

Developing Fish Crisps Using Microwave Frying

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Deep-fat frying

- It is a food process of drying, puffing and cooking through contacting with hot oil. The commercial products chips and instant noodles.
- Heat is transferred form hot oil to the food, moisture is evaporated from the food, and oil is absorbed by the food during deep-fat frying.
- The coupled heat and mass transfer rates of immersion frying are dependent on the temperature difference between hot oil and food.
- The long frying time at high temperature results in brown surface, oil uptake and acrylamide formation.



Microwave frying

- **Microwave is converted into thermal energy in the foods due to dipole water molecular rotation and ionic migration under the changing electric field.**
- **Microwave frying provides simultaneously cooking of both the interior and surface of foods with microwaves and hot oil, which makes products to achieve the necessary golden coloration and crispiness.**
- **Microwave frying may significantly shorten the frying time, and reduce lipid oxidation and oil content.**



Microwave frying system



Size : 610×510×630mm , Oil volume : 16L
Power : frying 2400W; microwave 2500W



Mackerel



- Mackerel is an abundant fish in Taiwan.
- The moisture content, crude lipid and fish meat are about 71%, 5.6% and 50%, respectively.
- The ratio of the white meat to red one is about 4:1.
- Mackerel white meat is the source of fish crisps.
- Traditional processing products are dried fermented fish, frozen salted fish and canned fish.
- The new product development of mackerel fish crisps by frying can increase value and product diversity.



Objectives

- To determine the effect of fish crisp diameters on moisture content changes at 180°C in deep-fat frying and microwave frying.
- To compare the moisture and oil contents of the fish crisps at pre-selected three frying temperatures and time combinations between deep-fat frying and microwave frying.
- To evaluate the quality of deep-fat fried fish crisps by microwave frying.



Experimental design of fried fish crisps

Frozen Mackerel



Boneless white meat: sweet potato powder : water (1:2.5:1.4)



500 g batter homogeneously mixed with 3% salt and 5 g baking powder in an emulsifier



The batter was modeled into a cylindrical shape with three diameters of 0.4, 0.6 and 0.8 cm



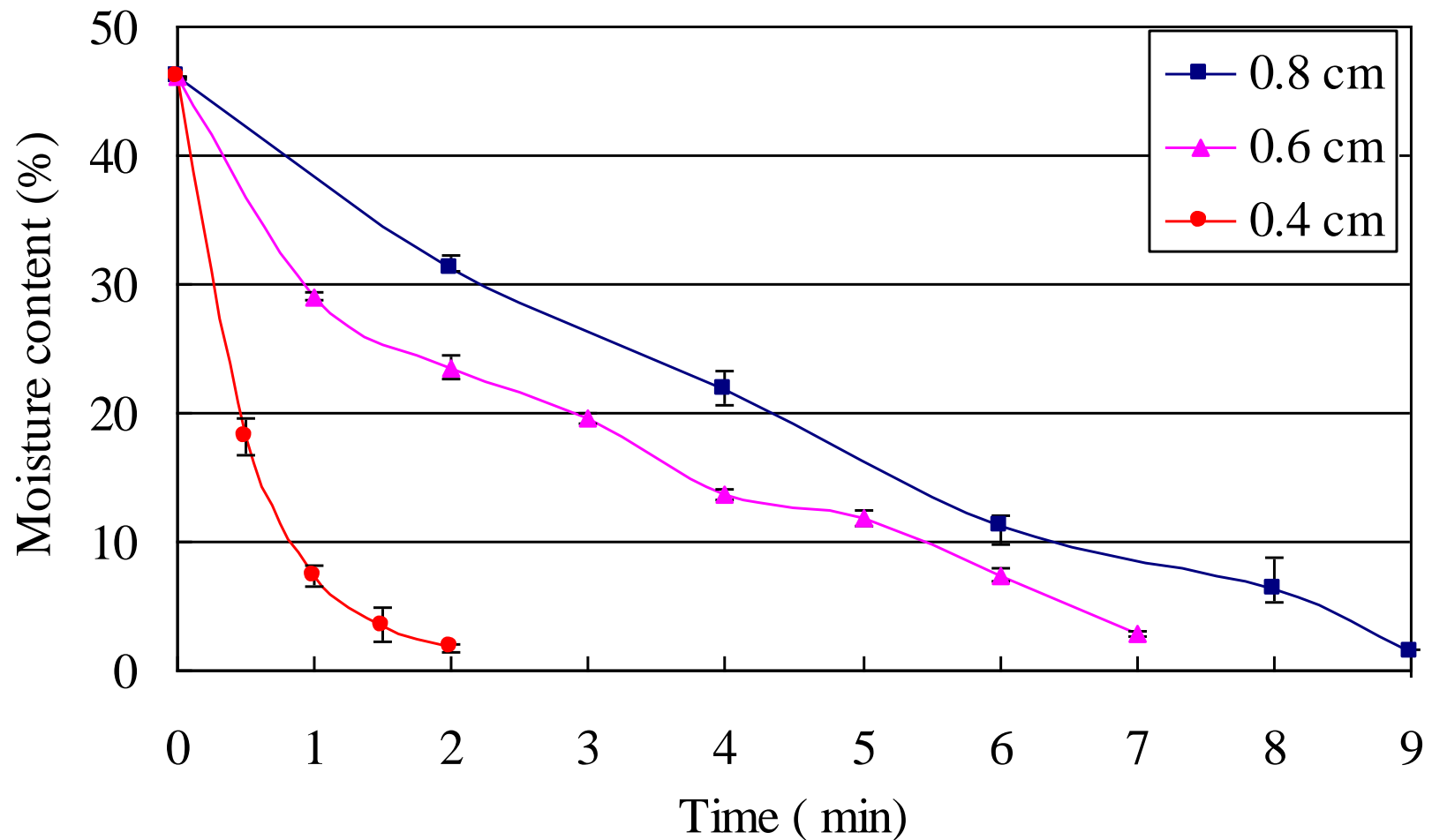
Deep-fat frying or microwave frying with 160, 170 and 180°C oil



