

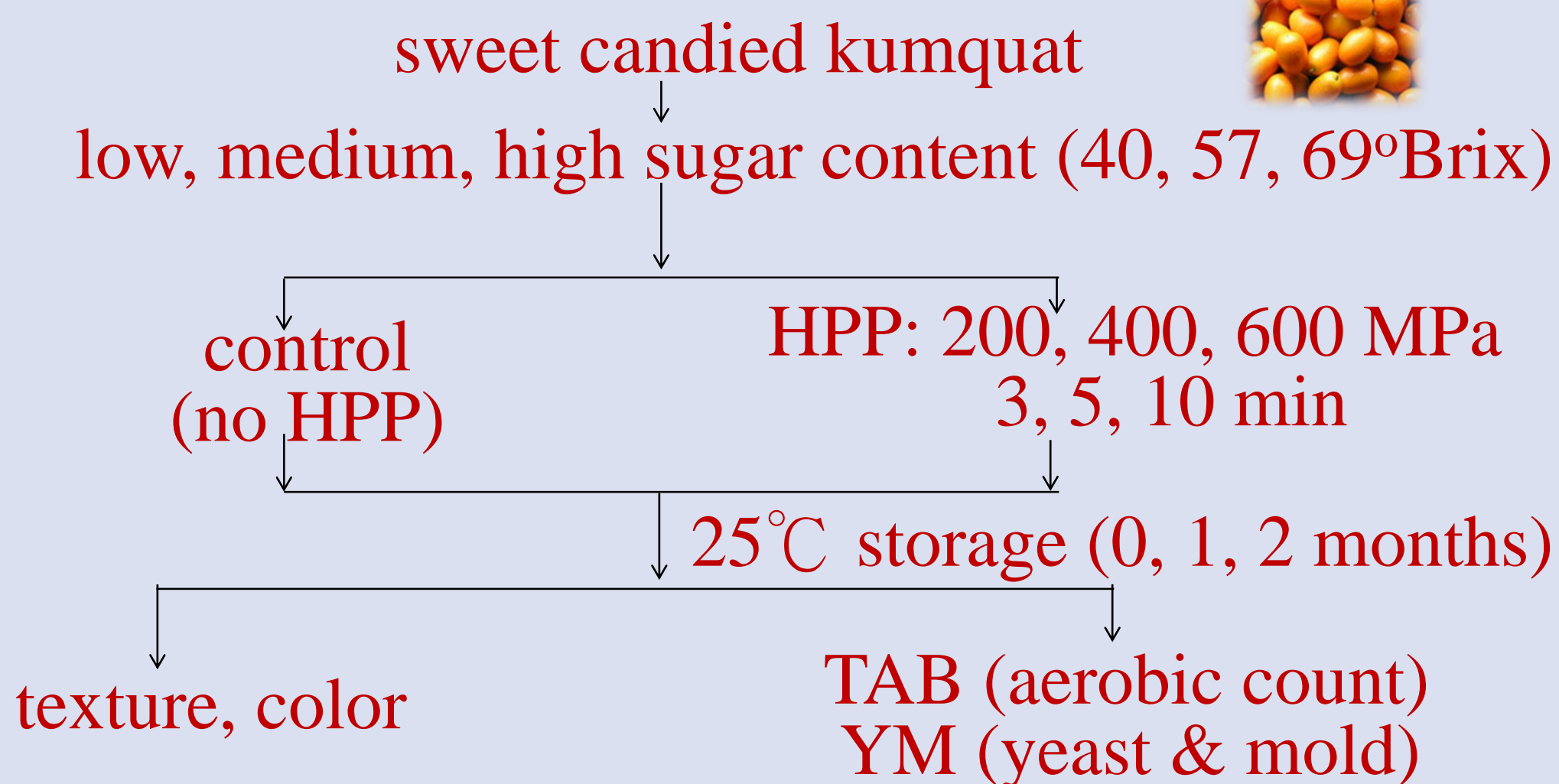
Introduction

The main origin of kumquat is located in Yilan area of Taiwan, and its cultivated kumquat cultivars are mainly *Fortunella margarita* Swingle. The kumquat is sweet and sour; therefore, it is the best raw material for making candied fruit. Traditional preserves processing is divided into three major steps: including pre-treatment, candied and drying.

Objective

The objective of this study was to obtain lower sugar high sweet candied kumquat by high pressure processing (HPP). There were three sugar contents 40, 57 and 69 °Brix of sweet candied kumquats as materials for high pressure processing (HPP) study in order to reduce sugar content without preservatives.

Experimental design



Results and discussion

The yeasts and molds of control were 1.60 log CFU/mL, which counts effectively reduced to 1.10 log CFU/mL after HPP-200 MPa - 3 min, and the counts less than 1.00 log CFU/mL (none detect) after HPP 200 MPa 5 min holding time and HPP 400, 600 MPa 3~10min holding time. Yeasts and molds of 57 °Brix lower sugar candied kumquat were significant increased after non-HPP treatment and 200 MPa HPP treatments during 25°C storage. However, 400 MPa and 600 MPa HPP treated 57 °Brix sweet candied kumquats during 25°C one month storage had no yeast and mold growth. The color difference of sweet candied kumquat increased with increasing pressure and holding time, which hardness reduced with increasing pressure and holding pressing time.

