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Physical Properties of Jujube Slices by Hot Air and Infrared Drying

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Abstract

Dried Chinese jujube slices are mainly consumed as snacks or soaked for tea drink. The requirements in physical properties and hydration characteristics of the dried jujube slices are related to the applications. Jujube slices with different thicknesses (3, 5 and 7 mm) were dried in single layer with hot air (HA) and infrared (IR) at different temperatures (60, 70 and 80°C). The drying characteristics, crispness, rehydration ratio and total soluble solid (TSS) content were investigated. The results showed that both drying method and drying temperature had significant influence ($p < 0.05$) on the drying time and crispness. The drying rate under IR drying was higher than HA drying at the same drying temperature, and the corresponding drying time was shorter. The rehydration ratio was mainly affected by the thickness. The TSS content of IR dried products was higher and the color of rehydrated solution was more attractive. The results indicated that IR dried slices are better for tea drinks and HA dried jujube slices are more suitable for crispy snacks.

Background

- China produces over 7 million tons of jujube annually (89% of world production), and over 90% of the jujubes are dried for consumption.
- Dried jujube slices with 5% moisture content (MC) are usually produced by HA drying from semi-dried jujubes (25%–28% MC), and the drying process is time consuming.
- The physical properties and hydration characteristics of jujube slices are important and may be affected by drying methods.



