Conference Proceeding of
1st International Conference "Food and Agriculture: New approaches"- 2013, Cairo, Egypt.

Original Research Article

Evaluation and Preservation Of Some Longan Cultivars

ABSTRACT (ARIAL, BOLD, 11 FONT, LEFT ALIGNED, CAPS)

Aims: This study was performed to choose or select the best cultivars of longan fruit (*Wuyuan*, " Wu " and *Kohala*, " Ko "). Longan is an untraditional new crop fruits recently grown in new reclaimed areas. Besides, to investigate the possibility of preserving those aforementioned fruits
Study design: Mention the design of the study here.
Place and Duration of Study: Department of horticulture research. Food Technology Research Institute. Agriculture Research Center, between June 2011 and November 2013.
Methodology: soaking in different concentrations of High Fructose Corn Syrup (HFCS) plus sucrose, then stored at ambient temperature (25±2°C) in glass jars for six months. As well as studying the influence of storage at ambient temperature (25±2°C) on chemical and physical properties of the processed product. The effect of preservation using (HFCS and sucrose) solution to final concentration (40 %) on the quality attributes during storage was investigated.
Results: The obtained results revealed that longan (Wu) cultivar soaked in (HFCS and sucrose by 1 : 3, 3 : 1 and 40 % HFCS) solution were found to be the best products. The obtained data also revealed that longan cultivar (Wu) had the highest palatability of sensory attributes scores especially color, taste, texture, odor and overall palatability when treated as follows: (HFCS) : sucrose (3 : 1) (treatment No. 3) and 1 : 3 (treatment No. 1) and HFCS 40 % (treatment No. 4), respectively. The results also ascertained that fresh as well as stored longan cultivars (Wu) had the highest values for qualitative characteristics, sugars, T.S.S., ascorbic acid, hunter color measurements and cyanidin 3 glucoside, compared to the other studied cultivar (Ko). This could be attributed to the addition of HFCS syrup to longan fruit. Dehulled of (Wu) cultivar were found to have the most amounts of (ascorbic acid, T.S.S. and attractive lightness color measurements) after soaking in HFCS plus sucrose solution as well as

during storage in glass jars up to 6 months at ambient temperature (25±2°C). So, " Ko " and " Wu " longan cultivars packed in glass jars covered with the aforementioned sugar HFCS solution retained their quite palatable, qualities during storage at ambient temperature for up to 6 months. All investigated samples maintained their original sensory properties up to 6 months. **Conclusion:** Thus, the technological trend for utilization of large quantities cultivated of longan fruits in new reclaimed areas is a matter of great importance. This would lead to produce new untraditional products passing high nutritional value plus high quality of sensory attribute greeting new work opportunities by establishing a factory to produce those aforementioned new products either for local or abroad consumption must be put in consideration through that investigation. Also, the utilization of high fructose corn syrup for the production of canned longan could be recommended to replace sucrose. This replacement would reduce sucrose consumption as well as the cost of production. .

Keywords: [Longan Cultivars, Wuyuan, " Wu " and Kohala, " Ko,new technology,processing]

1. INTRODUCTION

Canning is a new concept in the manufacture of longan fruit cultivars. It initiates a new product which could be favorable to the interesting consumer. Beside, other nutritional and economical trends could be attained.

Great quantities of longan are consumed in fresh form not in processed one. Meanwhile, in China the majority of that crop is preserved by canning in syrup or by dehydration. Some longan fruits have been maintained by cooking. The canned fruits were regularly shipped from Shanghat to the United States in the past. Today they are exported from Hong Kong and Taiwan.

Longan (Dimocarpus longan, lour.) is a member of the sapindaceous family, which is similar to litchi and rambutan. Longan is mainly cultivated in tropical and subtropical regions such as southern China (Wong, 2000).

Longan is an important commercial crop in the Northern part of Thailand, so, it became an important local crop available for exportation. Longan production in Egypt in the period from June to August gives a good chance to cover the needs of many European consumers. This crop covers up to 14.70 Kg / ha / year annually available for exportation, enabling to gain about 2 – 8 millions dollars (FAO, 2006). It is consumed mostly in fresh and dried forms. Besides, about half of longan production is exported to China in dried whole case (Lapsongphol and Mahayothee, 2008). Longan fruit has light – brown to brown peel and white translucent flesh, which is sweet, juicy and aromatic(having good aroma) (Rangkadilok et al., 2005). This product is popular among the Chinese people since they believe that eating longan with dragon – eye seed is good for human health. Therefore, China is the major importer of Thailand longan especially as dried unpeeled product with the value of about 35 million Euro in the year 2006 (Thai Customs Dept., 2007). Its aroma plays an important role on quality product. However, many studies were performed on drying process efficiency and its improvement (Mahayothee et al., 2006) worked on

volatile compounds of fresh and dried longan fruits. Due to the short shelf – life of fresh longan fruits, their uses can be extended by processing them into various products. In Thailand, the longan fruits have been processed into canned longan, dried longan nuts, longan nectar and frozen longan(Subhadrabanhu, 2001). There are substantial canning factories for longan in Thailand, China and Taiwan province of China. Due to the high brix content, little sugar additive is required as the fruits are canned in their own juice. It is believed that canned longan retained their individual flavour. .

Chunthaworn et al., (2012). Mentioned that the color characteristics of longan flesh were studied during air drying using the CIE system determining L*, a* and b*values. The values of L*, and chroma increased and then decreased when the drying time and drying air temperature increased. The hue angle decreased while the values of a*, b* and chroma increased and then decreased when the drying time and drying air temperature increased. (Luksamee et al. 2012) reported, Longan seed extract (LSE) contains high levels of beneficial polyphenolic compounds

The Dietary Reference Intake (DRI) values for vitamin C are 90 mg for adult males and 75 mg for adult females (Institute of Medicine (IOM), 2000). Therefore, consumption of about 12 – 14 longan fruit would meet the daily vitamin C requirements for the average adult. Depending on cultivar, consumption of 14 – 17 longan fruit would meet the average adult DIR for vitamin C. Mean ascorbic acid content of Hawaii's longan (60.1 mg / 100 g) was less than that listed by Tongdee (1997) (62.2 mg / 100 g). The USDA nutrient database (USDA – ARS, 2004) lists longan vitamin C content as 84.0 mg / 100 g.

