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Quantitative analysis of juice, citric acid, vitamin C content, sugar levels and sugar acid quantitative relation in some cultivated *Citrus* fruits

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Abstract
This study is probably going to represent the info on some organic chemistry element like the juice contents, acid content, sugar content, sugar acid quantitative relation, dry matter content and vitamin C concentration in Seed less, Jara, Kot, Bari-2, Kagji lebu, Gol lebu and China lebu cultivated within the Botanical garden of Rajshahi University campus, Bangladesh. Once plucking the fruits samples were washed with water and were unbroken at room temperature. The chosen physiochemical characteristics of the fruits were then evaluated on the identical day. The results of all the chosen parameter ascertained considerably different in numerous cultivars. Being associate acidic fruits all the cultivars contained a substantial quantity of citric acid. As citrus fruits are juicy therefore, all the experimental cultivars showed higher quantity of juice together with notable amount of sugar and vitamin C severally. It's suggested that these fruits ought to be used wide to satisfy the biological process demand of the native communities in addition as exported to get revenue.

Keywords: *Citrus* fruits, biochemical component, vitamin c, citric acid, sugar, juice

1. Introduction
Citrus genus belonging to the rue family (Rutaceae), and yielding non woody fruits coated with thick skins. Economically necessary plants during this cluster embody the lemon (*Citrus limon*), lime (*Citrus aurantiifolia*), Sweet orange (*Citrus sirensis*), Sour orange (*Citrus aurantium*), tangerine (*Citrus paradisi*), Citron (*Citrus medica*), and Shaddock (*Citrus maxima*). Citrus plants are usually evergreen trees or shrubs with shiny oval formed leaves; several species have thorns. The flowers are typically white with 5 petals and are terribly redolent. The fruits are a kind of changed berry referred to as hesperidia, and therefore the flesh is split into segments filled with ting juice-filled vesicles. The peel or rind of the fruits is leather like and decorated with oil glands. Thus it is the foremost wide created fruit, as a bunch of many species and it's grownup in quite 80 countries [1]. Citrus merchandise should be highlighted, as they're a significant supply of antioxidant compounds in soak up the diet of developed countries [2].
Annual international production of citrus fruits has witnessed robust and ascension in last many decades from just about 30 million metric tons within the late 1960s [3] to a complete estimate of over 150 million metric tons between 2000 and 2004, with oranges causative quite half of the planet wide citrus production [4]. According to 2009 originate the Food and Agriculture Organization of the United Nations (FAO), China, Brazil, the U.S.A. India, Mexico, and Spain are the Worlds' leading citrus fruit producing countries, representing near two-thirds of worldwide production [5]. In the United States, a complete of 10-9 million metric plenty of citrus production was reportable for 2009 to 2010, with Florida constituting 65% because the leading state, California 31%, followed by Texas and Arizona [6].
Citrus fruits have long been valued as a part of nutrition's and engaging diet. The flavour provided by citrus are among the foremost most popular in the planet, and it's progressively evident that citrus not solely tastes smart, however also is additionally sensible for folks. It is well established that citrus and citrus products are a fashionable supply of vitamins, minerals and dietary fibre (non-starch polysaccharides) that are essential for traditional growth and development and over all nutritionary well-being. However, it's currently commencing to be appreciated that these and alternative biologically active, non-nutrient compounds found in citrus and alternative plants (Phytochemical) may facilitate to cut back the danger of the many chronic diseases. Whereas, applicable dietary pointers and suggestions that encourage the consumption of citrus fruit and their products will cause widespread nutritionary edges across the population. Citrus fruits are accustomed medical sciences like it improve our immune system and digestion; brighten our skin; jumpstart our metabolism; fight infection.
The objective of the present study was to evaluate the contents of juice, soluble solids, citric acid, sugar levels and vitamin C and dry matter content of the seven popular cultivars.

2. Materials and Methods
2.1 Materials
2.1.1 Raw material
The Raw materials utilized in this study were Seed less, Jara, Kot, Bari-2, Kagji lebu, Gol lebu, and China lebu. Raw material collected from Botanical garden, Rajshahi University campus.

