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NUTRITIONAL AND PHYSIO CHEMICAL ANALYSIS OF COMMERICAL APPLE JUICES AND NATURAL APPLE JUICES AVAILABLE IN PAKISTAN

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Abstract
Apple juice, procured from a fresh natural or commercial source, is adored for its consumption across the globe since, it is sweet, nutrient rich and has incredible health benefits. Current study investigates and contrasts the components of some naturally manufactured and commercially available apple juices in Pakistan. Comparatively high levels of Manganese (0.55 ppm and 0.38 ppm), Chromium (1.62 ppm and 0.51 ppm), Iron (1.65 ppm and 1.08 ppm), Zinc (0.56 ppm and 0.52 ppm), Copper (0.66 ppm and 0.26 ppm), Vitamin C (1.88 mg/100 mL and 0.76 mg/100 mL) while relatively low contents of Nickel (0.02 ppm and 0.04 ppm) and Calcium (2.26 ppm and 2.98 ppm) were found in fresh natural and commercial apple juices, respectively. Furthermore, the pH of fresh one was 3.56, whereas, of commercial one was 3.01. Analysis of carbohydrates (NFE) (8.02% and 2.74%), total soluble solids (TSS) (8.38 °Brix and 8.22 °Brix), moisture (97.02% and 91.65%), ash (0.05% and 0.02%), crude fat (0.07% and 0.06%), crude protein (0.08% and 0.06%) along with crude fibre contents (0.08% and 0%) in fresh as well as commercial apple juice gave substantially variable results. Based on this comprehensive investigation, fresh apple juice is preferred over the commercial one.

Keywords: Apple juice, Minerals Content, Physico-chemical analysis, Crude Fat, Protein, Crude Fibre

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Conflict of interest
There are no conflicts of interest in this publication, and the manuscript has been approved by all named authors.

1. Introduction
Normally, apples are consumed in Pakistan in their purest form, however, during peak apple harvest, markets become saturated with apples. If not adequately preserved, the perishable nature of apples could cause significant losses. Although apples can be kept for a considerable period, doing so is not advised due to the significant costs associated with keeping of fresh apples (Dashti *et al.*, 2014; Noonari, 2015; Sheng *et al.*, 2017).

Making apple products like apple juice is a premium way to conserve excess apples considering the significance of apples and the tendency of squandering both during and after the growing season. Apple juice will not only ensure preservation of surplus apples but it could also induce huge prices for those apples that are usually considered low-grade and consumers are paying minimal prices for it (Zhong *et al.*, 2018; Dasenaki and Thomaidis, 2019).

Variety of sugars including oligosaccharides and polysaccharides along with polyphenols, amides, Vitamin C, soluble pectin, minerals and a range of esters (e.g. ethyl-methyl-butyrate and iso-butyl acetate) are present in apple juice which deliver it a distinctive apple like aroma (Filip *et al.*, 2016). Eating apples is associated with foods that can regulate weight, in addition to cardiovascular and lung conditions, it may also lower the risk of several types of cancer, including liver, colon, and prostate (Hyson, 2011; Neil *et al.*, 2015). Research demonstrates that phenolic acids and flavonoids are linked to a decline in cancer because they have higher antioxidant properties, apples are linked to the fruit's anticancer effects (Zahoor *et al.*, 2018; Han *et al.*, 2019; Khayam *et al.*, 2019). Apples are an excellent source of iron, other minerals and vitamins, which aid in regulating blood circulation, boosts the body's red blood cell count and strengthen the mind and body (Slavin and Loyd, 2012). Minerals, the nutrients that exist in the body, are as essential as our need for oxygen to sustain life (Na *et al.*, 2016). Around 5% of the human body weight is mineral matter, vital to all mental and physical processes as well as for overall well-being. Minerals are crucial for preventing blood and tissue fluids from becoming overly acidic or alkaline, allowing nutrients to enter the bloodstream and aiding in their transportation to cells. They also draw chemicals in and out of the cells. A small shift in the blood levels of vital minerals might seriously jeopardize life (Circuncisão *et al.*, 2018; Garrett *et al.*, 2017). Apple juice is available in packed form under different brand names in our country. The current study compares the nutritional makeup of fresh apple juice with that of commercially pack one, to asses whether or not these packed juices are nutritionally sound. With this project, the researcher focused on food composition, a crucial area of biochemistry.