Wall (2006) demonstrated that longan fruits had the highest vitamin C content (60.1 mg / 100 g on fresh weight basis) among the three specially fruits, ascorbic acid levels in fruit are influenced by the availability tested light to the crop and to individual fruits. He also found that, no correlation was found between ascorbic acid and total soluble solids (TSS %) content in longan fruit.

Also Wall (2006) added that longan was a very good source of k (324.9 mg / 100 g) and Cu (0.26 mg / 100 g).The 2005 Dietary Guidelines Advisory Committee recommends increasing the dietary intake vitamin A, C and E, Ca, Mg, K and fiber, may be due to increasing the consumption of longan fruits and also of vegetables to 5 – 13 servings per day (US Department of Agriculture and US Department of Health and Human Services (USDA / HHS, 2004 - 2005). The health – promoting potential of longan fruit may due in part, to the phytochemical bioactive compounds present in plants (Rangkndibk et al., 2005). They also mentioned that the longan flesh is sweet and juicy, therefore, it could be consumed in both fresh and processed products such as canned longan in syrup or as dried fruit. In Chinese medicine the flesh of the longan is utilized as a stomachic, febrifuge, vermifoge and also as an antidote for poison (Mortin, 1987). Phupaichitkon et al., (2005) revealed that the longan flesh consists of 70 % moisture and 16 % total soluble solids (T.S.S.).

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In order to improve quality attributes of processed longan fruit cultivars, the present investigation was designed to study the effect of some processes such as canning in HFCS solution plus sucrose by different percentage on the constituents and qualities of different cultivars of longan.

Thus, this study is an attempt to investigate the possibility of utilization of large quantities recently cultivated with longan fruits in producing some new processed products passing high nutritional value plus high quality attributes

2. MATERIAL AND METHODS

2.1MATERIALS:

About 20 Kg of longan cultivars namely *Wuyuan* (Wu) and *Kohala* (Ko) were used in this study which has been recently performed by (HRI), harvest at suitable stage of maturity. Cultivars were obtained from Horticultural Research Institute (HRI), Photos (1 and 2).

Photo (1) : Longan fruit, variety Kohala

Photo (2) : Longan fruit, variety *Wuyuan*

High fructose corn syrup (HFCS), sucrose, citric acid and potassium sorbate were brought from local markets of Egypt and El – Gomhoria Company. All of the aforementioned materials are of food grade

2.2. Methods:

About 20 kg for each cultivar were peeled and put in glass jars, then covered with high fructose corn syrup plus sucrose to obtain final concentration of 40 % as shown in Table (1).

Table (1) : Soaking treatments of fresh, peeled longan cultivars.

Treatment	HFCS	Sucrose	Final conc.	Other additives
1	1	3	40 %	Citric acid 0.1 % plus, potassium sorbate 0.1 % (this percentage added to maintain freshness in fruit)
2	1	1	40 %	
3	3	1	40 %	
4	40	----	40 %	
5	----	40	40 %	

1) 1 : 3 = 1 H.F.C.S : 3 Sucrose (40%) , 3) 3 : 1 = 3 H.F.C.S : 1 Sucrose (40%),

2) 1:1= 1 H.F.C.S : 1 Sucrose(40%) 4) H.F.C.S. = High fructose corn syrup (40 %). 5) Suc = Sucrose (40 %)

Note: Dissolve high fructose corn syrup to sucrose powder to obtain final concentrate 40 %, then heated at 95±2°C and poured in glass jars filled with peeled longan fruit. The jars kept in boiling water bath for 15 min and tightly closed then cooled. The jars were stored at ambient temperature(25±2°C) for up to 6 months during which samples were taken at intervals of three months for chemical analysis.

2.2.1 Physical and chemical analyses of fresh and canned longan cultivars:

The quality of fresh fruits were analyzed including total soluble solids, moisture content, pH value, sensory attributes and color parameters l,a,b of flesh and peel. Juice from longan pulp was used to measure TSS using a hand refractometer (BS+ ENGLAND), color of flesh and peel was measured using a Hunter Lab (D25 color and color differeneein 90 MMX heigh 12 MM), pH value of longan fruits was measured at(25±2°C) using pH meter (Fisher Accument, USA 41150). Moisture content, crude protein, ether extract, crude fiber, ash, total and reducing sugars, titratable acidity and cyaniding 3 glucoside were determined by the methods of A.O.A.C. (2005). Total ascorbic acid content was determined in fruit cultivars using the method described by Ranganna (1979). Minerals, iron, zinc, phosphorus, potassium, calcium and cupper content were determined by dry ashing using atomic absorption Pye Unican Spectrophotometre SP. England, as mentioned by Kasai et al., (1997).

2.2.2 Ascorbic acid analysis by HPLC method:

Ascorbic acid was extracted (under subdued light) from longan, on the day of harvest by blending 40 g edible portion with 100 ml of cold metaphosphoric – acetic acid (MPA) solution (30 g metaphosphoric acid, 0.5 g EDTA, and 80 ml glacial acetic acid diluted to 1 L with distilled water) in an pre – chilled, stainless steel blender for 3 min. The slurry was centrifuged for 15 min at 10,000 rpm in a cold centrifuge (2 – 4°C), and the supernatant was collected (Wall, 2006). With both HPLC techniques, so UL of the filtrate was directly injected into HPLC system. The eluent flow – rate was 0.7 ml / min and the column temperature was(25°C). Ascorbic acid was identified by comparing the retention time of the sample peak with that of the ascorbic standard at 254 nm. Quantification was carried out using external standardization (Romew – Nadal et al., 2006).