Semi-dried jujubes

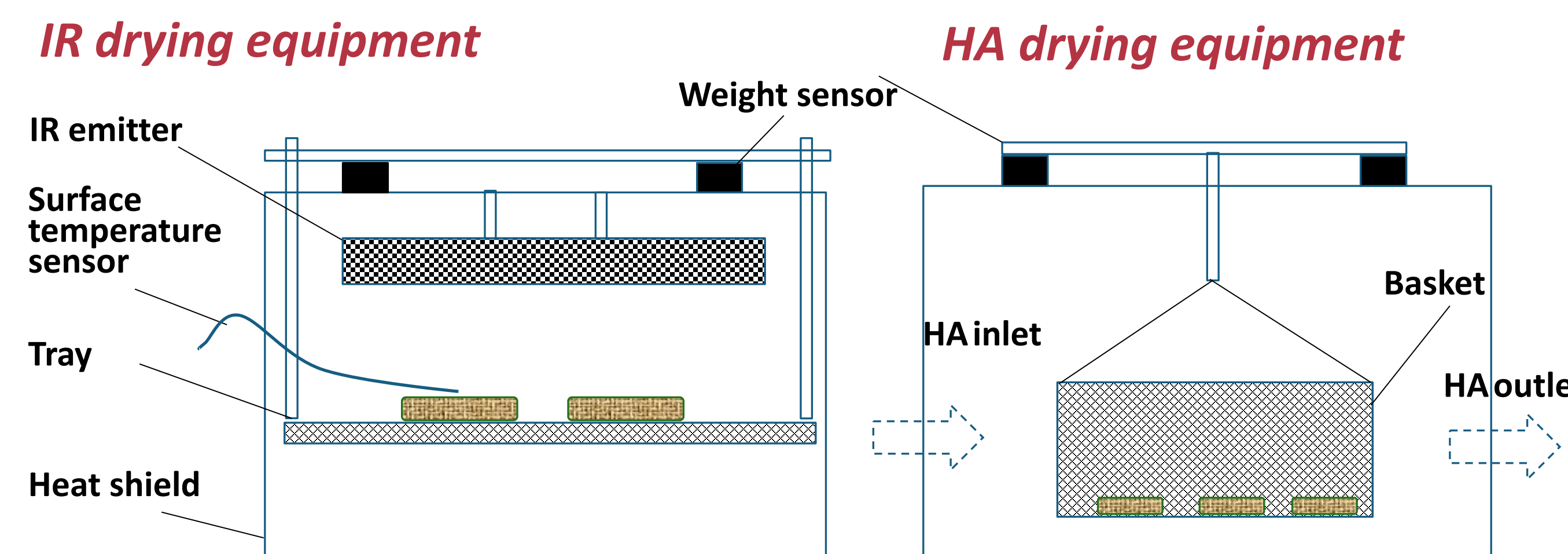
Jujube slices

Tea drink

Objectives

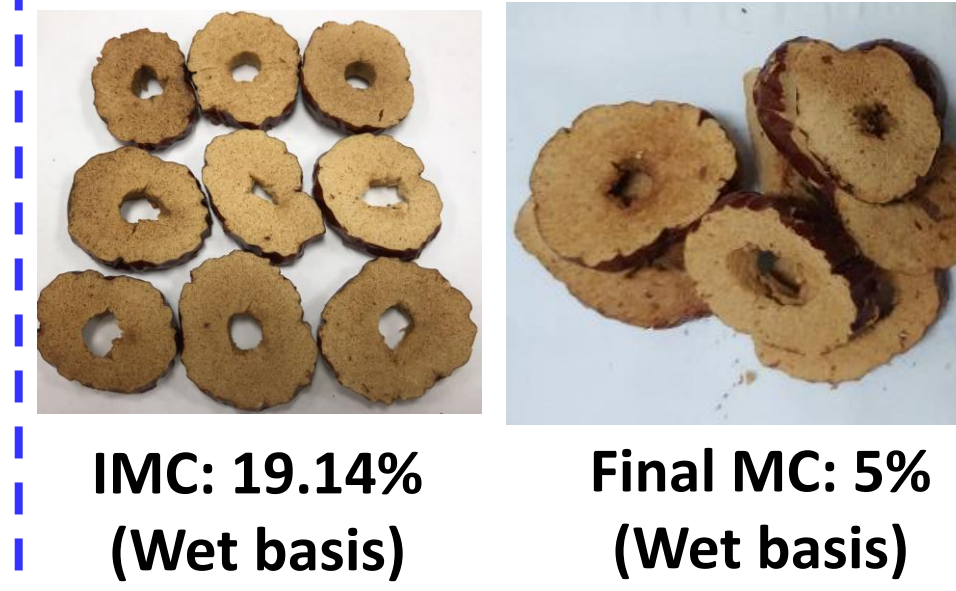
- Investigate the influence of operating conditions and system parameters on the drying characteristics of jujube slices.
- Study the physical properties of jujube slices dried by IR and HA heating.
- Determine the appropriate drying methods for jujube slices with respect to the product applications.

IR and HA Drying Systems



Materials and Methods

Drying experiment

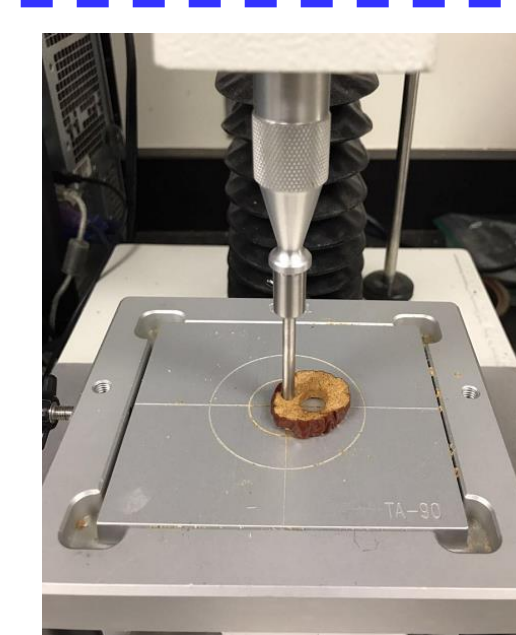


IMC: 19.14% (Wet basis) Final MC: 5% (Wet basis)