2. Materials and methods
Brands including Pure Heaven, Lacnor, Mezan, Slice, Nestle, Country, Nurpur, Frozty, Maza, Elixir were selected for the commercial packed juices. Carrot apple Quetta, Barottein Swat, Golden apple Quetta, Swat apple, Kabul apple, Amri, Bluish golden, Bonza, Discovery, Elastar, varieties of apples were selected to obtain fresh (natural) apple juices. Sargent Weleh pH meter was used for measuring pH of the samples according to manual instructions of the apparatus. Total acidity was determined by the standard method of AOAC (2017).

Standardization of NaOH Solution

Oxalic acid (6.3g) was weighed, dissolved in distilled water and the volume was made to 1L with distilled water. NaOH (405g) pellets were taken and dissolved in distilled water and the volume was made to 1 liter. The burette was then filled with roughly prepared 0.1 N NaOH solution and of 0.1 N Oxalic acid (10 mL) solution was taken in a beaker. One or two drops of phenolphthalein as an indicator was added to the beaker.

Titration of sample

Apple slurry (10 mL) was taken in a small beaker. One or two drops of phenolphthalein was added as an indicator and then titration was carried out against 0.1N NaOH solution till light pink color appeared. Three consecutive readings were taken and acidity was calculated by using the following formula:

$$\text{Acidity } \% = \frac{T \times 0.0067 \times 100}{L \times M} \times 100$$

T= ml of NaOH used
L = sample taken in gm for dilution
M = ml of diluted sample taken for titration

2.1. Determination of total soluble solids (TSS):

TSS was measured by using Refractometer. Refractometer prism was cleaned and dry, small amount of fresh juice was kept onto the prism of the refractometer. It was observed by eyepiece while adjusting the prism in the exact direction of light. The exact value was focused and taken where the base of the blue colour sits on the scale and the sugar (Brix^{o}) was recorded. A standard method of Association of Official Analytical Chemists (AOAC, 2017) was used to investigate the extracted samples for ash , moisture, crude protein, crude fat, crude fibre, NFE. The amount of Vitamin C was measured by reducing the dye to a colorless form, which was blue in alkaline solution and red in acidic solution. For the determination of elements such as calcium (Ca^{+2}), manganese (Mn^{+2}) and zinc (Zn^{+2}), the method of Garcia-Muñoz *et al.* (2020), modified for macro-levels was used by using double beam Atomic Absorption Spectrophotometer. Potassium (K) and sodium (Na) were detected by flame photometer. Phosphorus was investigated by UV–VIS Spectrophotometer following the Lança de Morais *et al.* (2018) method with slight modification.

2.2. Sample digestion and preparation:

A clear solution was prepared by destroying the organic matter prior to quantitation of analyte by atomic absorption spectrometry. Wet digestion method was used. About 5 mL of homogenized samples of fresh apple juice was taken and waste treated with 1 mL of HNO_3 and a grams of V_2O_5 in a multi place mineralized block. Digestion was carried out for 90 min at 120°C, the prepared sample was diluted to a 10 mL volume with double-distilled deionized water (Fathabad *et al.*, 2018).

2.3. Determination of calcium

The amount of calcium was checked by taking 10 mL of digestion solution which was then pipetted into 100 mL volumetric flasks. About 1 mL of 10% lanthanum oxide (La_2O_3) per 100 mL was poured to each flask before making up the volume. This was done to decrease the chemical interference. Each solution was mixed by inversion. These solutions were then used for the determination of defined minerals by using atomic absorption Spectrophotometer (AAS) and double beam AAS, which uses an air acetylene flame with laminar flow burner along with Hollow cathode lamps.

3. Results and Discussion

Fresh juice is packed with nutrients. The juice which is mainly in the liquids form, result in a concentrated blend of flavour and colour, as well as phytochemicals and minerals that are well absorbed in juice than in food that is raw but not juiced (Thanushree *et al.*, 2019). To know the nutritional status of fruit juices in any location is essential because it puts a huge impact on the survival of the place and helps the corresponding authorities to implement their policy on the base of result (Al-Manhel *et al.*, 2018).