2.2.3 Sensory properties:

Sensory attributes (color, taste, odor, texture and overall palatability) of prepared longan cultivars by different treatments were evaluated directly after preparation by more than ten panelists in Food Tech. Res. Inst. (FTRI) according to the method of Lindley et al., (1993).

2.2.4 Statistical analysis:

Data of organoleptic evaluation were analysed according to a completely randomized design, with six replications for each cultivar. Data were subjected to analysis of variance using the general linear methods (GLM) procedure of Statistical Analysts System SAS Program, SAS Institute, 1999 according to Steel and Torrie (1980). Significant differences were determined at the level $P < 0.05$.

3. RESULTS AND DISCUSSION

3.1 Chemical constituents of fresh longan fruit cultivars:

Data in Table (2) show the chemical constituents of two cultivars of longan. The data indicate obviously that the moisture content of longan cultivar (Ko) was higher than that of longan (Wu); being 82.1 and 80.45 %, respectively. These results are in accordance with those reported by (Wall, 2006). On the other hand, longan cultivars (Wu and Ko) had a slightly high sugar content being 12.34 and 11.92 % respectively, while T.S.S. were found to be 17.8 and 15.5 % in the same order. These results are in agreement with (Phupaichitkum et al., 2005) who found that flesh longan consists of 70 % moisture and 16 % T.S.S. Crude protein content was the lowest in cultivar No. (Ko) compared to the other tested cultivars (Table 2).

Longan fruit cultivars contained the highest percentage of crude fiber being 4.04 % in average. Ascorbic acid content was relatively high in cultivar (Wu) containing 49.25 mg / 100 g (fresh weight basis) (245 mg / 100 g dry weight basis). These results are in agreement with those reported by (wall, 2006).Qualitative and quantitative HPLC analysis of ascorbic acid (Figs. 2 and 3) ascertained that considerable variations in fresh fruits (88.56 and 59.76 mg / 100 g in cultivar Ko and wu respectively) might be due to genetic differences, climatic or soil conditions; maturity at harvest and handling conditions following harvest. Results in Figs (4 and 5) show that ascorbic acid.

Table (2) : Chemical composition of fresh longan fruits cultivar.

Constituents*(%)	DRI** mg / day	Cultivars	
		(Ko)	(Wu)
Moisture content	-----	82.10	80.45
Crude protein	-----	1.14	1.87
Ether extract	-----	0.09	0.08
Crude fibers	-----	3.96	4.12
Total sugars	-----	11.92	12.34
Reducing sugars	-----	4.21	3.85
Non reducing sugars	-----	7.71	8.49
Total soluble solids (T.S.S.)	-----	15.5	17.8
Total titratable acidity (as citric acid)	-----	0.345	0.524
Ascorbic acid (mg / 100 g)	-----	34.34	49.25

Mg cyanidin in 3 glucoside / g	**-----**	18.90	25.11
Total ash	**-----**	0.71	0.82
Minerals content (mg / 100 g)			
Phosphorus	700	28.38	28.36
Potassium	1700	345.89	387.20
Calcium	1000	12.44	13.89
Sodium	1500	14.17	14.60
Iron	18.8	0.55	0.60
Zinc	8.1	0.32	0.39
cupper	-----	0.73	0.82

149 * On fresh weight basis.

150 **DRI : Dietary Reference Intake.

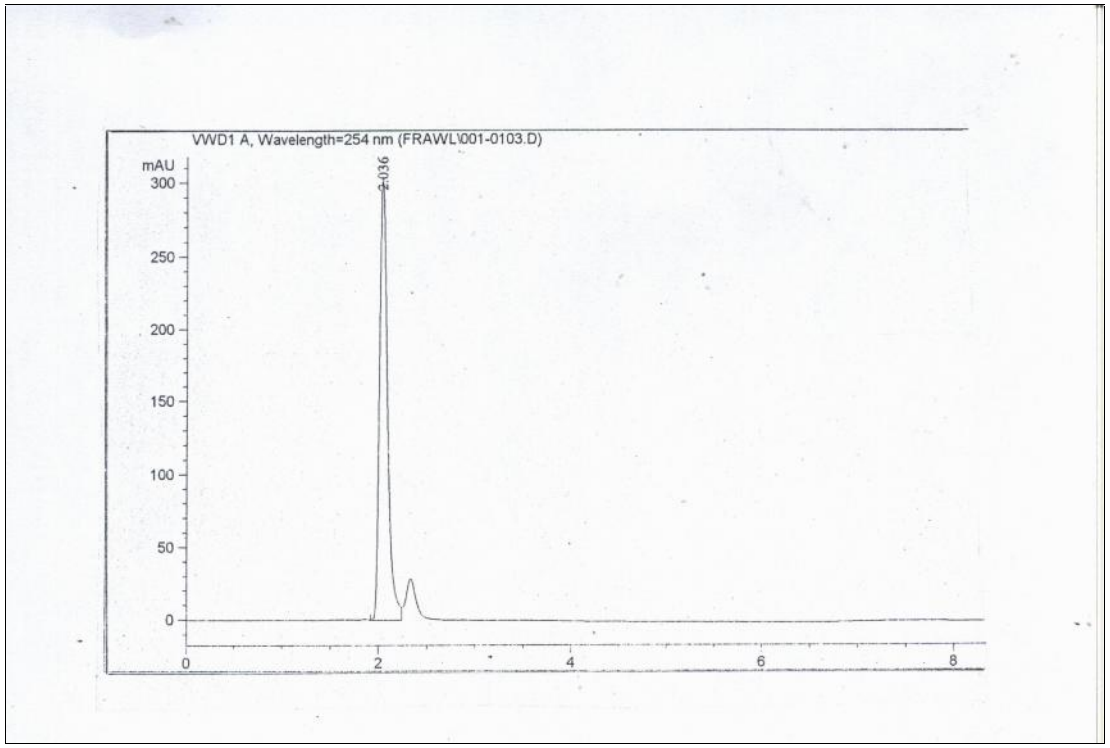
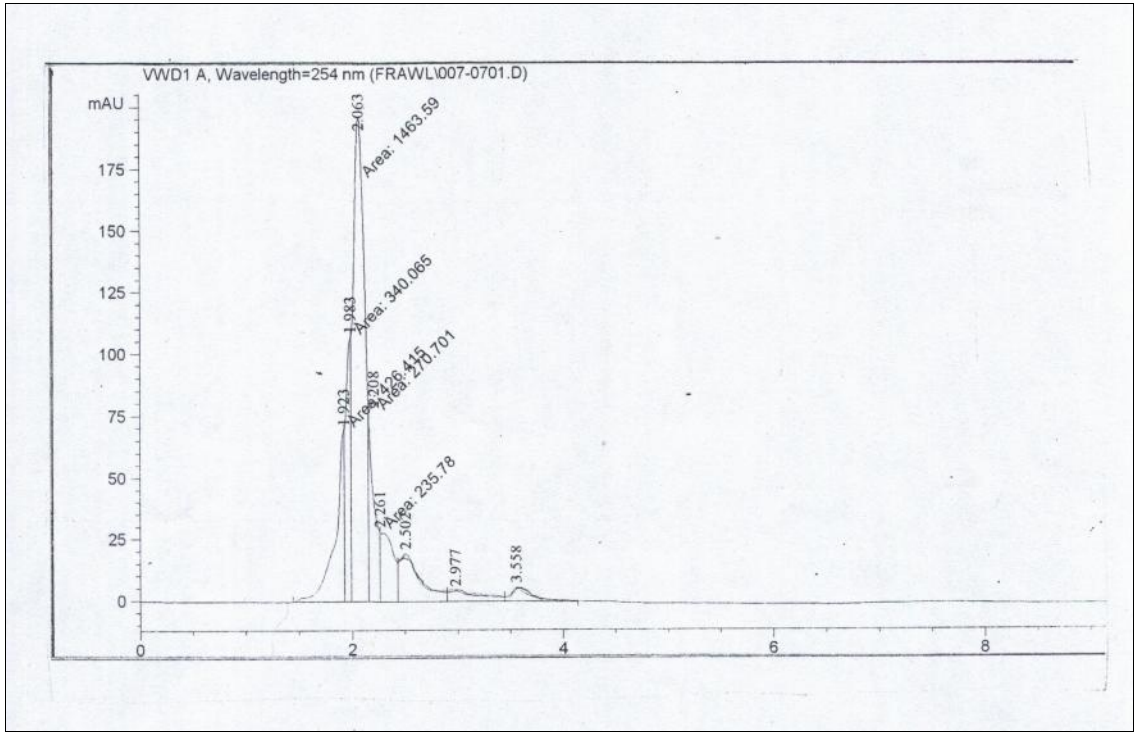