2.2 Methods
2.2.1 Methods for estimation of percentage of juice
The juice contents were weighed and recorded in grams [7-8]. The percent juice contents were calculated by exploitation the subsequent formula:

$$\% \text{ fruit juice} = \text{juice weight} \div \text{fruit weight} \times 100$$

2.2.2 Determination of Total Soluble Solids (TSS)
Total soluble solids of the fruit juice were determined (in triplicate) as °Brix by exploitation Abbe's refractometer (NAR- IT, Japan) below the protocol antecedently adopted [7].

2.2.3 Determination of acidity
Acidity of the juices was firm (in triplicate) by acid base volumetric analysis [7].
Percentage acid = titer × acid factor × 10/10 (ml juice)
Factor for citric acid is 0.0064 (citrus fruit)

2.2.4 Determination of sugars
The sugars were calculable (in triplicate) by exploitation chemical estimation methodology [9]. Strength of unknown glucose solution = 4 × W × V1/V gm. / litter
Where,
W= Weight of glucose in 250 ml standard solution
V1= Volume of standard glucose solution used for 25 ml Fehling's solution
V= Volume of unknown glucose solution used for 25 ml Fehling's solution

2.2.5 Estimation of the TSS to Acid Ratio
Total soluble solid to acidity ratio (TSS: acidity) was calculated by dividing the total soluble solids by percent acid [7-8]. TSS: Acid = °Brix value / Percentage acid.

2.2.6 Methods for determination of Dry matter content
The following procedure we used to determine the dry matter content [10].

$$\text{Dry matter content} = \frac{\text{Fresh weight Dry weight}}{\text{Fresh weight}} \times 100$$

2.2.7 Methods for estimation of Vitamin C
Vitamin C estimation was determined following the Folinciocalteu reagent method [11] with slight modifications. Extracts (0.5 ml) were added to 0.8 ml of 10% trichloroacetic acid and vigorously shaken and the mixtures were kept on ice for 5 min and then centrifuged at 3000 rpm for 5 min. This extract (0.2 ml) was then diluted to 2 ml with distilled water. Commercially prepared 2.0 M Folin-Ciocalteu was diluted 10 fold with distilled water and 0.2 ml of this diluted reagent was added to the mixture and vigorously shaken. After 10 min at room temperature, the absorbance was measured at 760 nm against distilled water as a blank and the vitamin C content was estimated through the calibration curve of ascorbic acid.

2.3 Technique of analysis of data
All experiments were performed having at least three replications for each sample. Collected information was analyses exploitation Microsoft excel and IBM SPSS-2001 software package. The significance level was at ($P \leq 0.05$).

3. Results and discussion
In the present study seven citrus cultivars were evaluated for 6 quantitative characters viz., percentage juice content, percentage sugar content or Brix, citric acid content, sugar acid ratio, dry matter content and vitamin c content. Collected information was analyzed so as to calculate mean performances, standard deviation and information were present with the lettering consistent with DMRT. The results derived from these analyses are delineated beneath the subsequent heads.

3.1 Percentage juice
The ascertained results indicates that percentage juice were totally different among the genotypes. Mean ranged from 24.59 to 50.65 %. The highest percentage of juice was recorded in Seed less (50.65) followed by China lebu (40.80), Kagji lebu (35.47), Jara (34.52), Kot (30.58), Bari-2 (30.57). The lowest percentage was found in Gol lebu (24.59) (Table 1).