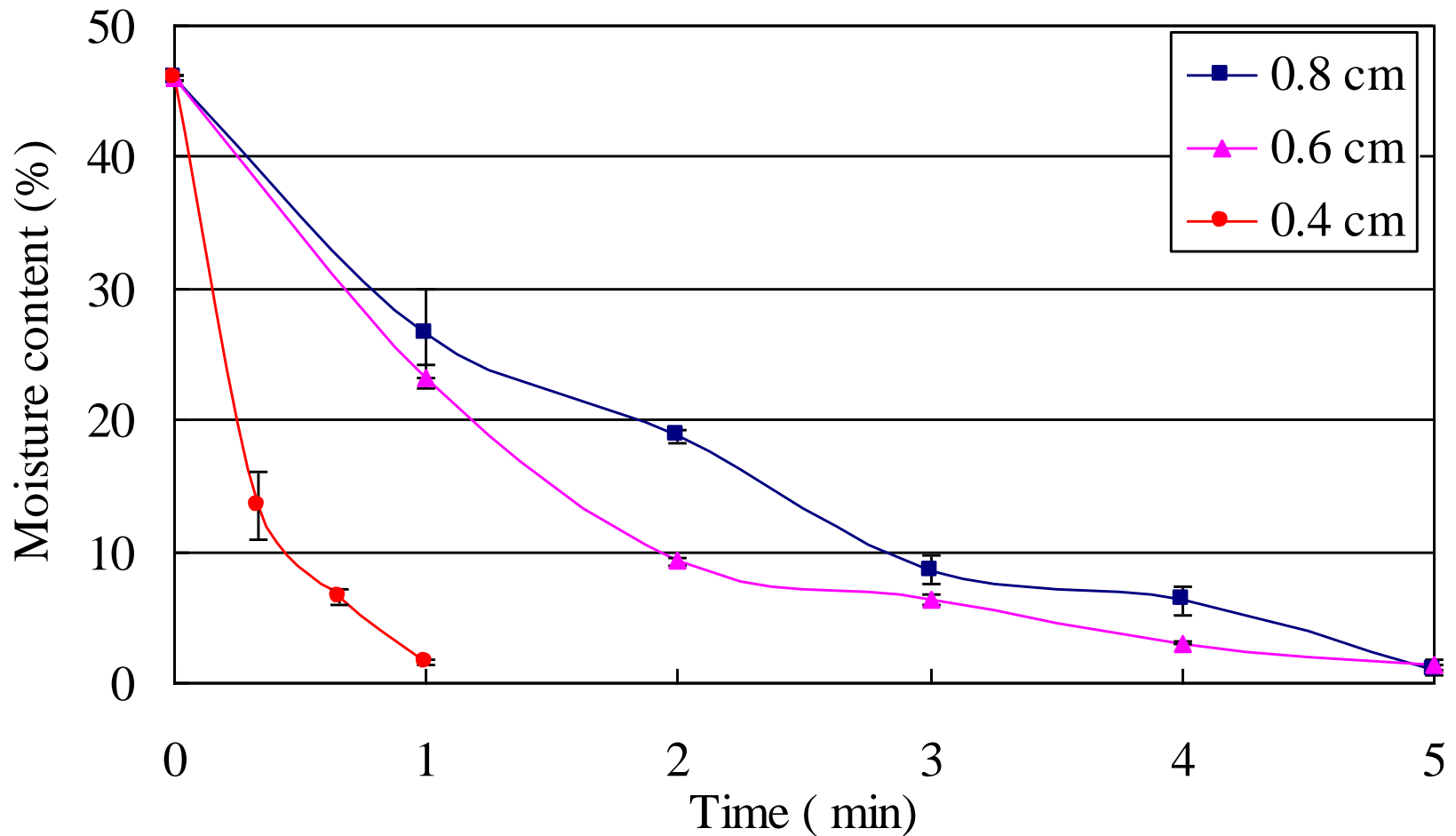
Qualities of fried fish crisps



Effects of different fish crisp diameters on moisture content changes during deep-fat frying at 180°C