Fig. (1): Standard of ascorbic acid contents by HPLC, technique.



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154 **Fig. (2): HPLC analysis of ascorbic acid content for fresh longan (Ko) cultivar.**

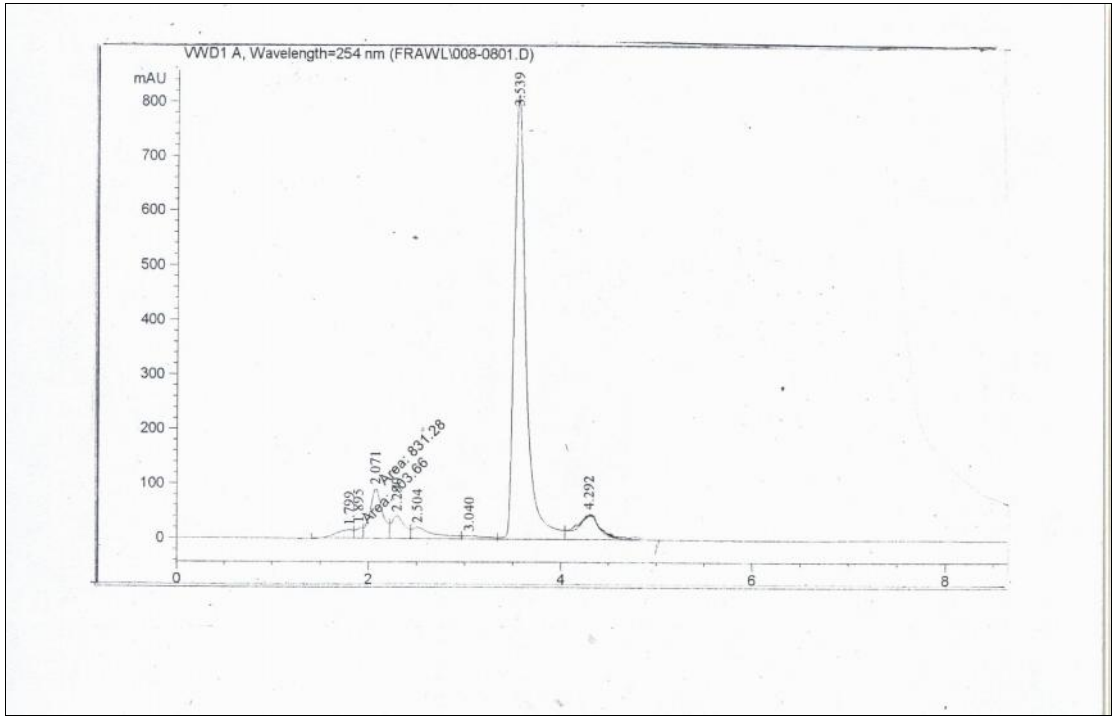

Fig. (3): HPLC analysis of ascorbic acid content for fresh longan (Wu) cultivars.

