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Short communication

Effect of rootstock on proximate analysis of kinnow mandarin peel

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Abstract
Increased cost for disposal of citrus waste has increased interest in the utilization of citrus crop for value added products and byproducts. Kinnow fruit in Pakistan is an underused source for value addition particularly its peel and pulp wasted after juicing. In the present study, the effect of citrumelo 1452, citrumelo 4475, yumacitrange, volkamariana, rough lemon, mithi, troyercitrange, and brazillian sour orange rootstocks on the quality parameters of kinnow peel was investigated. Kinnow peel analyzed for physico-chemical composition showed that fruit peel if Kinnow grafted on rough lemon rootstock had the highest contents of crude fat (1.61%), crude fiber (6.75%) and crude protein (5.61%), while with respect to moisture contents, rough lemon (74.13%) showed the top position with citrumelo 4475 (73.82%) among the tested rootstocks. Peel from mithi rootstock proved the second richest source of crude fat (1.525%) and crude fiber (6.82%); while with respect to crude protein, volkamariana stood second with 5.47% crude fat. Comparative study of proximate analysis of fruit peel from eight rootstocks in the alkaline soil conditions of Punjab Province proved the mithi a promising rootstock for kinnow after rough lemon.
Key words: Kinnow, physico-chemical, roots stocks, rough lemon, volkamariana

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Introduction

Juice is the primary processed citrus product, but the fruit residue remaining from juice extraction amounts to appropriately half the wet mass of the whole fruit with the peel (flavedo and albedo). Processing industry of citrus yield a considerable amount of waste, which pose a serious environmental threat being proved to microbial spoilage and decay [1]. In mandarin juice processing industry, the primary waste material collected is fruit peels, which is difficult to dispose off as they have a high biological oxygen demand [2]. Therefore, increased disposal costs have stressed to explore new byproduct applications to turn them into useful products by minimizing their environmental impact [3].

Traditional peel products of candied peel, marmalade, beverage bases and purses have potential to use only small quantities of the total mass of peel residue. Citrus peel has a number of potential uses which should be investigated considering their functional properties like pectin, flavonoids, carotenoids, limonene and polymethoxy flavones etc. [4, 5]. Peel uses depends upon their functional properties and intruded food product application; while their functionality depends on the basic peel composition [4].

Peels are important portion of citrus fruits due to the presence of essential oil secreting glands; higher the peel more would be the oil. Main objective of the proximate analysis of kinnow fruit peels was to determine the effect of rootstock on its constituents like moisture, ash, protein, crude fiber and crude fate etc. These constitute play vital role in designing the chemical integration of citrus fruit peels. The analyzed parameters directly affect the yield of essential oils from the citrus fruit peels.

Materials and Methods

The present study was carried out in the Experimental Fruit Garden Sq No 9, Institute of Horticultural Sciences, University of Agriculture Faisalabad. The study was carried out on Kinnow mandarin (*Citrus reticulata* Blanco) grafted on eight different rootstocks i.e. Citrumelo 1452, citrumelo 4475, yumacitrange, volkamariana, rough lemon, mithi, troyercitrange and brazillian sour orange. All the selected trees were maintained undersimilar agro-climatic conditions having the age of 17 years. The representative samples were taken from each root stock to conduct the analysis, such as moisture, crude protein, crude fat, and crude fiber from peel of the kinnow mandarin according to methods described in the Association of Official Agricultural Chemist (AOAC) [6].

Determination of moisture contents

For moisture contents, 5 g of fresh peel sample was taken in a china dish and dried in hot air oven at

65 °C for 24 hours. The moisture content was calculated by the following formula:

$$Moisture\ (\%) = \frac{Moisture\ loss\ (g)}{Wt.\ of\ orginal\ Sample\ (g)} \times 100$$

Determination of crude protein contents

Crude protein was measured by Kjeldahl's method. Oven dried 2 g sample was digested and diluted to 250 ml. Distillation was done in a micro Kjeldahl's apparatus. Liberated ammonia was condensed and collected in the receiver and was titrated against 0.1 N H_2SO_4 till golden yellow end point by using methyl red as an indicator. The crude protein was calculated by multiplying nitrogen percentage by a factor 6.25 as:

$$N\ (\%) = \frac{Vol.\ of\ 0.1N\ H2SO4\ used \times Vol\ of\ dilution \times 0.0014}{Wt.\ of\ orginal\ Sample\ (g) \times Vol\ of\ diluted\ sol.\ used} \times 100$$

$$Crude\ protein\ (\%) = Nitrogen\% \times 6.25$$

Determination of crude fat content

Crude fat was measured by using Soxhlet`s apparatus. Oven dried 3g sample in a thimble was extracted with petroleum ether, dried in a Petri dish till constant weight and calculated by following formula.

$$Crude\ Fat\ (\%) = \frac{Wt\ of\ fat\ in\ Sample\ (g)}{Wt\ of\ orginal\ Sample\ (g)} \times 100$$

Determination of crude fiber contents

Oven dried 3 g fat free sample was taken in a 1000 ml beaker. Firstly, it was digested with 1.25% H_2SO_4 solution by boiling for 30 min and then washed to make it acid free. It was again boiled for 30 minutes and digested with 1.24% NaOH solution filtered and washed to make it alkali free. The residue was oven dried at 105 ^{o}C using pre- weight crucible till constant weight. Finally the dried residue was ignited to grayish white ash in muffle at 550℃, then ash cooled and weighed during incineration and presented as below,

$$Crude\ Fiber\ (\%) = \frac{Wt\ loss\ on\ ignition\ (g)}{Wt\ of\ orginal\ Sample\ (g)} \times 100$$

Statistical analysis

Statistical analyses were performed by using Minitab statistical software version 16 (Minitab Inc., State College, PA, USA) and by using two way analyses of variance (ANOVA) and LSD multiple comparison test.

