

# Seasonal Changes in Mineral Nutrient and Seed Oil in Kinnow Fruit (*Citrus reticulata* Blanco)

TANWEER RAZA, MUHAMMAD IBRAHIM AND MUHAMMAD AMJAD

*Department of Horticulture, University of Agriculture, Faisalabad-38040, Pakistan*

## ABSTRACT

The analysis of various parts of kinnow fruit revealed that nutrients were at their peak in pulp and juice of kinnow during February. Phosphorus in peel and potassium in pulp and juice continued to increase as long as the fruits stayed on the trees. Potassium was most frequent element in both peel and the pulp. Seed oil extracted was 36% in February which later inclined to decline and was 23.9% by March.

**Key Words:** Seasonal changes; Kinnow fruit; Seed oil.

## INTRODUCTION

Kinnow is an important citrus cultivar of Pakistan used as fresh and now being processed too. It is picked by mid February and is available enough till the end of April. In juice factories abundant of pulp peel and seed is available after juice extraction. It is desired to find out some beneficial use of the left over product and hence the project was initiated to estimate the mineral contents of the rag and the oil contents of seeds which can be extracted for beneficial use if found in desirable high contents. Previously similar experimentation indicated that nitrogen contents which indicate the protein content too of the fruits decreased with the passage of time (Tadea *et al.*, 1988) while the juice nitrogen contents remained stable as reported by Moss and Higgins (1978) in valencia oranges. Kharebova (1971) reported that phosphorus is significantly higher in the pulp, than in the peel of mandarins. Phosphorus is known to decrease in the navelate and Washington navel fruits as maturity progresses (Gonzales-Ferrer *et al.*, 1984) but juice phosphorus remained stable like nitrogen and potassium during the harvesting period (Moss & Higgins, 1978). Potassium was reported in significant amounts in the pulp than in the peel of mandarins (Kharebova, 1971) and was a dominant cation in orange juice too (Jones, 1961). Zidan and Wallace (1954) reported that calcium contents of Washington navel and valencia fruits reached their peak value in October and steadily declined to its minimum value in March. Bitters (1961) reported that calcium was present in greater amounts in peel than in the pulp or juice of valencia oranges. Oil in citrus seeds is reported to range between 30-50% (Bartholomew & Sinclair, 1951) while in oranges the range reported was 30-35% (Sinclair, 1961).

## MATERIALS AND METHODS

The studies were carried out at the Post-graduate Agricultural Research Station (PARS), Department of Horticulture, University of Agriculture, Faisalabad during the year 1996-97. Eighteen moderately healthy kinnow mandarin trees grafted on "Rough lemon" rootstock were selected for this purpose. The experimental trees were about ten years old and at a prime bearing stage. There were three treatments under study i.e. time of harvesting (January 30, February 15 and March 1) with six replications.

The peel, pulp and juice of the fruits were analyzed for minerals and seeds for seed oil and protein. Nitrogen, phosphorus and potassium were estimated by the methods described by Chapman and Parker (1961). The other elements were estimated according to the method described by Yoshida *et al.*, (1976) by using Perkin-Elmer Atomic Absorption Spectrophotometer 3300 AA. The protein contents were calculated by multiplying the total nitrogen contents with 6.25. Seed oil was extracted by Soxhlet apparatus with ethyl ether as oil solvent.

## RESULTS AND DISCUSSION

The nutrient analysis of kinnow fruit revealed that majority of the nutrients reached their peak value during February which later inclined to decrease.

The nitrogen/protein contents of various parts tended to decrease after the first analysis. The peak values of nitrogen determined in peel and juice were 0.83% and 0.05% in February. The variation in juice nitrogen ranged between 0.04 to 0.05% which is in agreement with earlier findings of Moss and Higgins (1978) while on the other hand Tadea *et al.*, (1988) observed that juice N of Navelina, Washington Navel

**Table 1. Seasonal variation in minerals, protein and seed oil in Kinnow**

	Jan. 30	Feb. 15	March 1
<b>Nitrogen (%)</b>			
Peel	0.71	0.83	0.79
Pulp	0.90	0.87	0.61
Juice	0.04	0.05	0.04
Seed	0.36	0.31	0.77
<b>Protein (%)</b>			
Peel	4.47	5.20	4.95
Pulp	5.68	5.49	3.88
Juice	0.30	0.34	0.29
Seed	2.42	1.95	4.87
<b>Potassium (%)</b>			
Peel	1.91	2.25	1.81
Pulp	2.15	3.28	5.01
Juice	0.24	0.27	0.28
<b>Phosphorus (m/100 g)</b>			
Peel	120.00	140.00	149.00
Pulp	230.00	270.00	197.00
Juice	15.90	16.70	16.00
<b>Calcium (mg/100 g)</b>			
Peel	610.00	640.00	63.80
Juice	280.00	360.00	26.00
Juice	8.50	9.40	8.60
<b>Magnesium (mg/100 ml)</b>			
Peel	49.70	83.00	64.20
Juice	81.30	74.70	58.90
Juice	6.60	8.50	7.70
<b>Seed oil (%)</b>			
	33.43	36.05	23.91

and Navelate oranges kept on increasing. The nitrogen contents of the seeds however, rose very sharply from 0.31% in February to 0.77% in March. This could be an indication to N stored in seeds during the course of ripening/maturity.

The phosphorus level in pulp was found higher than that of peel (Table 1). It is in agreement with Kharebava (1971) who reported that phosphorus contents of pulp are higher than that of peel. The phosphorus in peel mg/100 g kept on rising throughout the period of study reaching its peak value of 149 in March. The pulp and juice phosphorus was maximum in February being 270 and 17, respectively. The juice P ranged between 159 in January to 167 in February. This is in agreement with Moss and Higgins (1978) who stated that P contents of juice remained stable during the harvest period in valencia oranges. Since phosphorus is known to reduce citric acid in the juice, it can be assumed that constant level of phosphorus is

responsible to decreasing acidity during ripening process in citrus fruits.

Potassium increased in the pulp and juice, reaching its peak value of 5.01% and 0.28% respectively in March. However, maximum potassium in peel was found by February to the level of 2.25% and then it declined afterwards. The K contents were significantly higher in the pulp than in the peel; hence in agreement with the findings of Kharebava (1971) who reported that K is present in higher amounts in the pulp than in the Peel and Jones (1961) who reported that K was the dominant cation in juices of oranges. The consistent increase of K in the pulp was an indication of increased moisture contents in the pulp till harvesting.

The calcium status of the peel, pulp and juice (mg/100 g) was found the highest i.e. 640, 360 and 9.35 mg/100 ml respectively in February. The peel had higher calcium contents than the juice or pulp which is in agreement with the findings of Bitters (1961) who had reported that valencia orange peel had higher Ca percentage than pulp or the juice.

As regards Magnesium in peel and juice, the maximum values i.e. 83 and 8.5 mg/100 ml respectively were found during February which tended to decline afterwards. The pulp Mg also decreased throughout the period of study being 81 to 59 mg/100 g between February to March.

The seed oil contents during January were 33.43% which increased to 36.05% during February. However it declined to 23.91% in March. Early findings reported by Bartholomew and Sinclair (1941) and Sinclair (1961) in case of lemons and oranges indicated a range of 30 to 50% seed oil.

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