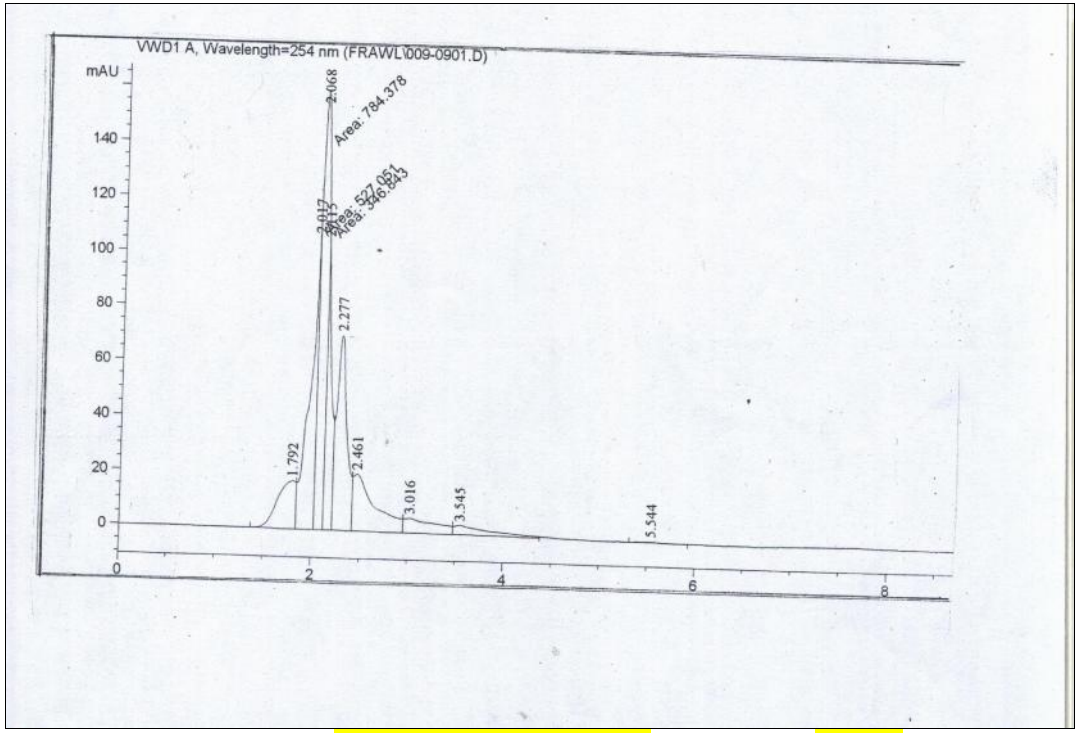

Fig. (4): HPLC analysis of ascorbic acid content for processing longan (Ko) cultivars.

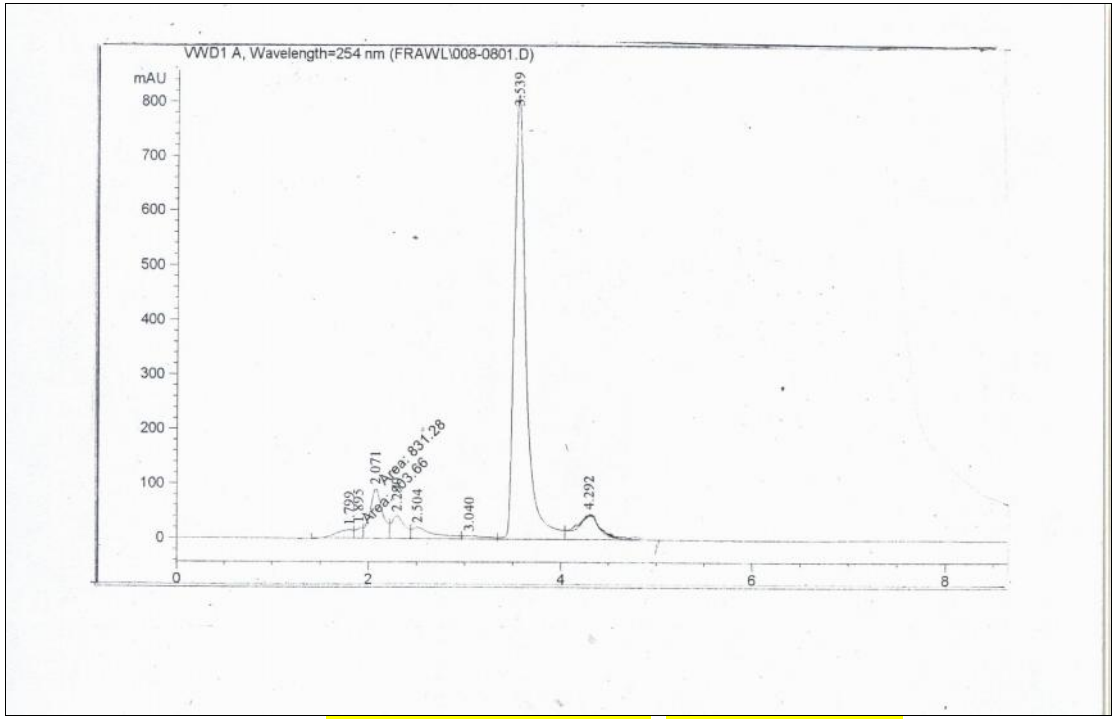

Fig. (5): HPLC analysis of ascorbic acid content for processing longan (Wu) cultivars.

content (42.89 and 54.18 mg / 100 g), it was decreased by 51.57 and 9.21 % after processing treatments for cultivars (Ko) and (Wu), respectively .This may be probably due to the effect of pasteurization process. It could be concluded that cultivar (Wu) contain stable ascorbic acid before and after processing technology(decrease by only 9.21%). No correlation was observed between ascorbic acid and T.S.S. content for longan. lychees, or rambutans, T.S.S may indicated slight maturity differences that are not easily detected by peel color (Wall, 2006). T.S.S. content is an estimate of fruit sugar content and eating quality.