Results and Discussion

Proximate analysis of citrus Peel

Fresh peel of Kinnow mandarin grafted on eight different rootstocks citrumelo 1452, citrumelo 4475, yumacitrange, volkamariana, rough lemon, mithi, troyercitrange and Brazilian sour orange were analyzed for moisture, crude fat, crude fiber and Crude protein with the object to have a view of their proximate composition.

Effect of root stock on moisture content of citrus peel

The highest moisture content was determined in kinnow mandarin peel grafted on Rough lemon (74.13 %) followed by Brazilian sour orange (74.09 %) and volkamariana (74.07 %).Methi (73.92%) and yumacitrange (73.91%) showed similar moisture contents. Similarly, citrumelo 1452(73.88%) and citrumelo 4475 (73.82%) also shows same moisture contents. Minimum moisture was observed in troyercitrange (73.47%) (Table 1). All tested rootstocks have statistically differences to each other and highly significant with respect to moisture contents in the peel of kinnow mandarin. Nagy et al.[7] who reported proximate compositions of California grape fruit peel on fresh weight basis as moisture 78%, total solids 22%, crude protein 6.2% and crude fiber 2% while on total solids weight basis as total solids 100%, protein 7.3% and crude fiber 9.1 %. A slight variation in the moisture contents might be due diversity in maturity and the difference in the fiber may be due to the effects of in rootstocks or variety, fruit condition, agro-climatic conditions and stage of harvesting. As the difference in protein is concerned, intercropping is a common practice in Pakistan, but soils are deficient in N, P, Zn, and Fe.

Effect of root stock on fat content of citrus peel

There were significant differences among various rootstocks with respect to crude fat content of kinnow peel crude fat percentage ranges from 1.61% for Rough lemon to 1.19% for citrumelo 4475 as given in Table 1.Rough lemon and mithi non-significantly each other in case of fat contents. While fat content in other varieties were as following: volkamariana (1.455%), brazillian sour orange (1.430%), yumacitrange (1.295%), citrumelo 4475 (1.195%). Results are in line with the study of Nagy et al. [7].

Effect of root stock on fiber content of citrus peel

Crude fiber contents in kinnow peel grafted on mithi and rough lemon rootstocks had maximum percentage of crude fiber of 6.82%) and 6.75%, respectively while yumacitrange had crude fiber

Table 1 Comparison of kinnow mandarin grafted on various rootstocks for proximate analysis of citrus peel.

Rootstocks	Peel moisture (%)	Crude fat (%)	Crude fiber (%)	Crude protein (%)
Citrumelo 1452	73.88 bc	1.235 e	5.580 f	4.375 f
Citrumelo 4475	73.82 a	1.195 f	5.505 f	4.410 e
Yuma Citrange	73.91 abc	1.295 e	6.605 b	5.115 c
Volkamariana	74.07 ab	1.455 c	5.850 e	5.470 b
Rough lemon	74.13 a	1.610 a	6.750 a	5.605 a
Mithi	73.92 abc	1.525 b	6.820 a	4.390 f
Troyer Citrange	73.47 d	1.520 b	6.155 d	5.095 d
Brazillian Sour Orange	74.09 ab	1.430 d	6.340 c	5.095 d

Mean followed by same letters in a column are insignificant statistically (P<0.05).

6.60%. The Brazillian sour orange (6.34%), troyercitrange (6.15%) and volkamariana (5.85%) fall between the maximum and minimum range of crude fiber (Table 1). The lowest percentage was recorded in peel of kinnow grafted on citrumelo 1452 (5.58%) and citrumelo 4475 (5.50%). Anonymous [8] reported the proximate composition of orange peels dry matter16.1 %, crude protein 6.8%, crude fiber 6.2% and ash 3.7%. Figuerola et al. [9] studied that fiber concentrates from apple pomace and citrus peel had a high content of dietary fiber (between 44.2 and 89.2 g 100 g^{-1} dry mass) with a high proportion of insoluble dietary fiber. Protein and lipid contents ranged between 3.12 and 8.42 and between 0.89 and 4.46% dry biomass, respectively.

Effect of root stock on protein content of citrus peel

There were significant differences among tested rootstocks with respect to the crude protein content of Kinnow peel (Table 1). The highest crude protein (5.60%) was observed in the peel of kinnow grafted on rough lemon than other selected rootstocks but it was statistically at par with volkamariana (5.47%), yumacitrange (5.11%), Brazilian sour orange (5.09%) and troyercitrange (5.09%). The citrumello 4475 (4.41%) and mithi (4.39%) were at par with each other. The lowest crude protein percentage was in citrumello 1452 (4.37%) rootstock. Results are in line with the study of Nagy et al. [7] who reported that protein contents in the peels of citrus fruits vary with verities, soil and other climatic conditions.

Conclusions

The studies investigated that the rootstocks have a profound effect on proximate compositions of Kinnow mandarin peel. Mithi proved to be reliable rootstocks in these studies as a substitute for Rough lemon, under highly alkaline conditions of Punjab province for different quality parameters of citrus fruit and peel compositions. However, these studies should be further carried out in the future to ascertain the impact of rootstocks on the scion and fruit quality characteristics. This study is considered to be the first step towards a planned progressive research project for citrus industry of Pakistan.

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