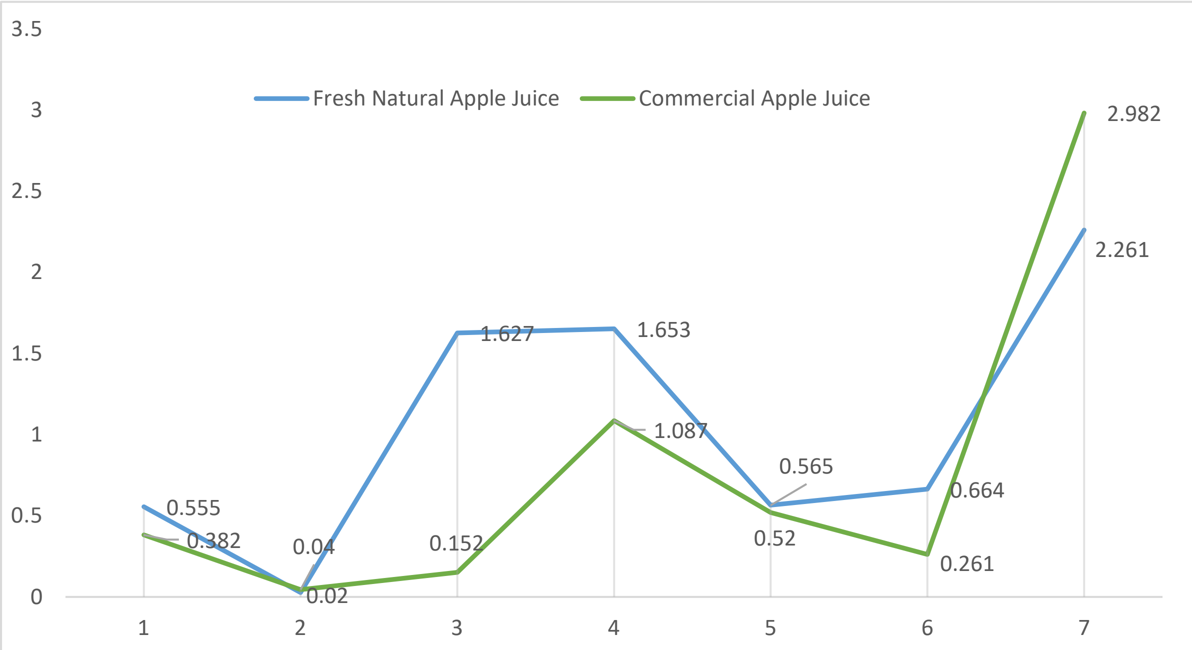
3.1. Mineral contents of Fresh Natural Apple Juice and Commercial Apple Juice

The high content of Zn^{+2} Cr^{+2}, Fe^{+2}, Mn^{+2} and Cu^{+2} content was found in fresh natural apple juices as compared to commercial packed apple Juices, while Ni^{+4} and Ca^{+2} content was high in commercial packed apple juices. The results were in line with the work of (Farid and Enani, 2010) where they observed high levels of Zinc, Copper, Iron, Chromium Manganese, Cobalt and Nickel in natural apple and mango fruit juices sample. All fresh juices had a higher content of trace elements and poly-phenol content than commercial once. Different factors such as processing techniques, clarification and pasteurization can affect these contents of commercial juices. Treml and Šmejkal (2016), had shown that trace minerals contents could be affected by different processing techniques. The highest level of manganese content was found in pure heaven juice sample with a value of 0.66 ppm. In contrast, the lowest value of manganese content was observed in Mezan, Nurpur and Frozty with the value of 0.2 ppm for each which represent a commercial one Fig1. In contrast, the highest level of manganese content was found in Amri apple sample with a value of 1.3 ppm. In comparison, the lowest value of Manganese content was observed in swat apple with a value of 0.27 ppm that represent a natural fresh apple juice Fig.1.

Comparatively high levels of Manganese content (0.55 ppm) were observed in fresh natural apple juices as compare to commercial packed apple juices (0.38 ppm) Fig1. High level of Nickel content was found in Nurpur, Maza, and Elixir sample with the value of 0.08 ppm for each while the lowest value of nickel content was observed in Lacnor, Mezan and Nestle with the value of 0.02 ppm for each. The highest level of nickel content was found in Carrot apple juice sample with the value of 0.09 ppm while the lowest value of nickel content was observed in Swat apple, Golden apple Kabul apple, Barotten with the value of 0.01 ppm for each.