Table 1: Six different quantitative characters of seven citrus cultivars

Sample	Juice %	Sugar %	Citric acid content	Sugar: Acid	Dry matter content	Vit - C content
Seed less	50.65±0.51 a	8.07±0.08 b	1.50±0.13 a	6.11±0.17 g	26.16±0.15 a	3.36±0.06 b
Jara	34.52±0.33 d	6.65±0.12 f	0.84±0.03 c	7.69±0.28 e	8.29±0.08 e	2.53±0.02 e
Kot	30.58±0.22 e	8.38±0.13 a	1.33±0.06 b	6.63±0.35 f	7.10±0.23 f	2.69±0.04 d
Bari-2	30.57±0.47 e	7.04±0.13 c	0.38±0.03 d	21.59±0.32 c	9.34±0.12 c	4.74±0.03 a
Kagji lebu	35.47±0.26 c	6.93±0.04 d	0.18±0.01 g	36.83±0.35 a	9.53±0.33 b	3.11±0.11 c
Gol lebu	24.59±0.33 f	2.75±0.05 g	0.34±0.02 e	9.03±0.38 d	8.61±0.11 d	1.36±0.04 g
China lebu	40.80±0.22 b	6.77±0.10 e	0.26±0.01 f	23.69±0.37 b	6.63±0.10 g	2.50±0.03 f

Values are mean of three replicates ± standard deviation, means followed by the same letters, within cultivars, do not differ significantly by DMRT test at 5% probability.

So it was evaluated that Seed less genotypes contain higher amount of juice content because of its larger size and lower was in Gol lebu for its little size. It was also observed that Kot and Bari-2 was statistically similar in case of percentage of juice content. The chemical level used will influence citrus quality. In line with Chitarra and Chitarra [12], some minerals like metallic element, magnesium, and Zn applied within the soil to extend fruit size and weight. Fruit juice yield are often reduced by applying high concentrations of N and metallic element within the soil, therefore increasing peel thickness. The relative humidity and temperature of the atmosphere may influence peel thickness in citrus [12].

Seed less > China lebu > Kagji lebu > Jara > Kot ≥ Bari-2 > Gol lebu (Fig. 1).

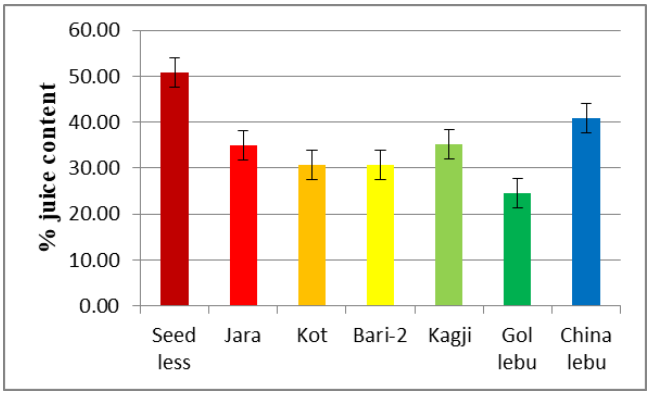

Fig 1: Percentage juice content of seven different citrus cultivards

3.2 Soluble solid content or brix or % sugar content

Percentage sugar content was varied among the cultivars ranged from 2.75 to 8.38. The highest value was observed in Kot (8.30) and followed by Seed less (8.07), Bari-2 (7.04), Kagji lebu (6.93), China lebu (6.77) and Jara (6.65). The lowest value was in Gol lebu (2.75) (Table 1). These results trust those determined by Marin *et al*. [13] obtained for the varieties Fino and Verna. Many different factors may have contributed to the low soluble sugar content within the pound samples. One in all them is mineral fertilization, whereas metallic element is that the crucial mineral element inflicting starch accumulation in Citrus leaves [14].

On the opposite hand, for citrus fruits, delay within the development of dry matter accumulation in the developing fruit augmented markedly prodigious the chemical action capability of leaf inflorescence [15]. The macromolecule reserves antecedently accumulated within the leaves may be mobilized and disaccharide levels will decrease showing a limitation in carbohydrate provide.