Potassium, phosphorus, calcium and sodium, were considered as the most predominant and important minerals for human nutrition. These minerals were determined and the obtained results revealed that considerable small variations in the minerals content of selected longan varieties depending upon the harvesting time. Wall (2006) reported that Longan are a good source of potassium and cupper. He also found that 100 g of fresh longan can supply 7 % of the DRI for potassium and 29 % of the DRI for cupper. Dietary Reference Intakes (DRI,

mg / day) of phosphorus for adults are 700 mg / day. As well as, DRI for potassium, calcium and sodium are 1700, 1000 and 1500 mg / day, respectively, (Table 2)

3.2 Physical properties of fresh longan cultivars:

The physical properties of fresh peels and flesh longan (edible portion) were presented in Table (3). Total soluble solids (T.S.S.%) of fresh longan cultivars (Ko) and (Wu) relating sweetness were found to be 15.5 and 17.87%, respectively. Those physical properties were found to be in the range of mature fruit (Mahayothee et al., 2006) and similar to others cultivars " Biew kiew " and " Sri champoo " (Wall, 2006). Hunter lab. Measurements indicated that L, a and b values of peel longan was lower than those of flesh (edible part), indicating an increasing in lightness for color measurements. The highest values of (L) means (lightness) while (a) means redness and to (b) means yellowness of color. Results also ascertained that fresh longan cultivar (Wu)had the highly values of L, a and b compared with the others one.

Table (3) : Physical properties of fresh stored longan cultivars.

Constituents	Cultivars (Ko)*	Cultivars (Wu)**
T.S.S.%	15.5	17.8
pH value	3.332	3.400
Hunter lab measurement		
Peels		
Colour L (lightness)	+ 30.64	+35.84
a (redness)	+ 1.02	+ 1.12
b (yellowness)	+ 1.18	+ 1.30
Flesh		
Colour L (lightness)	+ 45.37	+ 50.72
a (redness)	+ 10.48	+ 12.73
b (yellowness)	+ 20.33	+ 23.25

* Kohala cultivars (Ko) ** Wuyuan cultivers (Wu)

3.3 Sensory evaluation of canned longan cultivars:

The organoleptic evaluation could be considered the most important aspects in longan fruits, since its, reflects to the consumer preference for a respective food product. Sensory characteristics include, color, taste, odor, texture and palatability were evaluated and represented in Table (4). Analysis variance showed that longan cultivar (Wu) given the highest scores for all tested parameters and also different processing treatments than those of tested investigated (Ko) cultivar. Results also ascertained that longan (Wu) cultivar which composed of HFCS : Sucrose by the ratio of 1 : 3; 1 : 1 and 3 : 1 (treatments 1, 2 and 3) recorded the highest scores of color, taste, odor, texture and palatability compared with the other processing treatments (Table 4). It was obvious that panelists accepted the aforementioned longan products and the palatability was described by panelists as " like very much " for longan cultivar (Wu) included in all High Fructose corn syrup to sucrose added by different ratios (treatments 1 to 5), and " like moderately " for the second longan cultivar (Ko). Therefore, processed longan (Wu) cultivar came in the first order in comparison with other processed longan (Ko) cultivar one. This variation was mainly due to difference percentages of HFCS to sucrose added during processing of such products, and also different location of longan cultivars (environmental conditions).

Table (4) : Sensory evaluation of processed longan fruit cultivars.

Parameters	Cultivars (Ko)					Cultivars (Wu)					LSD
	Treatments					Treatments					
	1	2	3	4	5	1	2	3	4	5	
Color	8.0^{cd}	7.0^{e}	7.5^{de}	8.0^{cd}	8.0^{cd}	9.0^{ab}	9.5^{a}	9.0^{ab}	8.0^{cd}	8.5^{bc}	0.630
Taste	7.6^{d}	8.0^{cd}	6.4^{e}	6.3^{e}	6.0^{e}	9.0^{ab}	9.3^{a}	9.4^{a}	8.4^{bc}	8.7^{abc}	0.772
Oder	7.3^{c}	6.0^{d}	7.5^{c}	6.0^{d}	7.0^{c}	8.5^{b}	9.4^{a}	8.3^{b}	8.2^{b}	7.9^{b}	0.642
Texture	7.5^{cd}	7.0^{d}	7.6^{cd}	7.8^{c}	7.4^{c}	9.3^{a}	8.7^{a}	8.4^{b}	8.6^{b}	8.2^{b}	0.601
Overall palatability	8.4^{ab}	7.3^{d}	7.6^{cd}	8.3^{abc}	8.0^{bcd}	8.6^{ab}	8.4^{ab}	8.7^{ab}	8.0^{cd}	8.3^{bc}	0.718

Mean under the same line bearing different superscript letters are different significantly ($p \leq 0.05$).

1) 1 : 3 = 1 H.F.C.S : 3 Sucrose (40%) , 3) 3 : 1 = 3 H.F.C.S : 1 Sucrose (40%),

2) 1:1= 1 H.F.C.S : 1 Sucrose(40%) 4) H.F.C.S. = High fructose corn syrup (40 %). 5) Suc = Sucrose (40 %)

Table (5) illustrates the organoleptic properties in different percentages of HFCS to sucrose added to either (Ko) or (Wu) longan cultivars at zero time storage at(25±2°C t) up to six months. Results show that slightly significant differences were noticed in color, taste, odor, texture and palatability of stored longan (Wu) cultivar up to six months at ambient temperature, also, no significant differences were noticed in all soaking treatments of longa(Wu) n) cultivar especially 1, 3 and 4 for palatability parameter (Table 5). It could be clearly observed that the accepted longan cultivar(Wu)) treated by HFCS : Sucrose by 1 : 3 ; 3 : 1 and HFCS only by 40 % given the highest scores and came in the first order compared to all other tested longan cultivar (Ko) during storage in glass jars up to six months. Therefore, these five soaking treatments (had slightly significant differences) especially in longan cultivar(Wu)) were chosen to continue for all analysis up to six months. This observation lead to the conclusion that storage of these accepted cultivars especially ((Wu)) and treatment 1, 3 and 4 for up to 6 months at ambient temperature remained in the same acceptability (Table 5).

Table (5): Sensory evaluation of canned longan cultivars after storage for 6 months at ambient temperature.