As a whole, high levels of nickel content (0.045 ppm) were observed in commercial packed apple juices as compare to fresh natural apple juices (0.027 ppm). The level of chromium content found in Elixir sample (1.39 ppm) was higher as compared to Nestle, Country and Nurpur which had 0 ppm of it individually. The highest level of chromium content was found in Discovery, Elastar juice sample with the value of 3.16 ppm while the lowest value of chromium content was observed in swat apple with the value of 0.08 ppm. Based on this, high levels of chromium content (1.62 ppm) were observed in fresh natural apple juices as compare to commercial packed apple juices (0.51 ppm).

The level of iron content was found high in Maza sample with the value of 2 ppm while it was measure in low amount in Nurpur with the value of 0.43 ppm. The highest level of iron content was found in Bluish Golden sample with the value of 3.44 ppm while the lowest value of iron content was observed in Swat apple and Golden Apple with the value of 0.49 ppm for each. Relatively, high levels of iron content (1.65 ppm) were observed in fresh natural apple juices as compare to commercial packed apple juices (1.08 ppm). Comparatively high levels of zinc content (0.56 ppm) were observed in fresh natural apple juices as compare to commercial packed apple juices (0.52 ppm). Comparatively high levels of copper content (0.66 ppm) were observed in fresh natural apple juices as compare to commercial packed apple juices (0.26 ppm). Comparatively high levels of calcium content (2.98 ppm) were observed in commercial packed apple juices as compare to fresh natural apple juices (2.26 ppm).



1: Manganese, 2: Nickel, 3: Chromium, 4: Iron, 5: Zinc, 6: Copper, 7: Calcium

Fig. 1. Mineral contents of natural and different brands of commercially packed apple juices

3.2. pH and Titratable Acidity of Fresh Natural and Commercial Apple Juice

Highest pH was found in the Mezan sample with the value of 3.42 while the lowest value of pH was observed in Nurpur with the value of 2.58. Table.1 shows pH of different commercially packed and naturally available apple juice varieties. The highest level of pH was found in Discovery sample with the value of 4.4 while the lowest value of pH was observed in Carrot apple with the value of 2.59. Comparatively high levels of pH (3.56) were observed in fresh natural apple juices as compare to commercial packed apple juices (3.01). The highest level of acidity content was found in Amri sample with the value of 0.34% while the lowest value of acidity content was observed in Barotten with the value of 0.13%. The highest level of acidity content was found in pure heaven sample with the value of 0.5% while the lowest value of acidity content was observed in Country with the value of 0.10%.Comparatively high levels of acidity content (0.22%) were observed in commercial packed apple juices as compare to fresh natural apple juices (0.18%) as shown in table.2.

Table.1 pH of different commercially packed and naturally available apple juice varieties.

Juice variety	pH	Juice variety	pH	Juice variety	pH
Pure Heaven	4.7	Carrot Apple	2.59	Amri	4.08
Lacnor	3.2	Swat Apple	2.64	Bluish Golden	4.13
Mezan	2.8	Golden Apple	3.9	Discovery	4.4
Slice	1.9	Quetta Apple	2.97	Fortzy	2.8
Nestle	1.7	Kabul Apple	3.14	Maza	2
Country	4.7	Barotten Swat	3.92	Elixir	1.9

Table.2 Acidity (%) of different commercially packed and naturally available apple juice varieties.

Juice variety	Acidity %	Juice variety	Acidity %	Juice variety	Acidity %
Pure Heaven	0.50	Carrot Apple	0.142	Amri	0.341
Lacnor	0.37	Swat Apple	0.189	Bluish Golden	0.203
Mezan	0.18	Golden Apple	0.147	Discovery	0.172
Slice	0.23	Elastar	0.203	Fortzy	0.16
Nestle	0.25	Kabul Apple	0.244	Maza	0.14
Country	0.10	Barotten Swat	0.133	Elixir	0.18

3.3. Vitamin C content of Fresh Natural Apple Juice and Commercial Apple Juice

vitamin C content (1.883 mg/100 mL) were observed high in fresh natural apple juices as compare to commercial packed apple juices (0.762 mg/100 mL). The highest level of ascorbic acid content was found in Lacnor and Mezan sample with the value of 1.11 mg/100 mL for each while the lowest value of vitamin C was observed in Slice, Nestle, Nurpur and Frozty with the value of 0.51 mg/100mL individually. Comparatively high levels of vitamin C content (1.88 mg/100 mL) were observed in fresh natural apple juices as compare to commercial packed apple juices (0.76 mg/100 mL) Fig. 2.