Kot > Seed less> Bari-2 > Kagji lebu > China lebu >Jara > Gol lebu (Fig. 2)

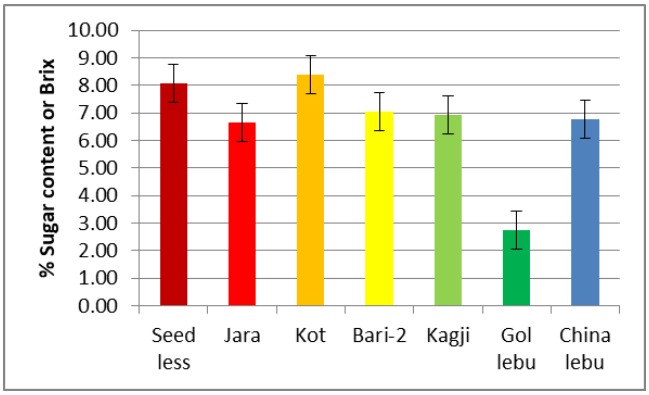

Fig 2: Percent sugar content/Brix of seven different cultivars

3.3. Citric acid content

Citric acid content was varied among the cultivars which ranged from 0.18 to 1.50. The highest citric acid was observed in Seed less (1.51) and it was followed by Kot (1.33), Jara (0.84), Bari-2 (0.38), Gol lebu (0.34), China lebu (0.26). The lowest was in Kagji lebu (0.18) (Table 1).

Seed less> Kot > Jara > Bari-2 > Gol lebu > China lebu > Kagji lebu (Fig. 3).

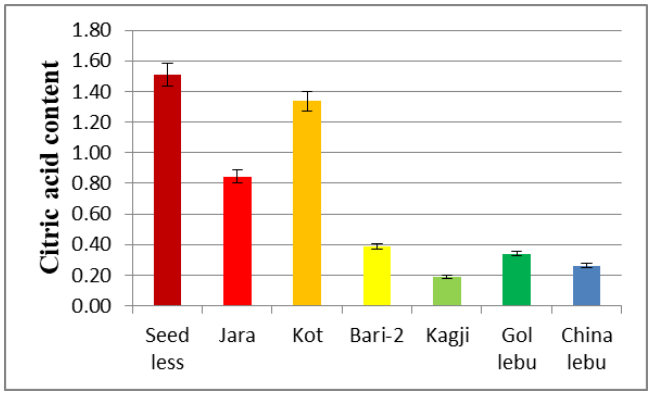

Fig 3: Citric acid content of seven different cultivars of citrus

3.4 Sugar acid ratio

Sugar acid ratio differs among the cultivars which ranged from 36.83 to 6.11. The highest ratio was measured in Kagji lebu (36.83) and it was followed by China lebu (23.69), Bari-2 (21.59), Gol lebu (9.04), Jara (7.69), Kot (6.63). The lowest was observed in Seed less (6.11) (Table 1).

Kagji lebu > China lebu > Bari-2 > Gol lebu > Jara > Kot > Seed less (Fig. 4).

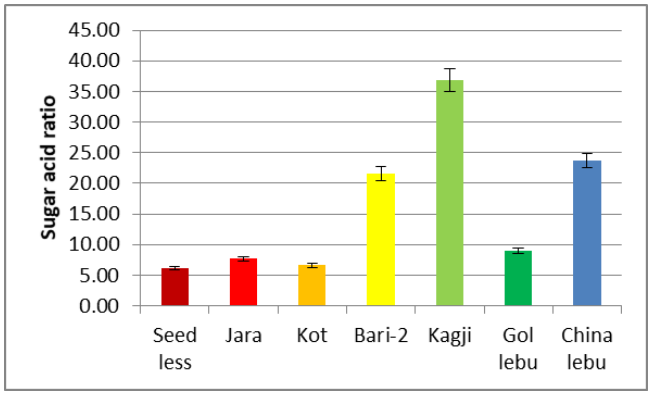

Fig 4: Sugar acid ratio of seven different citrus cultivars

3.5 Dry matter content

Significant differences exist among the genotypes for dry matter content and the mean ranged from a 6.64 - 26.16 (Table 1). The height was observed in seed less (26.16) and it was followed by Kagji lebu (9.53), Bari-2 (9.34), Gol lebu (8.61), Jara (8.29), Kot (7.10). The lowest was observed in China lebu (6.63) (table 1).