Cultivars	Treatments	Storage Period														
		Zero time					After 3 months					After 6 months				
		Color	Taste	odor	Texture	Palatability	Color	Taste	odor	Texture	Palatability	Color	Taste	odor	Texture	Palatability
Ko	(1)	8.0^{bc}	7.6^{d}	7.3^{cd}	7.5^{e}	8.4^{ab}	7.9^{cd}	7.4^{d}	7.2^{d}	7.4^{c}	8.3^{ab}	7.6^{cd}	7.2^{cd}	6.8^{de}	7.0^{c}	7.6^{bc}
	(2)	7.0^{d}	8.0^{cd}	6.0^{e}	7.0^{f}	7.3^{d}	7.0^{ef}	7.8^{cd}	5.9^{f}	6.8^{d}	7.2^{d}	6.8^{ef}	7.5^{cd}	5.6^{f}	6.5^{c}	7.0^{c}
	(3)	7.5^{cd}	6.4^{e}	7.5^{cd}	7.6^{def}	7.6^{cd}	7.3^{def}	6.1^{de}	7.3^{cd}	7.3^{c}	7.4^{c}	7.0^{de}	5.9^{e}	7.0^{cd}	7.1^{c}	7.1^{c}
	(4)	8.0^{bc}	6.3^{e}	6.0^{e}	7.8^{cde}	8.3^{ab}	7.8^{cd}	6.2^{e}	5.8^{f}	7.5^{c}	8.1^{abc}	7.3^{de}	5.8^{e}	5.5^{f}	7.0^{c}	7.6^{bc}
	(5)	7.0^{d}	6.0^{e}	7.0^{d}	7.4^{e}	8.0^{bcd}	6.8^{f}	5.9^{e}	6.8^{e}	7.3^{c}	7.8^{abcd}	6.3^{f}	5.7^{e}	6.3^{e}	7.1^{c}	7.2^{c}
Wu	(1)	9.0^{ab}	9.0^{ab}	8.5^{b}	9.3^{a}	8.6^{ab}	8.8^{ab}	8.6^{ab}	8.1^{b}	9.1^{a}	8.3^{ab}	8.5^{ab}	8.3^{ab}	7.8^{b}	8.8^{a}	8.0^{ab}
	(2)	9.5^{a}	9.3^{a}	9.4^{a}	8.7^{ab}	8.1^{ab}	9.4^{a}	9.2^{a}	9.0^{a}	8.4^{b}	7.7^{b}	9.1^{a}	8.9^{a}	8.6^{a}	8.0^{b}	7.3^{bc}
	(3)	9.0^{ab}	9.4^{a}	8.3^{b}	8.4^{bc}	8.7^{ab}	8.8^{ab}	9.3^{a}	8.1^{b}	8.2^{b}	8.5^{a}	8.3^{b}	8.8^{a}	7.6^{bc}	7.9^{b}	8.2^{a}
	(4)	8.0^{bc}	8.4^{bc}	8.2^{b}	8.6^{b}	8.8^{a}	7.6^{de}	8.1^{bcd}	7.9^{b}	8.3^{b}	8.5^{a}	7.3^{de}	7.8^{bc}	7.4^{bc}	8.1^{b}	8.1^{a}
	(5)	8.5^{b}	8.7^{abc}	7.9^{bc}	8.2^{bcd}	8.3^{ab}	8.4^{bc}	8.3^{bc}	9.3^{a}	8.2^{b}	8.0^{b}	8.1^{bc}	7.0^{d}	9.0^{a}	7.9^{b}	7.6^{abc}
LSD		0.630	0.772	0.642	0.601	0.718	0.680	0.792	0.652	0.611	0.755	0.693	0.742	0.661	0.620	0.745

Mean under the same line bearing different superscript letters are different significantly (p ≤ 0.05).

3.4 Effect of both processing and [storage at ambient temperature (25±2°C**] on quality attributes of longan cultivars:**

Changes in physico – chemical constitutes of canned longan (wu) cultivar stored at(25±2°C) up to six months are presented in Table (6). Results show that total soluble solids (% T.S.S.) in processed longan cultivar (soaked in either HFCS or sucrose) increased by the percentage of 31.8 % (in average) compared to the fresh longan cultivars (Table 2). The increment in T.S.S. may be related to the hydrolysis of insoluble polysaccharides such as starch to soluble sugars and insoluble pectin to soluble pectin, also, the addition of the High Fructose Corn Syrup and sucrose treatments. Meanwhile, ascorbic acid recorded the slightly decrease by processing treatments as compared to the fresh one. These results could be interpreted to the effect processing and pasteurized process which may enhance the degradation of ascorbic acid content during processing as well as storage period up to six months (Table 6).

It could be noticed that slight changes in pH value by processing treatments as well as storage conditions at ambient temperature (25±2°C) up to 6 months. Changes in Hunter lab. measurements in processed as well as stored longan cultivar ((wu)) are shown in Table (6). Results indicated that the lightness increased in longan cultivar for all soaking treatments (1 – 5) compared to fresh one. Data from the same table indicated that there are a little pronounced obvious changes in moisture content, pH value, total acidity, sugar and also Hunter lab. measurements in different processing treatments during storage up to 6 months in glass jars.

Table (6): Changes in physicochemical constituents of canned longan cultivars (Wu) during storage for 6 months at room temperature