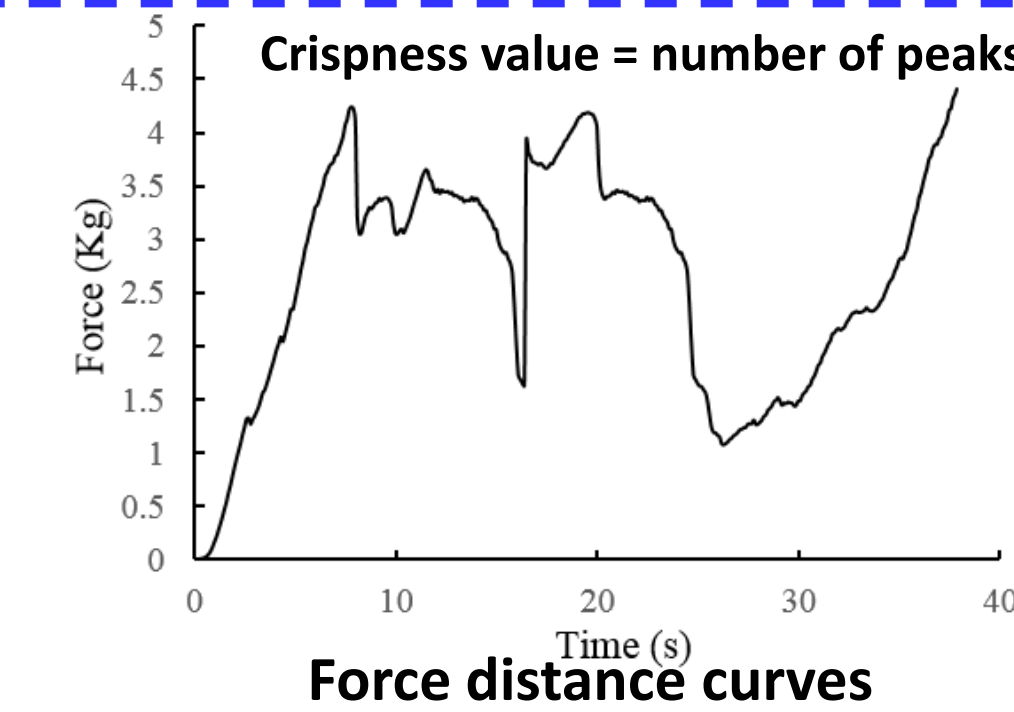
Drying methods	HA					IR				
	60	70	80	70	70	60	70	80	70	70
Drying Temperatures (°C)	60	70	80	70	70	60	70	80	70	70
Thicknesses (mm)	5	5	5	3	7	5	5	5	3	7

Crispness

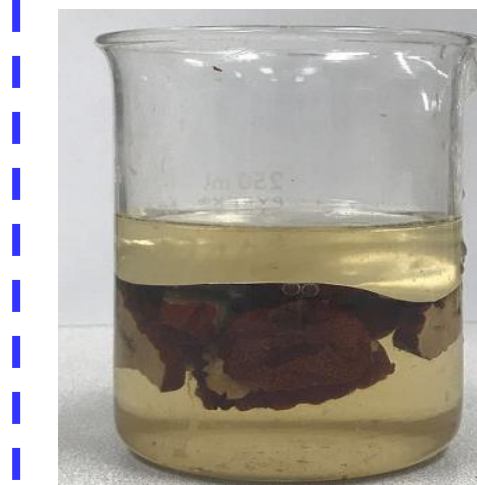
Texture analysis parameters	
Parameter	Value
Pre-test speed	1 mm/s
Test speed	0.1 mm/s
Max force	4.5 kg



Texture analyzing



Rehydration test



The weight of jujube slices was measured after different soaking times in water (1, 3, 5, 7, 10, 20, 30, 40, 50, 80, 110, 200 min)

15 ± 0.5g sample/150ml water at 25 °C

Solution color and TSS

The color of hydrated solution (L, a, b and ΔE) was measured by colorimeter and the TSS content was measured by refractometer



