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SUMMARY – Fruits from 7 year-old Loquat (*Eriobotrya japonica* Lindl.) cv. Golden Nugget trees were harvested at three maturity stages, determined by skin colour: (i) dark orange (Munsell 5YR 7/11); (ii) intense yellow orange (Munsell 7.5YR 7/11); and (iii) light yellow orange (Munsell 10YR 8/10); and also by fruit size: either fancy (4.3-5.3 cm), or choice (3.5-4.3 cm). Fruit was characterized by: soluble solids, pH, total acidity, and sugar/acidity ratio. Fruits were halved and canned in glass jars using heavy syrup (30°Brix), or pureed, cooked and canned in glass jars. Chemical treatments were evaluated after 180 days of storage as described above, and a tasting panel of 16 judges evaluated flavour, sweetness, acidity, texture, general quality and acceptability in the products. An analysis of variance was used, using a randomized block design with four replicates; sensory evaluation was analysed with the Friedman test. The results showed the effect of maturity stage and fruit size on the quality of canned loquat halves. The quality of the canned puree was also affected by the maturity stage of the fruit.

Key words: Loquats, canned, puree, maturity, fruit.

RESUME – *"Effet du stade de maturité et de la taille du fruit sur la qualité des nèfles (*Eriobotrya japonica *Lindl.) cv. Golden Nugget, après mise en conserve du fruit entier ou comme purée". Les nèfles (*Eriobotrya japonica *Lindl.) cv. Golden Nugget, provenant d'arbres âgés de 7 ans, ont été récoltées à trois stades de maturité, déterminés par la couleur de la peau : (i) orange foncé (Munsell 5YR 7/11) ; (ii) jaune orangé intense (Munsell 7,5YR 7/11) ; et (iii) jaune orangé clair (Munsell 10YR 8/10); et également d'après la taille du fruit : soit fancy (4,3-5,3 cm) ou choice (3,5-4,3 cm). Le fruit a été caractérisé par : les solides solubles, pH, acidité totale, et ratio sucre/acidité. Les fruits ont été coupés par moitié et mis en conserve dans des bocaux en verre en utilisant un sirop lourd (30ºBrix), ou mis en purée, cuits et mis en conserve dans des bocaux en verre. Les caractéristiques chimiques ont été évaluées après 180 jours de stockage comme décrit auparavant, et un panel de 16 dégustateurs a évalué les produits en ce qui concerne la flaveur, douceur, acidité, texture, qualité générale et acceptabilité. On a utilisé l'analyse de variance, en employant un dispositif en blocks aléatoires avec quatre répétitions ; l'évaluation sensorielle a été analysée selon le test de Friedman. Les résultats montrent un effet du stade de maturité et de la taille du fruit sur la qualité des moitiés de nèfles mises en conserve. La qualité de la purée mise en conserve a également été affectée par le stade de maturité du fruit.*

Mots-clés : *Nèfles, mise en conserve, purée, maturité, fruit.*

Introduction

Loquat fruit is a very seasonal and highly perishable product, with difficult post-harvest handling and uneven quality. Given these characteristics, there is always a relatively large proportion of fruit that cannot be marketed. Thus, other countries have developed processed products that extend the presence of loquat in retail markets throughout the year. In general, the quality of processed products is highly influenced by the quality of the raw material. In Chile loquat is eaten fresh and there are no reports of its consumption in processed forms. Given that, this research seeks to evaluate the effect of fruit size and maturity stage on the quality of canned loquats cv. Golden Nugget, both halved and pureed.

Materials and methods

Loquat cv. Golden Nugget fruit was harvested from 7 year old trees grown at the La Palma Experimental Station. Harvest was done during the month of October, and fruits were separated

according to their maturity stages as determined by the exocarp color: deep orange (Munsell 5YR 7/11, stage M1), intense yellow orange (7.5YR 7/11, M2), and light yellow orange (10YR 8/10, M3). Fruit was taken to the laboratory and washed; blemished and rotten fruits were discarded. For each maturity stage, 10 fruits were processed, and the following parameters were measured: titratable acidity, expressed as meq of citric acid per 100 ml of juice (AOAC, 1980); soluble solids, ratio of soluble solids/acidity and pH. The fruit was peeled, de-seeded, and kept in an antioxidant solution of 0.6% citric acid and 0.1% ascorbic acid (w/v). Then the fruit from each maturity stage was either pureed (Experiment 1) or halved (Experiment 2).

Experiment 1. Fruit halves were cooked for 30 minutes and then pulped and pureed. The puree was put into 350 ml glass jars at 80-90°C, capped with a twist-off lid, and sterilized at 100°C for 25 minutes.