Conclusion

There was no detect yeasts and molds in 57°brix sweet candied kumquat after over 400 MPa 5 min HPP during 25°C 2 months storage. The color difference of sweet candied kumquat increased with increasing pressure and holding pressing time, which hardness reduced with increasing pressure and holding pressing time.

Table 1. Moisture content, water activity, color and hardness of different sugar concentration sweet candied kumquat preserves

Kumquat	Sugar (°Brix)	Moisture (%)	Aw	L*	a*	b*	Hardness (N)
Fresh	8.3	86.1	0.989	49.69 ^a	20.69 ^a	56.54 ^a	122.09 ^a
Low sugar	40.3	60.4	0.936	38.42 ^b	5.22 ^c	37.51 ^b	66.38 ^c
Medium sugar	57.0	43.5	0.887	36.46 ^c	6.56 ^b	32.33 ^c	105.83 ^b
High sugar	69.0	29.5	0.829	27.87 ^d	7.19 ^b	19.09 ^d	119.40 ^a

Data are expressed as mean ± S.D. (n=3). ^{a-d} Means within each row with followed by different letters are significantly different (P<0.05).



fresh low sugar medium sugar high sugar

Table 2. Effect of different sugar concentration on total aerobic bacteria, yeasts and molds of sweet candied kumquat during 25°C storage

	Storage (month)	log CFU/mL		
		Low sugar	Medium sugar	High sugar
TAB (Total aerobic bacteria)	0	1.45 ± 0.15	ND	ND
	1	1.63 ± 0.15	ND	ND
	2	1.84 ± 0.04	ND	ND
YM (Yeasts & molds)	0	2.35 ± 0.05	1.60 ± 0.17	ND
	1	5.96 ± 0.08	5.42 ± 0.05	ND
	2	5.46 ± 0.12	5.51 ± 0.06	4.17 ± 0.05

Data are expressed as mean ± S.D. (n=3). ND : No detect.

Table 3. Effect of different high pressure processing on color and texture of 57°Brix sweet candied kumquat

HPP (MPa)	Time (min)	L*	a*	b*	ΔE	Hardness (N)
Control	0	36.46 ^a	6.56 ^{cd}	32.33 ^{bc}		105.83 ^a
	3	35.15 ^{bcd}	7.77 ^{abc}	32.66 ^{ab}	1.64	106.36 ^a
	5	34.83 ^{cd}	6.36 ^{cd}	31.00 ^d	2.23	101.54 ^{abc}
200	10	35.96 ^{ab}	7.81 ^{abc}	30.39 ^{def}	2.79	95.42 ^{abcd}
	3	34.61 ^d	7.34 ^{bc}	33.18 ^{ab}	2.37	102.66 ^{ab}
	5	34.36 ^d	7.73 ^{abc}	31.37 ^{cd}	3.35	99.17 ^{abcd}
400	10	35.01 ^{bcd}	8.13 ^{ab}	30.65 ^{de}	3.69	93.46 ^{bcd}
	3	35.65 ^{abc}	8.95 ^a	31.44 ^{cd}	3.58	98.18 ^{abcd}
	5	35.80 ^{bcd}	9.12 ^a	33.71 ^a	4.43	96.76 ^{abcd}
600	10	35.07 ^{cde}	6.36 ^{cd}	29.32 ^f	5.52	90.62 ^{cd}

Data are expressed as mean ± S.D. (n=3). ^{a-f} Means within each row with followed by different letters are significantly different (P<0.05).

Table 4. Effect of different high pressure processing on the total aerobic bacteria, yeasts and molds of 57°Brix sweet candied kumquat during 25°C 2 months storage

Pressure (MPa-min)	TAB (log CFU/mL)			YM (log CFU/mL)		
	0	1	2	0	1	2
Control	ND	ND	ND	1.60 ± 0.17	5.42 ± 0.05	5.51 ± 0.06
200-3	ND	ND	ND	1.10 ± 0.14	3.90 ± 0.04	4.00 ± 0.16
200-5	ND	ND	ND	ND	3.33 ± 0.03	3.57 ± 0.07
200-10	ND	ND	ND	ND	3.05 ± 0.07	3.61 ± 0.06
400-3	ND	ND	ND	ND	1.71 ± 0.18	1.89 ± 0.16
400-5	ND	ND	ND	ND	ND	ND
400-10	ND	ND	ND	ND	ND	ND
600-3	ND	ND	ND	ND	ND	ND
600-5	ND	ND	ND	ND	ND	ND
600-10	ND	ND	ND	ND	ND	ND

Data are expressed as mean ± S.D. (n=3). TAB (Total aerobic bacteria), YM (Yeasts and molds). ND : No detect.