Seed less > Kagji lebu > Bari-2 > Gol lebu > Jara > Kot > China lebu (Fig. 5).

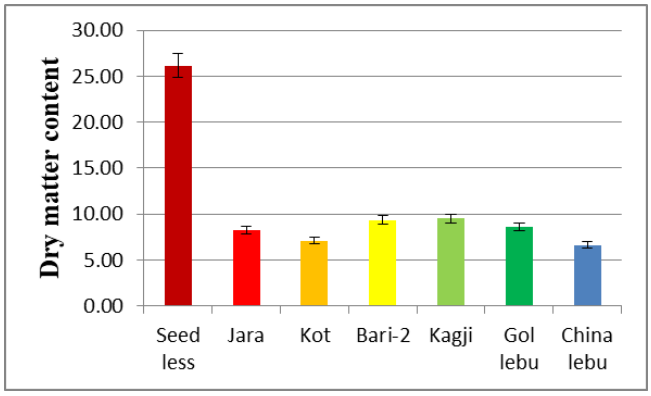

Fig 5: Dry matter content of seven different cultivars of citrus

3.6 Vitamin C content

Significant difference existed among the cultivars for vitamin C content and the mean ranged from a maximum of 4.75 mg^{-1} in Bari-2 and minimum of 1.37 mg^{-1} in Gol lebu (Table 1). The height concentration was followed by seed less (3.36), Kagji lebu (3.11), Kot (2.69), Jara (2.53),China lebu (2.50) (table 1). These results are in accordance with the Brazilian identity and quality commonplace [16] that determines a minimum of 20.0 mg.100 g^{-1} for water-soluble vitamin in acid juice.

Bari-2 > Seed less > Kagji lebu > Kot > Jara > China lebu > Gol lebu (Fig. 6)

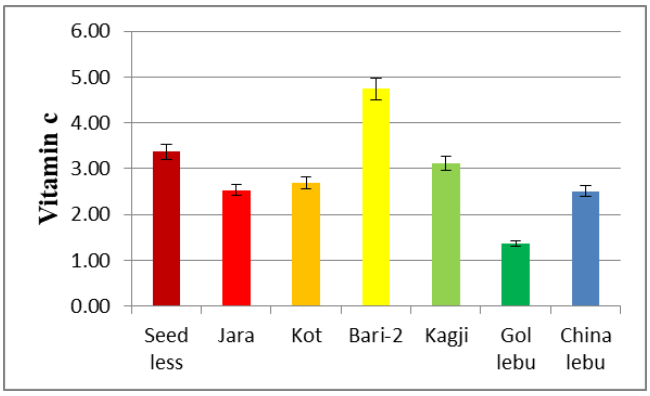

Fig 6: Vitamin C content of seven different culvars of citrus

Titration results showed that Seed less contain highest amount of citric acid content which was 1.51 g/ml which is in the range of standard value of citric acid content (3.82 g/ml) also evaluated by Penniston *et al*. [17]. While Kagji lebu contain small amount of citric acid, content equals to 0.19 g/ml. The tretrable acidity varies from the values in previous works where the value ranges from 3.33-5.55 g/ml [18]. Kot lebu and China lebu contains 1.34 g/ml and 0.26 g/ml of citric acid concentration respectively and these results are in line with Penniston [17]. Regarding citric acid content in the samples, it was concluded that citrus fruits are useful for the protection of kidney stones and it maintains the pH of urine.

4. Conclusion

There have been clear significant differences observed in the studied seven cultivars according to all the parameter. On the opposite hand, the organic biodynamic fruit bestowed lower citric acid, total soluble solids contents; furthermore as higher juice%, sugar%, sugar acid ratio was accompanied with vitamin C concentration of the citrus fruits samples. Among the studied cultivars Seed less, Bari-2 and China lebu is better than to other cultivars according to juice content, sugar acid ratio and vitamin C concentration.

Nevertheless, fruit crush from biodynamic crops may will be a decent selection since it's free from pesticides and alternative agents that cause issues to human health maintaining the degree kind of like those of vital nutritionary compounds.

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