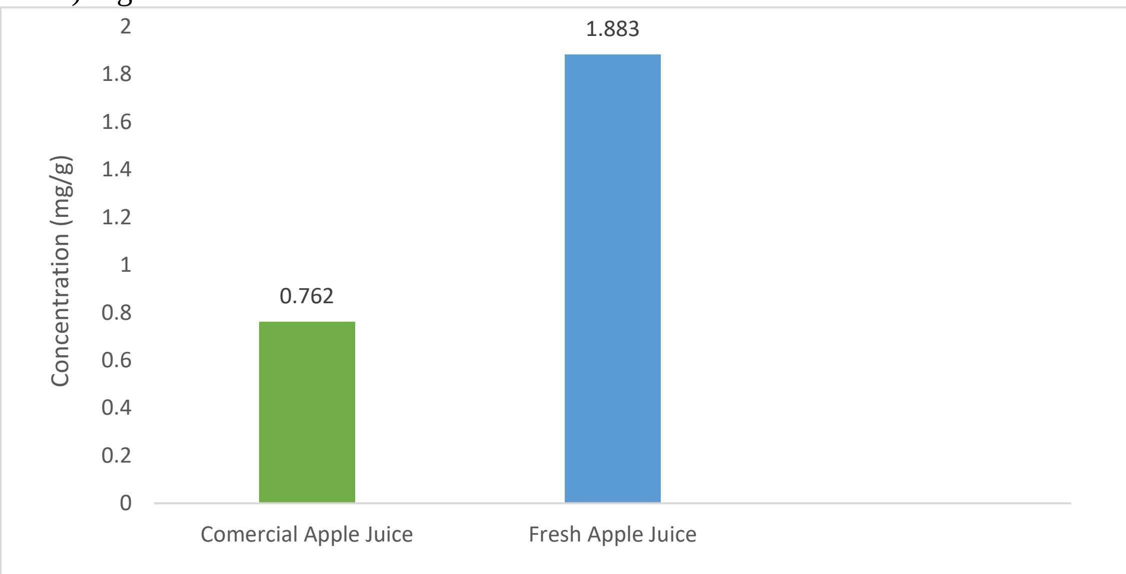


Fig. 2. Comparison of mean values of vitamin C content in commercial packed and fresh natural apple juice

3.4. Total soluble solids (TSS) º Brix, Carbohydrate (NFE) %, Crude Fat and Protein % of Fresh Natural and Commercially packed Apple J uice

The carbohydrate content (NFE) was high in pure heaven sample with a value of 4.7% while it was lowest in Nestle and Nurpur with the value of 1.7% for each. Similarly, NFE in Bonza sample with the value of 16.5%, which was high as compare carbohydrate content observed in Barotten apple with the value of 1.4%. Comparatively high levels ofNFE (8.02%) were observed in fresh natural apple juices as compare to commercially packed ones (2.74%). The highest level of TSS content was found in Elixir sample with a value of 13 ^{o}Brix while the lowest value of TSS content was observed in Frozty with the value of 2.5 ^{o}Brix. The highest level of TSS content was found in Amri sample with the value of 14.7 ^{o}Brix while the lowest value of TSS content was observed in Barotten apple with the value of 1.5 ^{o}Brix. Comparatively high levels of TSS content (8.38 ^{o}Brix) were observed in fresh natural apple juices as compare to commercial packed apple juices (8.22 ^{o}Brix) The highest level of crude fat content was found in Pure heaven sample with a value of 0.13% while the lowest value of fat content was observed in Elixir with the value of 0.02%. The highest level of fat content was found in Bonza sample with the value of 0.15% while the lowest value of fat content was observed in Baroteen Apple with the value of 0.02%. Comparatively high levels of fat content (0.07%) were observed in fresh natural apple juices as compare to commercial packed apple juices (0.06%). The highest level of protein content was found in pure heaven and Lacnor sample with the value of 0.1% for each while the lowest value of protein content was observed in Nurpur with the value of 0.01%. The highest level of protein content was found in Bonza sample with the value of 0.17% while the lowest value of protein content was observed in Barotten apple with the value of 0.02%. Comparatively high levels of protein content (0.08%) were observed in fresh natural apple juices as compare to commercial packed apple juices (0.0629%). Comparison of mean values of NFE, TSS, crude fat and Protein contents of fresh natural and commercially packed apple juice is shown in fig.3 respectively.

