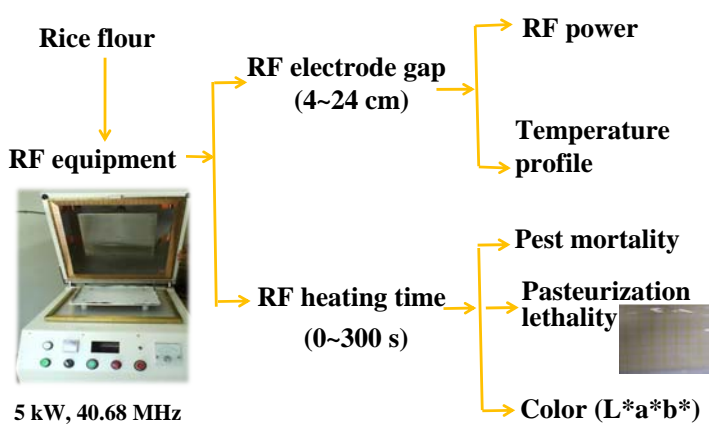
## Abstract

Rice is the most important grain in Asia, and rice flour can be expended the application in the food industry. However, insect infestation and microorganism contamination in rice flour may occur in the hot and humid area. When temperature is above 60°C, adults and eggs of rice pest will be heated to die. The objective of this study was to develop the thermal inactivation process by a 40.68 MHz, 5 kW radio frequency (RF) system to replace chemical fumigation for disinfestations and pasteurization of rice flour. The energy outputs of RF were influenced by the RF electrode gaps and types of rice flour. The 3 kg rice flour reached above 60°C operating at 60 s RF treatment with gap of 8.5 cm to obtain the 100% pest mortality. The 4.5 kg rice flour reached around 100°C operating RF 300 s heating with gap of 16 cm, and obtained 100% lethality after the pasteurization. The b\* value of rice flour after RF 300 s heating was higher than untreated and RF 60 s heating. The moisture content of rice flour after RF 300 s heating was slight lower than untreated.

## Introduction

Chemical fumigation is common used for pest infestation of rice. However, there are several non-chemical alternative methods such as ionizing radiation, cold storage, controlled atmospheres, microwave or radio frequency (RF) heating and combination. RF has lower frequency than microwave; therefore RF has larger penetration depth than microwave, and more uniform heating for pest control than microwave. The thermal resistant level of rice weevil are adult > pupae > larvae > eggs. Adults and eggs of rice weevils (*Sitophilus oryzae* L.) suffer 100% mortality when final rice temperature is above 55°C. The 62.8 °C continuous heating 28.2 s can kill 90% of bacteria. The objective of this study was to develop the thermal inactivation process of rice flour by RF system to replace chemical fumigation

## Materials and methods



## Results and discussion

Increasing rice flour loading increased height of rice flour and led to larger RF electrode gap operation. Decreasing RF electrode gap caused larger RF power. (Fig. 1 and Fig. 2) The temperature profiles of 3 kg indica rice flour and glutinosa rice flour were above 60 °C and led to 100% mortality after RF heating 60 sec (Fig. 3). However, 4.5 kg loading indica rice flour at least required 90 sec to reach 60 °C and about 300 sec to obtain temperature near 100°C and have 100% lethality during RF heating with 16 cm gap (Fig. 4). There was no significant difference in moisture content and color (L\*, a\*, b\* value) among the untreated, 60 s and 300 s RF heating (Table 1).

## Conclusions

The temperature of rice flour immediately increased in the 40.68 MHz, 5 kW radio frequency (RF) heating system; therefore, RF can replace chemical fumigation for disinfestations and pasteurization of rice flour. The energy outputs of RF increased with decreasing RF electrode gap distance, increasing with loading weight and types of rice flour. The 3 kg rice flour reached above 60°C after RF 60 s heating to obtain the 100% pest mortality. The 4.5 kg rice flour reached around 100°C after RF 300 s pasteurization to obtain 100% bacterial lethality. The rice flour color (L\*, a\*, b\* value) of the RF treatments were no significant difference.

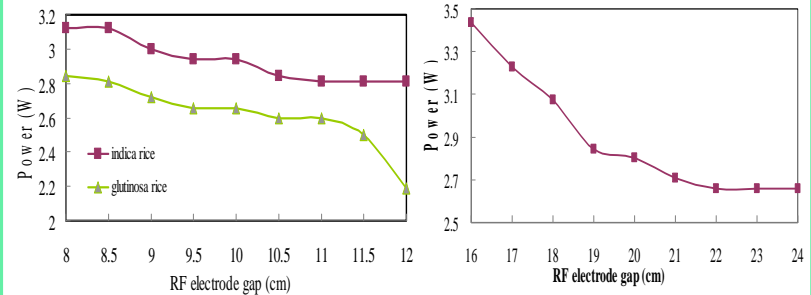


Fig. 1. Power of loading 3 kg rice flours with 7.5 cm height at different RF gaps. Fig. 2. Power of loading 4.5 kg rice flour with 15 cm height at different RF gaps.

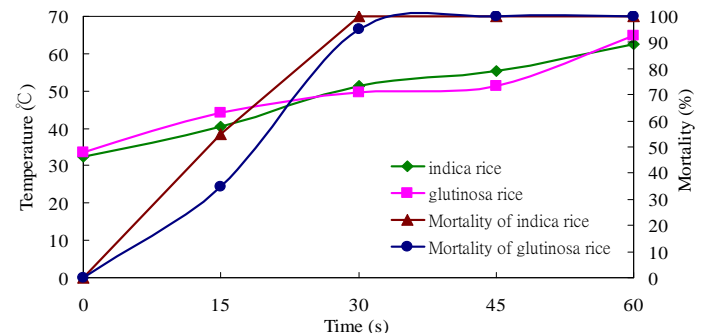


Fig. 3 The mortality of *Sitophilus oryzae* adults in 3 kg rice flour with height of 7.5 cm after RF with 8 cm electrode gap heating.

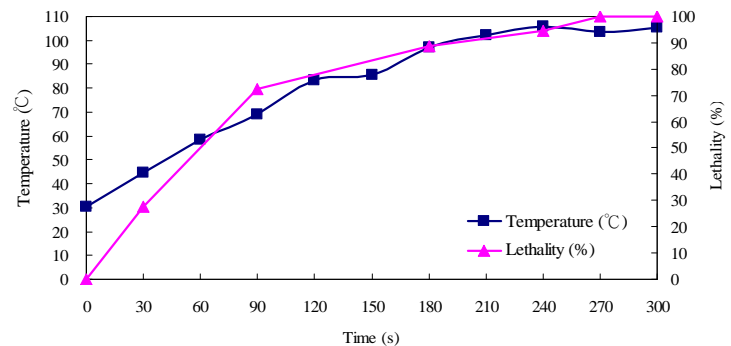


Fig. 4 The lethality of total bacteria in 4.5 kg rice flour with height of 7.5 cm after RF with 16 cm electrode gap heating.

Table 1. Effect of RF time on the appearance and quality of rice flour

RF heating time (s)	Moisture (%)	Color			Mortality (%)	Lethality (%)
		L*	a*	b*		
0	0.97	97.69	-0.68	4.20	0	0
60	1.09	97.60	-0.68	4.21	100	25
300	0.82	97.55	-0.73	4.54	---	100