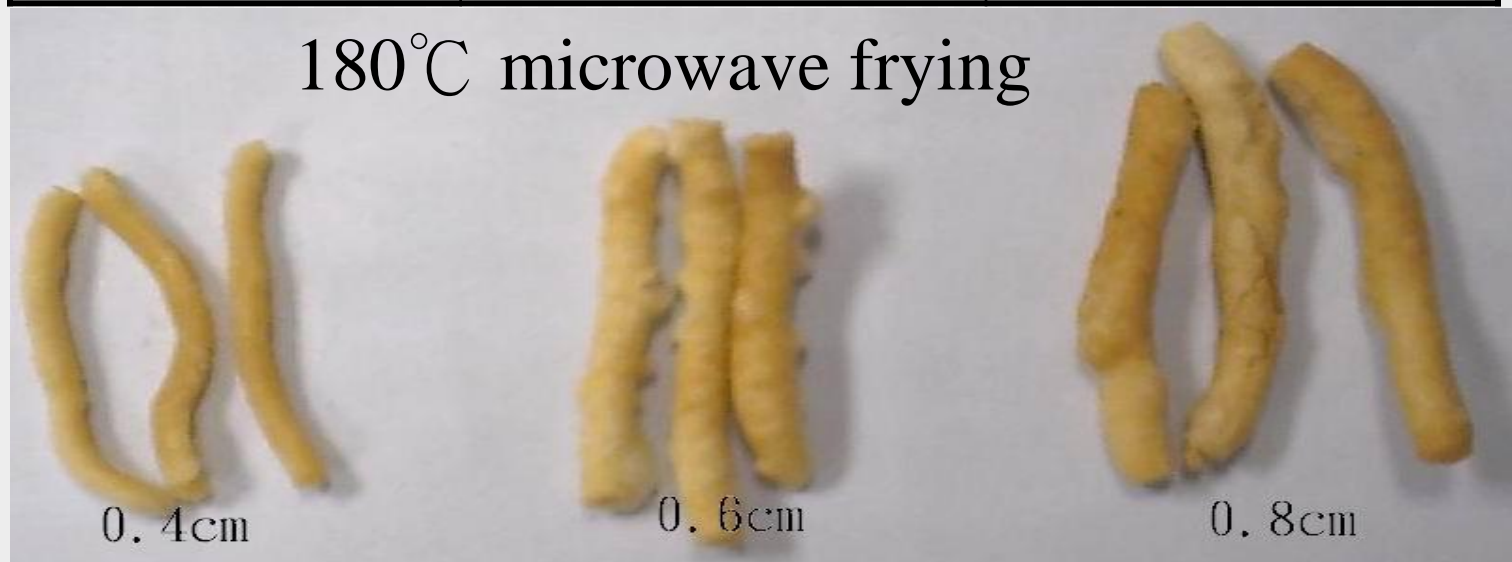


Effects of different fish crisp diameters on moisture content changes during microwave frying at 180°C



Effect of diameter of fish crisps on frying time

Types Diameter	180°C Deep-fat frying	180°C Microwave frying
0.4 cm	2 min	1 min
0.6 cm	7 min	5 min
0.8 cm	9 min	5 min