3.4. Fibre, Moisture and Ash Content of Fresh Natural Apple Juice and Commercial Apple Juice

No fibre content was found in the sample as commercial packed apple juices. The highest level of fibre content was found in Carrot apple sample with the value of 0.4% while the lowest value of fibre content was observed in Bulish Golden and Kabul apple with the value of 0.01% for each. Comparatively high levels of fibre content (0.0853%) were observed in fresh natural apple juices as compare to commercial packed apple juices with no fibre content. The highest level of moisture content was found in Nestle and Nurpur sample with the value of 98.2% for each while the lowest value of moisture content was observed in pure heaven with the value of 95%. The highest level of moisture content was found in Barotten apple sample with the value of 98.5% while the lowest value of moisture content was observed in Bonza with the value 83%. Comparatively high levels of moisture content (97.02%) were observed in commercial packed apple juices as compare to fresh natural apple juices (91.65%). The highest level of ash content was found in pure heaven sample with a value of 0.06% while the lowest value of ash content was observed in Slice with the value of 0.01%. The highest level of ash content was found in Bonza sample with the value of 0.12% while the lowest value of ash content was observed in Barotten Apple with the value of 0.018%. Comparatively high levels of ash content (0.0573%) were observed in fresh natural apple juices as compare to commercial packed apple juices (0.029%).

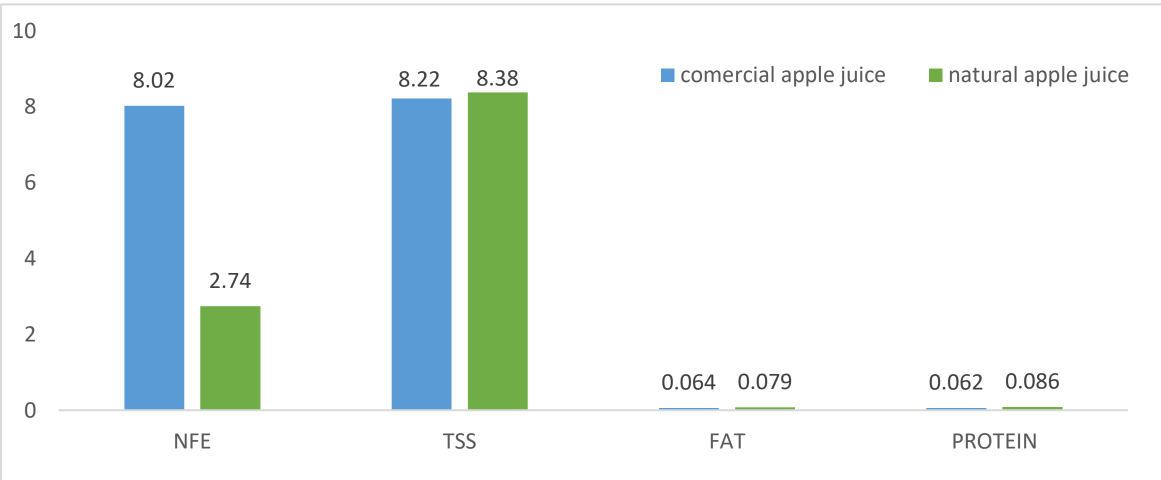


Fig. 3. Comparison of mean values of NFE, TSS, crude fat and Protein contents of fresh natural and commercially packed apple juice