Experiment 2. Fruits were classified according to their size as C1, extra-fancy, with a diameter of 4.3-5.3, and C2, choice, with a diameter of 3.5-4.3 cm. Halves were placed in glass jars and covered in hot (90°C), heavy (30°Brix) syrup. Jars were sealed and sterilized for 25 minutes at 100°C.

Jars were kept at room temperature inside cardboard boxes for 180 days, after which the contents were analyzed for soluble solids, pH, titratable acidity, and the ratio of soluble solids to acidity. A taste panel consisting of 16 judges evaluated flavor intensity, sweetness, acidity, texture, general acceptability and quality.

Chemical parameters were analyzed with a multi-variable analysis of variance with 4 replicates in each experiment. Sensory analysis was carried out with a randomized block design with 16 replicates (judges), using Friedman's non-parametrical test.

Results and discussion

Experiment 1

Raw material characterization

Fruit harvested at the same time with different exocarp colors showed variable soluble solids, titratable acidity, pH, and ratio of soluble solids to acidity (Table 1). These differences could be explained because the M1 stage corresponds to a more advanced maturity stage, with a higher synthesis of sugars and lower acid content (Hirai, 1980; Kursanow, cited by Shaw, 1980; Shaw and Wilson, 1981; Fernández, 1986).

Table 1. Chemical characterization of fresh loquat fruit cv. Golden Nugget harvested at three maturity stages

Maturity stage	Titratable acidity (meq acid/100 ml of juice)	Soluble solids (ºBrix)	pH	Soluble solids/acidity
M1	13.19a[†]	12.2a	3.52a	0.94a
M2	16.15b	10.3b	3.32ab	0.66b
M3	19.82c	9.1b	3.14b	0.47c

[†]Numbers followed by the same letter are statistically significant according to Simultaneous Confidence Intervals ($p<0.05$).

Canned puree after 180 days of storage

Table 2 shows that there were no differences among the maturity stages in soluble solids. Nevertheless, they were higher than in the fresh fruit, mainly due to the addition of the antioxidants and partly because of the thermal processing that eliminated water. The acidity level was also influenced by the antioxidant solution.

Table 2. Chemical characterization of loquat fruit cv. Golden Nugget harvested at three maturity stages and canned as puree, after 180 days of storage

Maturity stage	Titratable acidity (meq acid/100 ml of juice)	Soluble solids (ºBrix)	pH	Soluble solids/acidity
M1	15.52a†	14.0	3.69a	0.90a
M2	27.52ab	14.8	3.49b	0.51b
M3	34.18b	13.3N.S.	3.32c	0.39b

†Numbers followed by the same letter are statistically significant according to Simultaneous Confidence Intervals ($p<0.05$); N.S. = not significant.

The taste panel showed that as a processed product, the puree from the more intense-colored loquats was more acceptable than that from the other maturity stages, since it was sweeter, even though the difference in soluble solids was marginal (Table 3). As general acceptability was higher for the fruit harvested with deep orange color (M1), this stage is thus the most adequate ripening stage for loquat fruit processed as canned puree (Table 4).

Table 3. Effect of three maturity stages on the sweetness intensity, acidity, flavor and texture of loquat fruit cv. Golden Nugget canned as puree, after 180 days of storage†

Maturity stage	Sweetness intensity	Acidity intensity	Flavor intensity	Texture intensity
M1	3.0a††	2.3a†	3.9a	3.3
M2	2.0b	3.5b	2.8b	3.6
M3	1.5c	4.3c	2.5b	3.6N.S.

†Scoring scale: sweetness from (1) "little or no sweetness" to (5) "too sweet"; acidity from (1) "little or no acidity" to (5) "too acid"; flavor from (1) "bad" to (5) "very good"; texture from (1) "too hard" to (5) "too soft".
††Numbers followed by different letters are statistically significant, according to Friedman's Multiple Comparison Test ($p<0.05$); N.S. = not significant.

Table 4. Effect of three maturity stages on general acceptability of loquat fruit cv. Golden Nugget canned as puree, after 180 days of storage†

Maturity stage	General acceptability
M1	3.9a††
M2	3.3b
M3	2.6c

†Scoring scale: general acceptability from (1) "I dislike it very much" to (5) "I like it very much".
††Numbers followed by different letters are statistically significant, according to Friedman's Multiple Comparison Test ($p<0.05$).