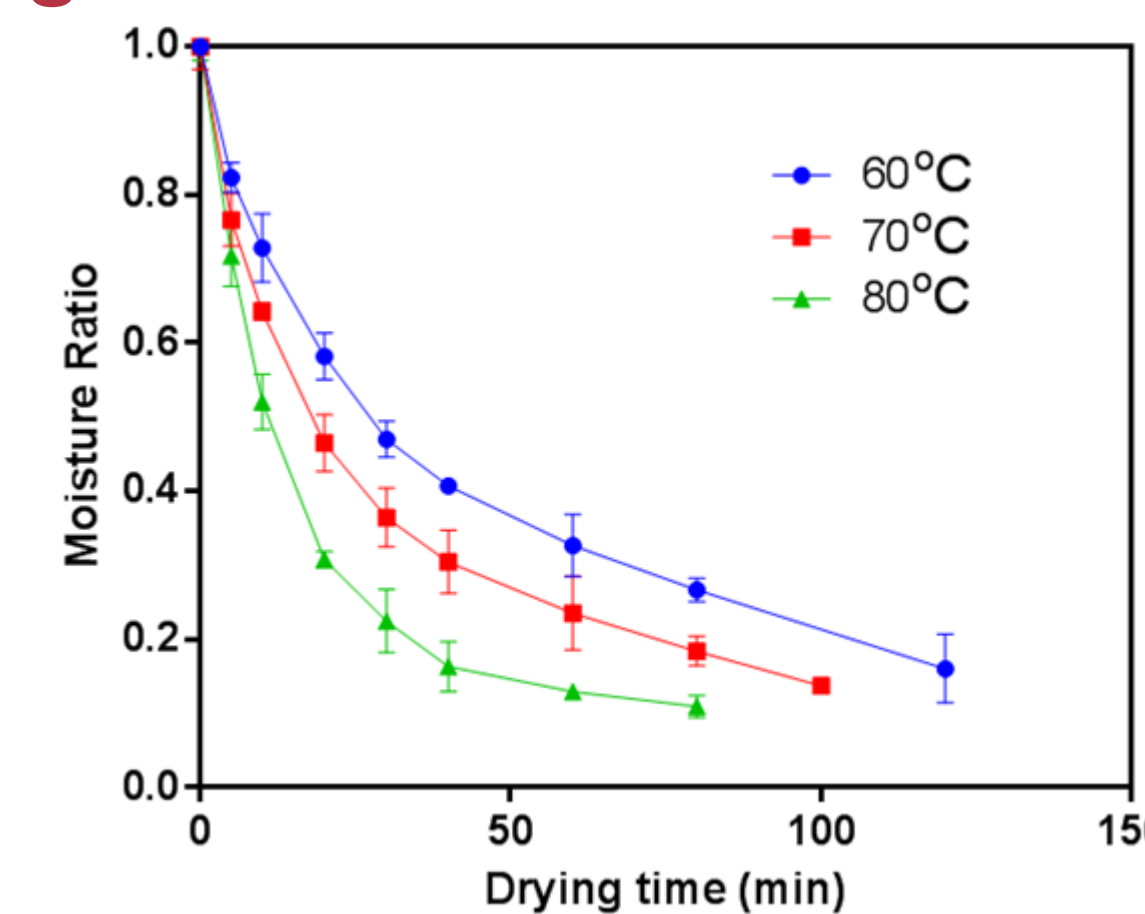
Sugar refractometer



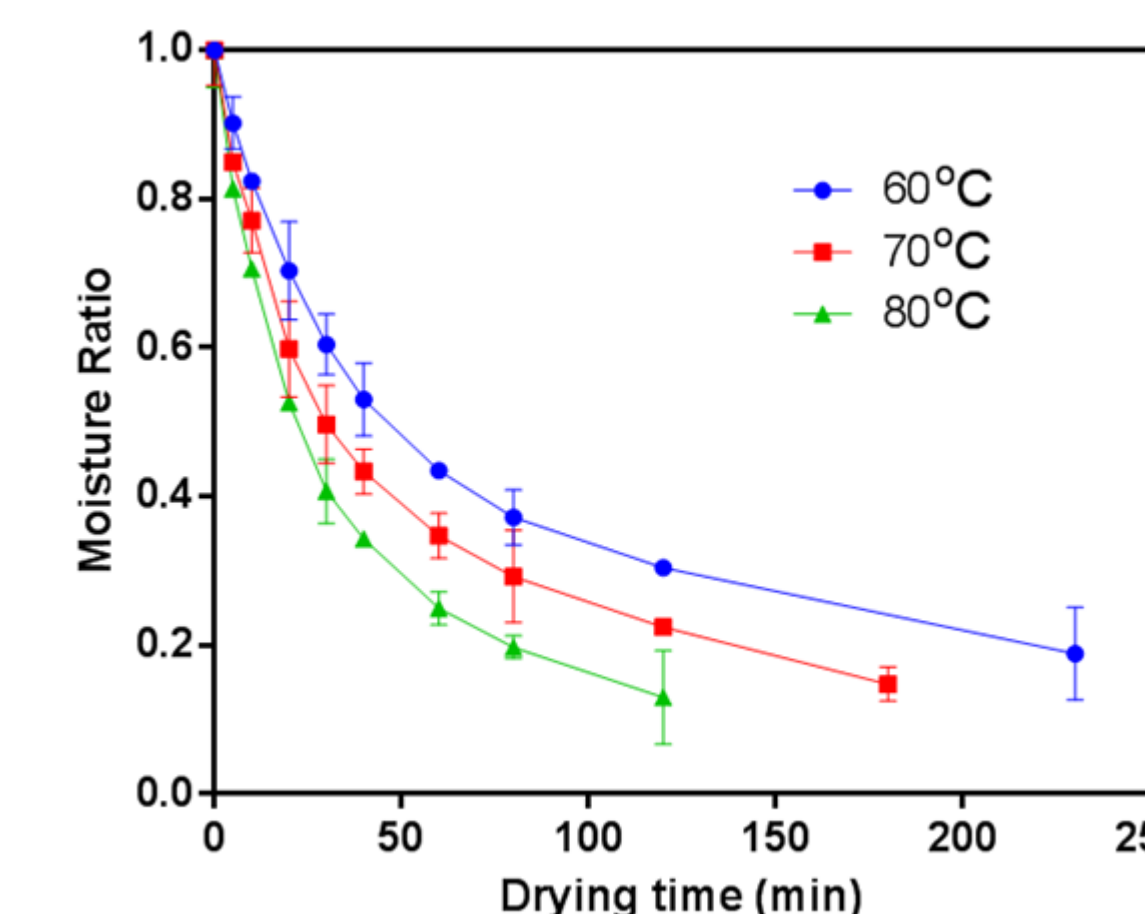
Colorimeter

Results and Discussions

Drying time



Drying curves under IR heating



Drying curves under HA heating