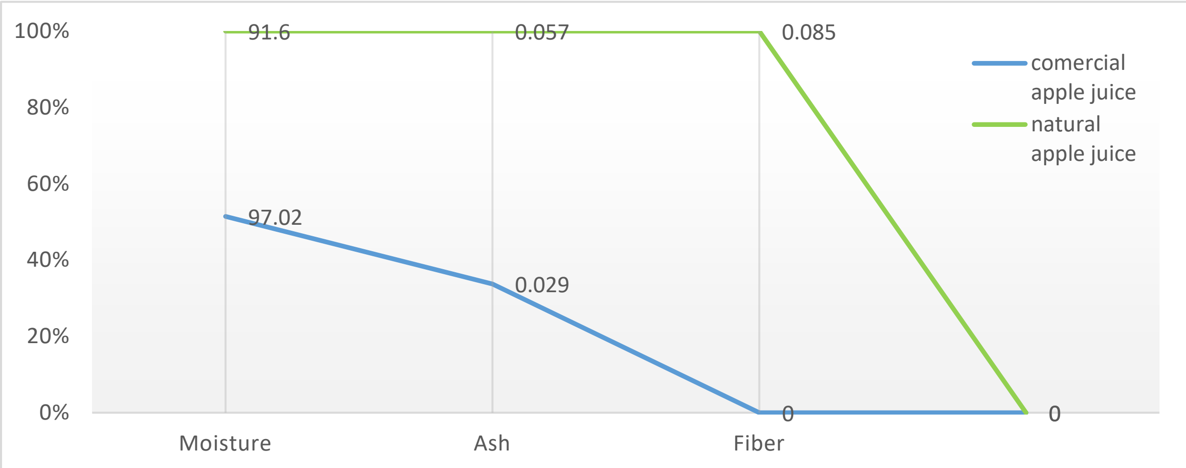


Fig. 4. Comparison of mean values of crude fibre, moisture and ash Content of Fresh and Commercial Apple Juice

Detailed proximate analysis including moisture, ash, crude protein and crude fiber contents of some of the commercially packed and naturally available apple juices taken as sample for the research are given in table 3 and 4 which gives the range of results obtained from analysis of apple juice collected from different brands available in Pakistan as well as naturally available apple juices sold in Pakistani Markets by street vendors.

Table.3 comparison of Ash, Moisture, Protein, Fat and Fiber contents of commercially packed apple juice varieties

Juice variety	Ash (%)	Moisture (%)	Protein (%)	Fat (%)	TSS (ºBrix)
Pure Heaven	0.06	95	0.1	0.12	11
Lacnor	0.059	96	0.1	0.13	10
Mezan	0.02	97	0.09	0.05	2.8
Slice	0.01	98	0.04	0.03	12.3
Nestle	0.02	98.2	0.02	0.03	10.2
Country	0.05	95	0.09	0.11	5.9
Nurpur	0.019	98.2	0.019	0.029	4.1
Fortzy	0.019	97	0.07	0.049	2.5
Maza	0.013	97.8	0.07	0.07	10.4
Elixir	0.02	98	0.03	0.027	13

Table.4 comparison of Ash, Moisture, Protein, Fat and Fiber contents of commercially packed apple juice varieties

Juice variety	Ash (%)	Moisture (%)	Protein (%)	Fat (%)	TSS (ºBrix)
Carrot Apple	0.019	97	0.08	0.05	2.7
Swat Apple	0.02	97	0.09	0.07	2.9
Golden Apple	0.019	98	0.029	0.026	1.6
Quetta Apple	0.02	98	0.028	0.027	10.7
Kabul Apple	0.018	98.5	0.021	0.024	1.5
Barotten Swat	0.1	84	0.15	0.14	14.7
Amri	0.09	86	0.13	0.12	13.4
Bluish Golden	0.12	83	0.17	0.15	14.6
Discovery	0.087	87	0.1	0.1	11.6
Elastar	0.08	88	0.07	0.09	10.1

Conclusion

It was inferred from the outcomes of the present study that the minerals and organic contents of fresh natural apple juices are higher than those of commercial ones. The contents are present in fresh natural apple juices as a good source of biologically active compounds such as fibers and total polyphenols compound due to which natural juices are considered to be very effective in enhancing health status and could be considered as an excellent replacement to carbonated and preserved soft drinks. Our study investigated all the parameters that are necessary for the nutritional value of any substance. It seems that until the active components of fruits and their products are clearly established measuring their total minerals and organic contents may be useful in planning diets for health promotions.

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