Experiment 2

Raw material characterization

Table 5 shows that fruit harvested with different exocarp colors were variable in their content of soluble solids, titratable acidity, pH, and ratio of soluble solids to acidity. Nevertheless, for each maturity stage there was no effect of fruit size on internal parameters, results that are similar to those obtained by Rivas and Martos (1978).

Table 5. Chemical characterization of fresh loquat fruit cv. Golden Nugget harvested at three ripening stages and two sizes

Maturity stage and fruit size	Titratable acidity (meq acid/100 ml of juice)	Soluble solids (ºBrix)	pH	Soluble solids/acidity
M1-C1	10.84a†	13.3a	3.67a	1.26a
M1-C2	10.70a	12.6ab	3.67a	1.23ab
M2-C2	14.95ab	11.7abc	3.37ab	0.79ab
M2-C1	15.30ab	11.5abc	3.35ab	0.76ab
M3-C2	18.03ab	10.0bc	3.19b	0.52ab
M3-C1	21.22b	9.3c	3.13b	0.43b

†Numbers followed by the same letter are statistically significant according to Simultaneous Confidence Intervals ($p<0.05$).

Canned halves after 180 days of storage

Soluble solids in the canned halves were similar in all of the maturity stages, but higher than those of the raw fruit due to the addition of sucrose in the coating medium. As shown in Table 6, fruit size did not affect the parameters within each maturity stage.

Table 6. Chemical characterization of fresh loquat fruit cv. Golden Nugget harvested at three maturity stages and two sizes, and canned in halves, after 180 days of storage

Maturity stage and fruit size	Titratable acidity (meq acid/100 ml of juice)	Soluble solids (ºBrix)	pH	Soluble solids/acidity
M1-C2	2.75a†	24.3	3.69a	9.00
M1-C1	3.69ab	23.3	3.67a	7.75
M2-C2	5.50ab	26.5	3.40ab	5.02
M3-C2	5.95ab	25.1	3.40ab	4.35
M2-C1	5.45ab	22.0	3.31b	4.07
M3-C1	8.55b	23.0N.S.	3.32b	2.65N.S.

†Numbers followed by the same letter are statistically significant according to Simultaneous Confidence Intervals ($p<0.05$); N.S. = not significant.

Sweetness and flavor showed no differences between different maturity stages and fruit sizes. Nevertheless, larger fruit (C1) from the less advanced maturity stage (M3) showed higher acidity than smaller fruit from the more advanced maturity stages (Table 7).

In general, acceptability of the processed product was not influenced by the interaction of maturity stage and fruit size (Table 8).

Conclusions

Experiment 1. The differences shown among maturity stages in the raw material remain in the processed product, with the exception of soluble solids, a parameter that was similar among the three maturity stages. The puree made from fruit in the M1 maturity stage showed the best ratings in terms of sweetness, acidity, flavor, and acceptability.

*Experiment 2***.** Quality parameters within each maturity stage did not vary between the two fruit sizes. The processed products obtained from the different maturity stages and fruit sizes specified showed no differences in sweetness, flavor, texture and general acceptability, but differences were detected in the acidity.

Table 7. Effect of three maturity stages and two fruit sizes on the sweetness intensity, acidity, flavor and texture of loquat fruit cv. Golden Nugget canned as halves, after 180 days of storage†

Maturity stage and fruit size	Sweetness intensity	Acidity intensity	Flavor intensity	Texture intensity
M3-C1	3.8	2.6a	4.0	3.0b
M3-C2	3.8	2.4ab	3.6	3.1b
M1-C1	3.9	2.1ab	3.6	3.1b
M2-C2	4.1	2.0ab	3.6	3.1b
M1-C2	4.3N.S.†	1.6b	3.8N.S.	2.6b

†Scoring scale: sweetness from (1) "little or no sweetness" to (5) "too sweet"; acidity from (1) "little or no acidity" to (5) "too acid"; flavor from (1) "bad" to (5) "very good"; texture from (1) "too hard" to (5) "too soft".
††Numbers followed by different letters are statistically significant, according to Friedman's Multiple Comparison Test ($p<0.05$); N.S. = not significant.

Table 8. Effect of three ripening stages and two fruit sizes on general acceptability of loquat fruit cv. Golden Nugget canned as halves, after 180 days of storage†

Maturity stage	General acceptability
M2-C1	3.5
M3-C1	4.1
M3-C2	3.9
M1-C1	3.5
M2-C2	3.8
M1-C2	3.8N.S.††

†Scoring scale: general acceptability from (1) "I dislike it very much" to (5) "I like it very much".
††N.S. = not significant in the Friedman's Multiple Comparison Test.

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