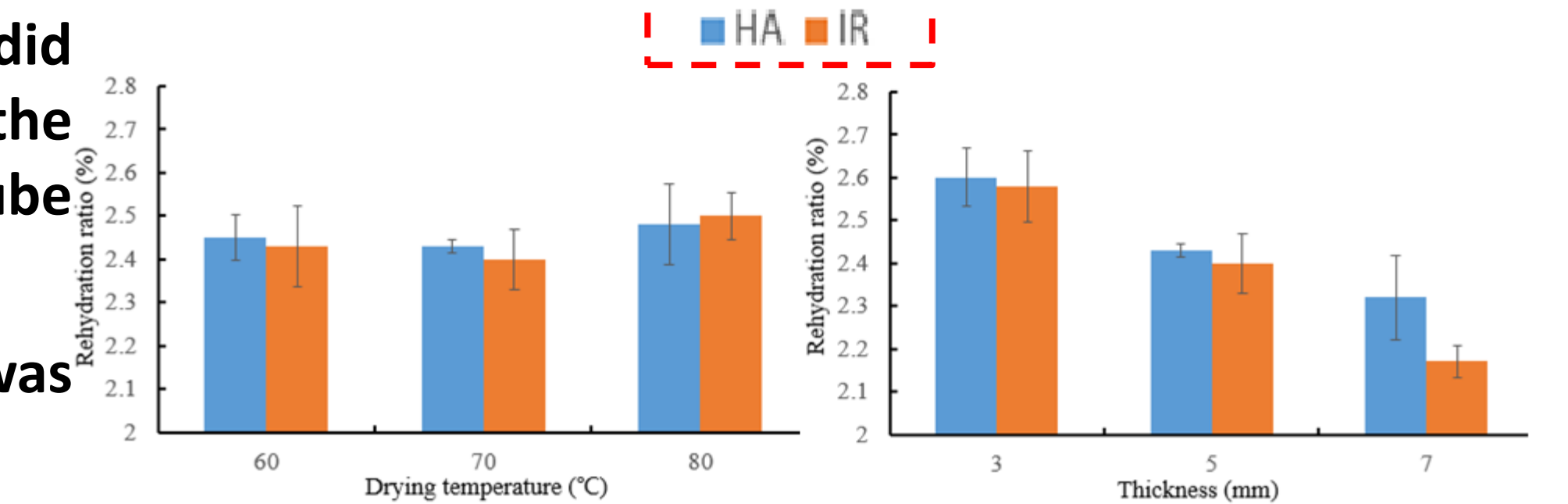
The drying time of jujube slices by IR heating was significantly shorter than that by HA heating at the same temperature

Results and Discussions (continued)