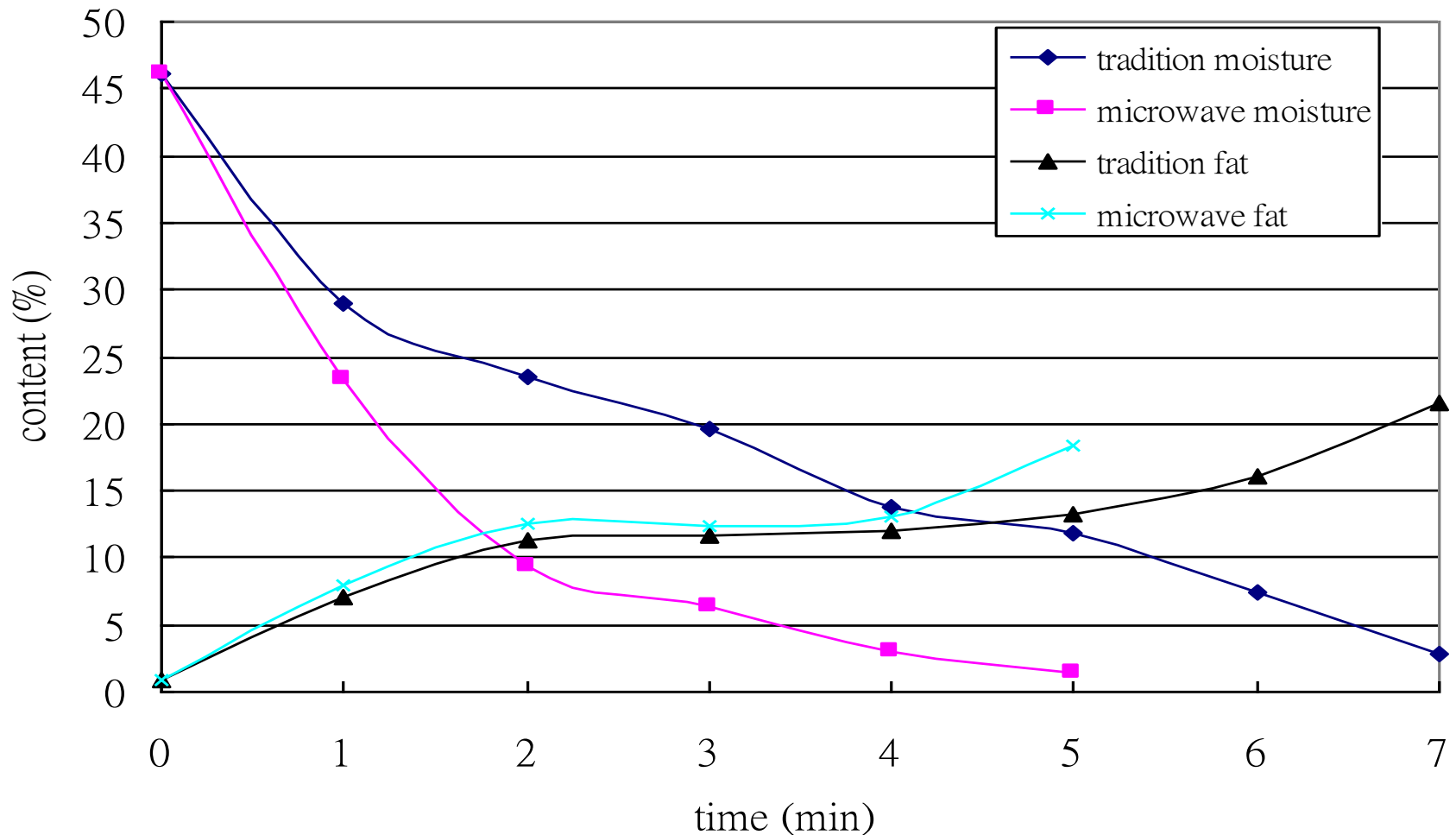


Frying time of different frying types and oil temperature for fish crisp with diameter of 0.6 cm

Frying type	Oil temperature (°C)	Frying time (min)
Conventional Deep-fat frying	160	17
	170	12
	180	7
Microwave frying	160	5
	170	5
	180	5



The changes of moisture and fat content of fish crisps during deep-fat and microwave 180°C frying methods



Effect of frying condition on water and lipid contents of fish crisps

Frying types	Oil temperature and frying time	Moisture (%)	Lipid (%)	Aw
Deep-fat frying	160°C 17min	1.9	19.5	0.20
	170°C 12min	2.5	19.8	0.30
	180°C 7min	2.8	20.2	0.19
Microwave frying	160°C 5min	1.4	17.0	0.20
	170°C 5min	1.1	17.9	0.26
	180°C 5min	1.4	18.3	0.16