Constituents (%)	Storage period in months														
	0					3					6				
	Treatments					Treatments					Treatments				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Moisture content	71.64	71.85	71.72	71.64	71.01	71.03	71.24	71.13	71.04	70.82	70.24	70.52	70.45	70.23	70.00
Total soluble solids	26.25	26.75	26.25	26.25	26.50	26.84	27.64	26.93	26.82	28.45	27.15	27.94	27.38	27.05	28.84
Total titratable acidity	0.63	0.79	0.84	0.45	0.51	0.74	0.82	0.53	0.52	0.66	0.82	0.84	0.58	0.57	0.54
Total sugars	26.80	26.02	26.08	26.03	26.04	26.01	26.18	26.07	25.66	26.42	26.08	25.99	25.82	25.42	26.01
Reducing sugar s	11.64	9.74	13.81	13.93	11.82	13.15	11.42	14.97	14.81	13.45	15.60	13.75	16.35	16.82	15.77
Non reducing sugars	14.36	16.28	12.27	12.10	14.22	12.89	14.76	11.10	10.85	12.97	10.48	12.24	9.47	8.60	10.24
Ascorbic acid (mg/100g)	40.78	40.84	39.67	39.33	39.82	37.84	37.92	36.27	37.62	37.93	37.68	37.55	36.74	36.32	37.29
pH value	3.14	3.57	2.69	2.53	2.32	3.11	3.43	2.54	2.50	2.22	3.08	3.39	2.50	2.48	2.40
Hunter lab measurement															
L	+68.45	+67.32	+70.23	+76.43	+72.52	+68.10	+67.05	+68.82	+76.15	+72.14	+67.66	+66.72	+69.45	+75.33	+71.63
a	+7.82	+8.03	+8.46	+8.74	+8.92	+7.63	+7.96	+8.24	+8.66	+8.73	+7.48	+7.72	+8.13	+8.43	+8.52
b	+15.90	+15.60	+16.80	+16.40	+16.00	+15.72	+15.36	+16.45	+16.33	+15.82	+15.40	+15.23	+16.18	+16.12	+15.67

As sown in Table (7), changes in physico – chemical constituents of processed as well as stored longan (Ko) cultivar may lead to:

a) Slightly changes in T.S.S., moisture, total acidity, sugars and pH value due to the stable storage conditions up to six months.

b) Slight reduction in ascorbic acid content were occurred among all tested samples especially after processing treatments compared with the fresh one (pasteurized process which may enhance the degradation of ascorbic acid content during processing as well as storage up to six months). It has been also noticed as mentioned by that the rate of oxidation of ascorbic acid was mainly dependent upon the dissolved oxygen and storage temperature 25±2°C (Mohamed et al., 2000). So, results indicated that the lightness increased in longan cultivar (Wu) for all soaking treatments (1 – 5) compared with the other cultivar one.

Finally, it could be clearly recommended and concluded through this aforementioned study that it is successful, economic and available to expand in new reclaimed areas with longan fruits. Consequently, this would develop and increase processed qualities. This would have a significant reflex on increasing our exportation of that processed crop in future. Through that investigation it has been also concluded that longan variety Wuyuan was the best cultivar among other longan investigated cultivar being rich and good source for many important physico – chemical nutrient such as ascorbic acid, Hunter L, a and b, crude protein, total soluble solids and total sugars and cyanidin 3 glucoside.

This mentioned cultivar (Wuyuan) was also found to be very palatable among other investigated cultivar either in sensory evaluation or in chemical analysis of its components. Minimum desirable changes observed after processing of thus cultivar (Wuyuan) or after storage at ambient temperature (25 ± 2°C) up to 6 months should be a matter of great significance to prefer that longan cultivar (Wuyuan).

318 Table (7): Changes in physicochemical constituents of canned longan cultivars (Ko) during storage for 6 months at room temperature .

Constituents (%)	Storage period in months														
	0					3					6				
	Treatments					Treatments					Treatments				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Moisture content	72.37	72.42	72.28	72.43	72.33	71.77	71.37	71.61	71.84	71.44	70.22	70.45	70.81	70.93	70.32
Total soluble solids	26.00	26.75	25.50	25.63	25.25	26.91	27.84	26.45	26.84	25.73	27.15	28.01	26.85	27.03	25.97
Total acidity	0.53	0.88	0.41	0.42	0.48	0.64	0.91	0.45	0.48	0.52	0.63	0.92	0.46	0.59	0.58
Total sugars	25.63	25.77	25.48	25.31	25.02	25.28	25.44	25.16	25.06	24.77	24.91	25.17	24.83	24.81	24.15
Reducing sugars	10.42	9.03	14.10	12.37	10.24	12.27	11.84	16.72	14.26	12.33	14.28	13.77	17.93	16.73	14.56
Non reducing sugar	15.21	16.74	11.38	12.94	14.78	13.01	13.60	9.44	10.80	12.44	10.63	11.90	6.90	8.08	9.57
Ascorbic acid (mg/100g)	28.72	28.68	28.75	28.68	28.23	27.02	27.23	27.13	27.33	27.37	27.20	27.52	26.34	26.25	27.05
pH value	3.04	3.42	2.36	2.64	2.36	2.94	3.95	2.27	2.54	2.30	2.91	3.18	2.21	2.46	2.28
Hunter lab. measurement															
L	+44.52	+48.33	+50.38	+54.30	+52.70	+44.01	+47.81	+49.75	+52.31	+50.34	+43.82	+47.30	+49.15	+51.84	+50.03
a	+2.48	+3.97	+5.18	+5.97	+5.97	+2.50	+4.03	+5.24	+6.28	+6.05	+2.48	+3.97	+5.18	+5.97	+5.97
b	+4.05	+5.82	+7.15	+10.31	+8.00	+4.22	+6.15	+7.28	+10.42	+8.15	+4.05	+5.82	+7.15	+10.31	+8.00

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4. CONCLUSION

Thus, the technological trend for utilization of large quantities cultivated of longan fruits in new reclaimed areas is a matter of great importance. This would lead to produce new untraditional products passing high nutritional value plus high quality of sensory attribute greeting new work opportunities by establishing a factory to produce those aforementioned new products either for local or abroad consumption must be put in consideration through that investigation.

CONSENT (WHERE EVER APPLICABLE)

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APPENDIX

Further study of this research may be content different titles

1- Biological studies on longan
2- Studies on longan seed utilization

Abbreviation

L*, a*, b*	color parameters L (lightness), a (Redness) and b (yellowness)
t	time (min)

T	temperature
TSS	total soluble solids
H.F.C.S.	High fructose corn syrup
Suc	Sucrose
Ko	Longan fruit, variety Kohala
Wu	Longan fruit, variety Wuyuan
DRI	Daly required intake
Ca	Calcium
Mg	magnesium
K	Potassium
Cu	Cupper

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