Rehydration ratio

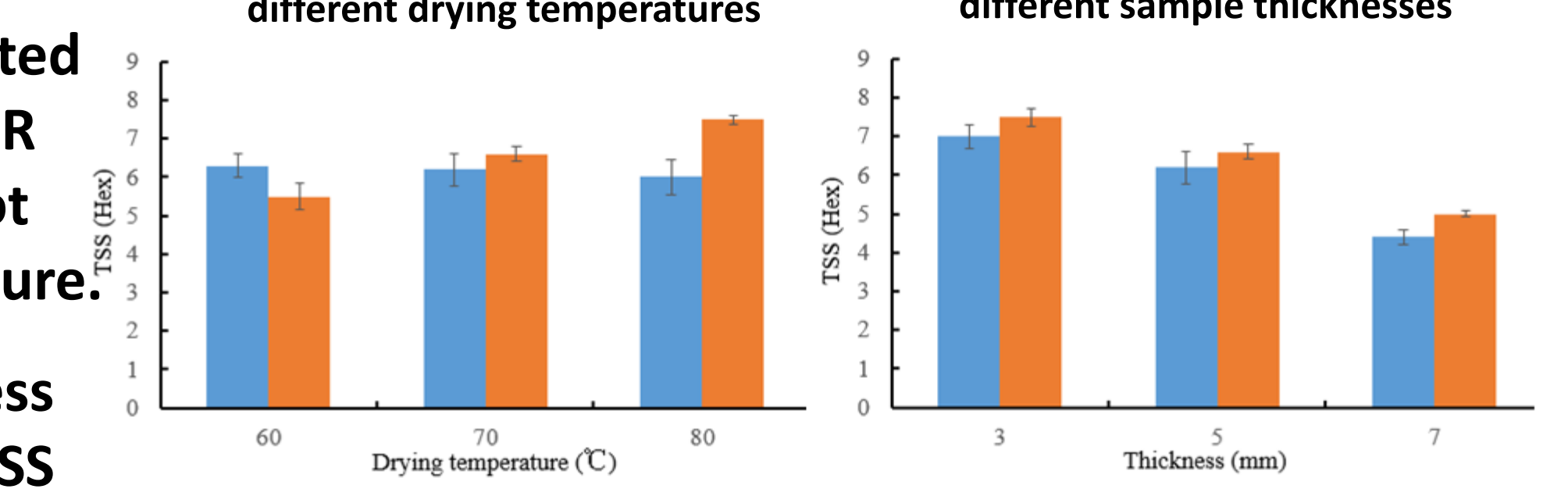
Drying temperature did not significantly affect the rehydration ratio of jujube slices.

The rehydration ratio was higher for thinner slices.



TSS content

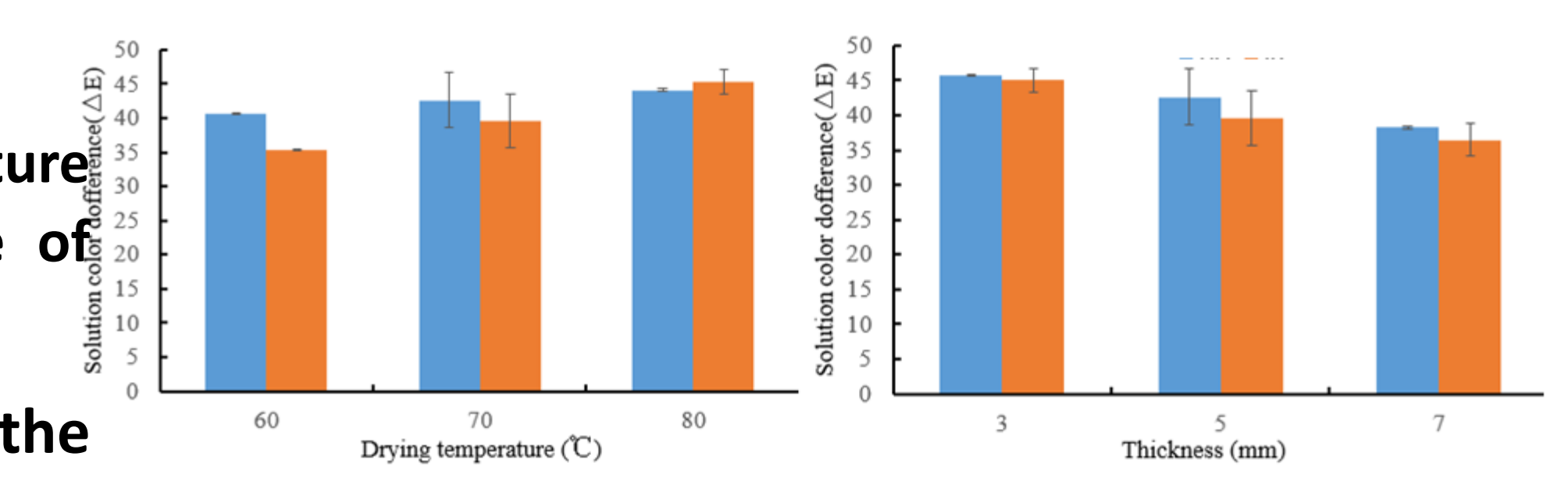
TSS content of the hydrated solution increased with IR temperature, but was not affected by HA temperature.