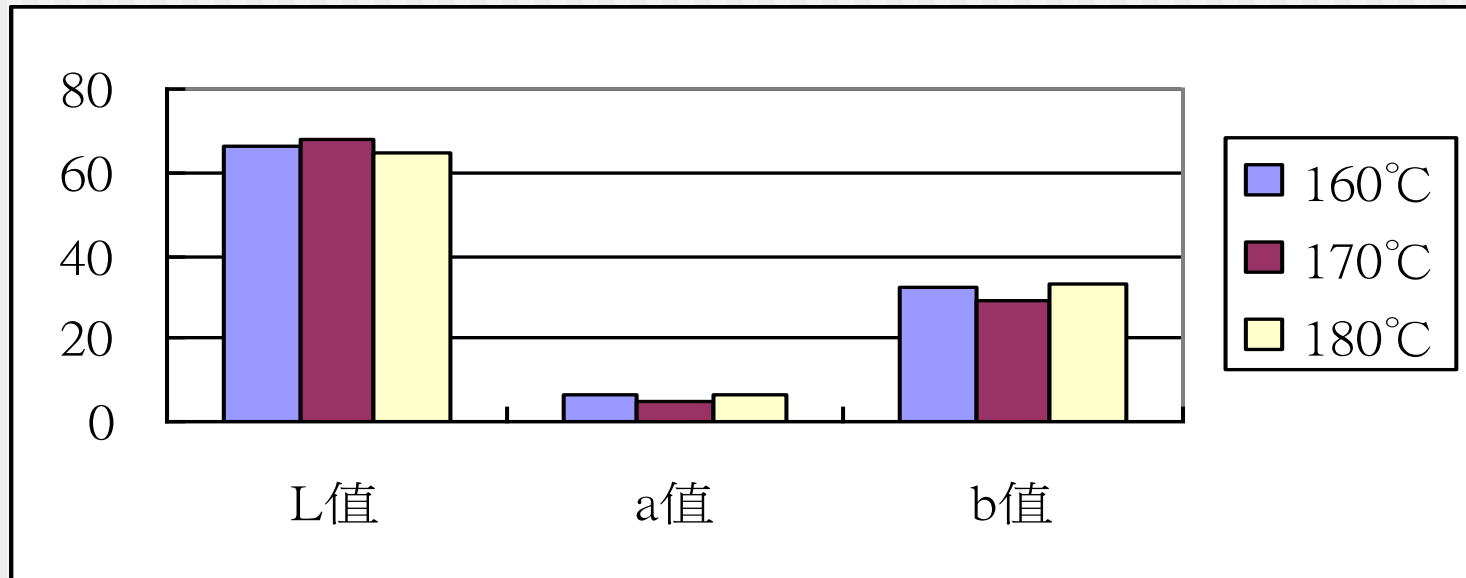


Effect of frying condition on bulk density and breaking force

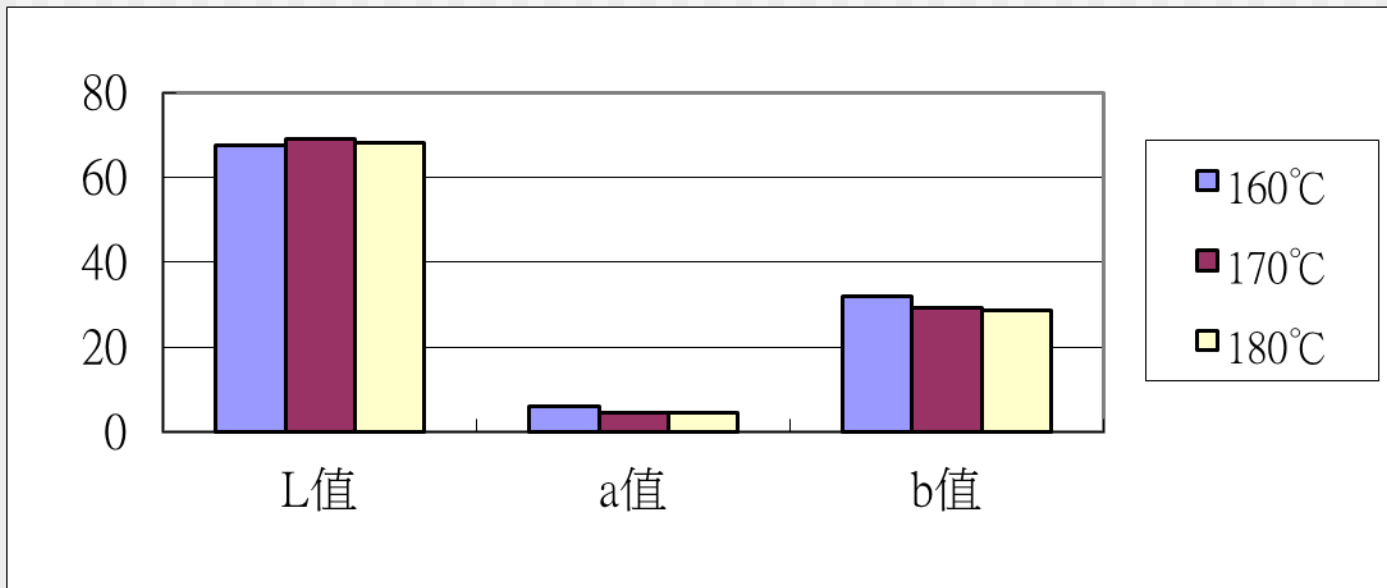
Frying types	Oil temperature and frying time	Bulk density (g/mL)	Breaking force (g)
Deep-fat frying	160°C 17min	0.71	3.6
	170°C 12min	0.56	3.6
	180°C 7min	0.72	2.8
Microwave frying	160°C 5min	0.39	3.7
	170°C 5min	0.42	3.5
	180°C 5min	0.26	2.4



Color and appearance of fish crisps with 0.6 cm diameter by different oil temperature of deep-fat frying



Color and appearance of fish crisps with 0.6 cm diameter by different oil temperature of microwave frying



Conclusions

- Increasing the diameter of fish crisps affected heat and moisture transfer resistances and extending the frying time.
- Increasing frying oil temperature in the deep-fat frying process reduced significantly the processing time, but had no effects on microwave frying time.
- Microwave frying reduced the frying time and the oil uptake slightly as compared to deep-fat frying. Bulk density, breaking force and surface color in the microwave fried fish crisps at 180°C were lower than those treated by deep-fat frying.
- Microwave frying process could be developed as a potential technique to the production of fish crisps.



Thank your attention!

