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**Controlling Processing
for Persimmon Product Texture**



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Abstract

'Fuyu' sweet persimmon is cultivated commercially in the northern part of New Zealand. In 2012, 2,250 tonnes from 50 New Zealander growers was produced with domestic and international market values of \$4.0M and \$7.1M respectively. Approximately 50 % of persimmon do not meet export standards due to external skin blemishes, and consequently could be processed into alternative products. The global preserved or prepared fruit market has been gradually increasing and is estimated at US \$34B.

Many food products such as jams, marmalades, spreads, fillings and toppings are produced by using fruit purée as a key ingredient. Texture and colour are important quality attributes in these products which influence customer acceptability. The properties of fruit purée are dependent on the input fruit quality. Changes after harvest in terms of physicochemical and sensory properties significantly influence the quality of manufactured products and its properties as an ingredient. Processing persimmon into a desired product is a challenge due to the limited knowledge of the relationship between postharvest quality of fruit and their processed characteristics. The overall objective of this research was to create generalised guidelines for the effects of persimmon fruit quality and processing conditions on the resulting textural properties of a persimmon product. This research informs manipulation of processes in order to achieve the required product properties that result in positive sensorial experiences.

During postharvest shelf life at 20 °C whole persimmon firmness reduced on average with large variation. Persimmon skin turned from a pale green-yellow to orange-red. A correlation of hue angle between persimmon skin and tissue was developed. In addition, influences of fruit colour on final product quality were demonstrated and provide a guideline for future work in order to investigate the effects of β -cryptoxanthin changes during fruit ripening on final product colour characteristics.

β -galactosidase was found to be the predominant enzyme in persimmon ripening and its activity increased approximately 3 times at fully-ripe state. As ripening progressed, pectinmethylesterase (PME) activity increased and later declined, while no significant change in polygalacturonase (PG) activity was detected, even though total galacturonic acid (GalA) content declined. Increasing β -galactosidase and PME with decreasing total GalA during ripening resulted in a flowable purée and low purée yield when processing more ripe fruit due to cell wall components of fruit tissue being degraded and solubilised.

After puréeing, persimmon gels spontaneously formed at 20 °C which was symptomatic of calcium gel behaviour. In contrast, the degree of methylesterification of persimmon was observed to be 53 % on average which could be classified as a high methoxyl pectin. Ethylenediaminetetraacetic acid (EDTA) chelation prevented the gel structure forming by sequestering calcium ions. Heating tissue to 73 °C for 30 minutes prior to tissue puréeing resulted in the strongest gels in all samples. Heat treatment and processing activated PME resulting in long chains of GalA which are sensitive to calcium crosslinking. Interestingly, combining 25 % of mature-green tissue with 75 % of overripe tissue resulted in increasing gel strength dramatically by approximately 85 % in comparison to gel made from 100 % of overripe tissue. This strong gel from combining tissue is thought to be due to calcium crosslinks created between the long chains of methyl free GalA from mature-green tissue and the short chains of methyl free GalA presented in overripe tissue.

This research develops general guidelines for how fruit maturity and heat treatment influence persimmon purée product final quality attributes. Textural characteristics of persimmon purée product can be manipulated to achieve the final desired product quality by controlling fruit ripeness and processing conditions (EDTA addition, temperature and combining different types of tissue). Based on a preliminary study, the investigation of the degree of blockiness of persimmon pectin is suggested for future work in order to characterise in the structures of persimmon pectin which impart gelling mechanism and the subsequent result on gel characteristics. This

future work would be beneficial for the improvement of processing guidelines to achieve the desired final product quality attributes.

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Abbreviations

IU	International unit
μg	microgram
mg	milligram
g	gram
GalA	galacturonic acid
HMP	high methoxyl pectin
LMP	low methoxyl pectin
DMe	degree of methylesterification
PME	pectinmethylesterase
PG	polygalacturonase
Hz	hertz
s	second
G'	storage modulus
G''	loss modulus
G*	complex modulus
η*	dynamic viscosity
° δ	loss tangent
Pa	Pascal
mm	millimeter
∅	diameter
H	height
FW	fresh weight
DW	dry weight
w	weight
v	volume
TSS	total soluble solids
DM	dry matter
HG	homogalacturonan
RG I	rhamnogalacturonan I

RG II	rhamnogalacturonan II
E_a	activation energy
R	gas law constant
T	absolute temperature
k	reaction rate constant
kg_f	kilogram force
CIE L*C*h*	colour parameter measured by spectrophotometer (lightness, chroma and hue angle)
NaOH	sodium hydroxide
DNS	dinitrosalicylic acid
H ₂ SO ₄	sulfuric acid
NaCl	sodium chloride
MeOH	methanol
W_{flesh}	weight of flesh persimmon tissue
W_{can}	can weight
W_{dry}	weight of flesh persimmon tissue after drying
WHC	water holding capacity
m_a	filter paper weight
m_p	purée weight
m_f	weight of filter paper after 15 minutes
EDTA	ethylenediaminetetraacetic
ω	angular frequency
Hz	hertz
M.W.	molecular weight
A.W.	atomic weight
M	molarity
J	Joule