Reduced slice thickness resulted in higher TSS content in hydrated solution.

Color difference

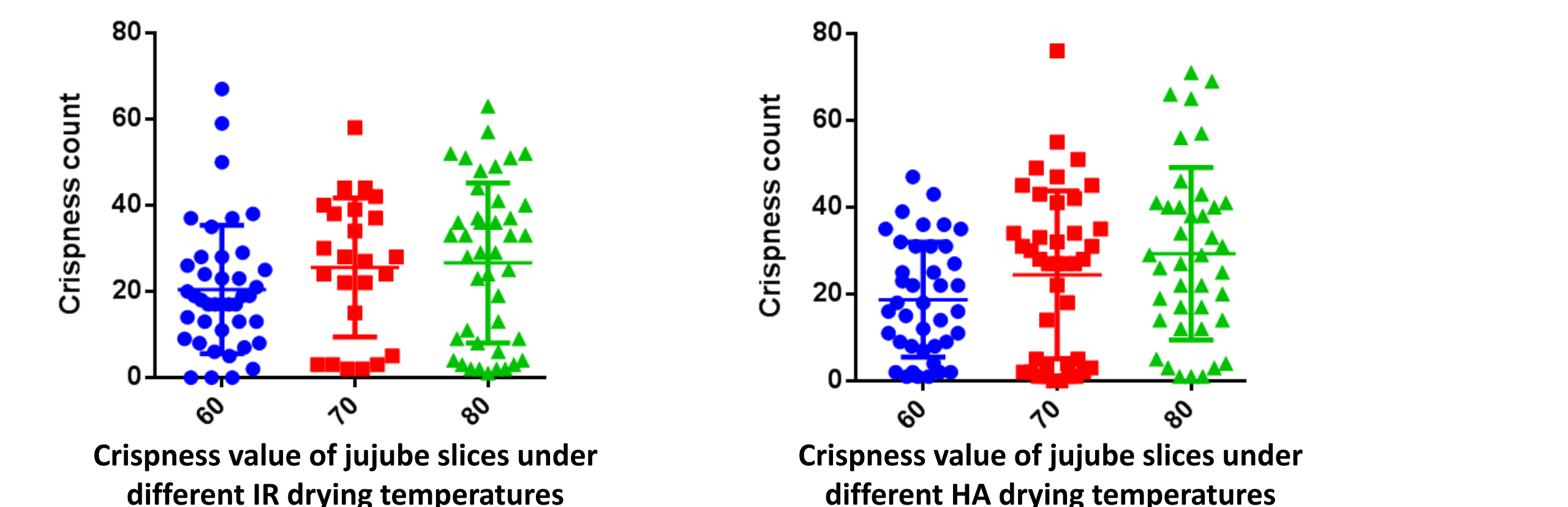
Higher drying temperature led to higher ΔE value of hydrated solution.



The ΔE value of the hydrated solution was higher for thinner slices.

Crispness value

The crispness value of dried jujube slices increased with drying temperature, and the products dried by HA drying was crispier than that by IR drying.



The crispness value of dried jujube slices increased with drying temperature, and the products dried by HA drying was crispier than that by IR drying.

Conclusion

The results indicated that HA drying produced crispier jujube slices, but the color and TSS content of hydrated solution were better for IR dried jujube slices. Higher drying temperature and thinner slices resulted in better product quality. This study provided important information for the selection of appropriate drying methods of jujube slices for different applications.

Acknowledgment

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