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Physico-chemical, nutritional and functional characterization of *Pathernakh* pear (*Pyrus pyrifolia* L.) from Himachal Pradesh of India

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Abstract
The present study was conducted to evaluate the physico-chemical, nutritional and functional properties of *pathernakh* pear grown in Himachal Pradesh. The physical properties (weight, length, width and colour), chemical and nutritional properties of the *pathernakh* pear including moisture, ash, total sugar, reducing sugar and minerals of *pathernakh* pear were studied. Moreover, the pear variety was characterized for functional components with respect to total phenols, ascorbic acid and fiber analysis. The results indicated that the fruit is a good supplier of sugars, minerals, ascorbic acid and polyphenols. The edible portion of the fruit possess a high level of fiber content. Additionally, textural properties in terms of firmness of the fruit were also studied. The overall results concluded that *pathernakh* pear could be best for consumption owing to superior nutritional and functional properties that has many health benefits.

Keywords: *Pathernakh* pear**,** functional properties, minerals, firmness

Introduction
Fruits are the dense sources of essential nutrients and considered as functional foods. They are the major sources of phytochemicals such as vitamins, carbohydrates, minerals and dietary fiber. Pear fruit is grown in temperate and subtropical environment due to its broad adaptability to environmental conditions. In India, it is grown in semi-temperate regions of states of Himachal Pradesh, Punjab, Haryana, Utter Pradesh and North East region. *Pathernakh* is a variety of pear that is known so, because of its hard texture. The fruits of *Pathernakh* are mostly like by consumers owing to its crispness, sweetness, fragrance and unique flavour. It has grit cells that improve its eating quality. The fruits of *Pyrus* genus have high nutritional and functional value as common pear provides 11.90g of carbohydrates and 52 kcal of energy per 100 g of edible portion. It also possesses health-promoting bioactive compounds such as carotenoids and plant sterols (Andreotti *et al*., 2006) [2]. Moreover, pears are fat-free and a good source of potassium, all plays an important role in disease prevention (Mariana *et al*. 2010) [8]. Total sugars, total soluble solids and titratable acidity are the certain chemicals that have great influence on organoleptic properties of the fruit (Teng and Liu, 2009) [13]. Besides the above chemical properties, various functional compounds are also identified in pears (Chaalal *et al*., 2013) [6]. Pear fruit also contains a high amount of moisture thereby highly perishable and spoil rapidly that result in unexpected economic losses.
Henceforth, keeping all these points, the present study was conducted to evaluate the nutritional and functional components of *Pathernakh*, whether, they are similar to common pear or not. So, that it provides a better understanding for researchers to produce or to think of new products and convenient processing characteristics of the pathernakh fruit in order to preserve it for longer period or maintain it's fresh like characters even after harvesting.

Materials and Methods
The fruits of *pathernakh* pear (*Pyrus pyrifolia*) harvested at optimum maturity were procured from the local market of Solan Himachal Pradesh. Fruits were collected randomly and brought to the laboratory for carrying out the present study.

Physical characteristics of *pathernakh* pear

Size

The size of the fruits was analyzed by measuring the length and width with the help of digital vernier caliper. The average fruit size (length and width) was expressed in millimeter (mm).

Weight

The weight of ten fruits was taken by using digital weighing balance individually and then average of all was expressed as fruits' weight in grams (g).

Textural Analysis

Firmness one of the parameter of texture analysis was determined using a TA-XT2i texture analyzer (Stable Micro Systems, Godalming, UK) connected to a computer. Ten fruit were selected randomly for this. A force was applied to produce a 5 percent deformation by a 100mm aluminum probe. The slope was determined in the linear zone of the force deformation curve and the results were expressed in bioyield point and firmness value in gram (g).

Colour analysis (Ranganna, 2009) [12]

Colour of samples was measured in a 'Lovibond Colour Tintometer Model PFX-I series spectro-colorimeter' in which Red, Yellow, Blue and Neutral (RYBN) colour were obtained along with CIE readings i.e. L^*, a^* and b^* values. The L* value gives a measure of the lightness of the sample colour from 100 to 0, 100 for perfect white while 0 for black colour, a* value represents the green to red colour range and b* values indicates yellow to blue colour range. The colour of each sample was measured thrice.

Chemical parameters of *pathernakh* pear

Moisture content (AOAC, 2000) [3]

Weighed sample in replication (5.00g) was taken and dried at 70 ±2 ^{0}C in hot air oven to a constant weight. Loss in weight of sample after drying denotes the moisture content and expressed as per cent (%).

$$\text{Moisture (\%)} = \frac{\text{(Weight of fresh sample - Weight of dried sample)}}{\text{Weight of fresh sample}} \text{ X } 100$$

Ash (Ranganna, 2009) [12]

Total ash was estimated through gravimetrically by taking sample of 5.0 g in silica crucibles and burnt on a hot plate. Thereafter, crucibles were placed in a muffle furnace for ashing at 550 °C for 5-6 hrs to obtain a carbon free white ash sample with a constant weight. The ash content of samples was calculated and expressed as per cent (%) on fresh weight basis as given below:

$$\text{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \text{ X } 100$$

Titratable acidity (AOAC, 2000) [3]

Titratable acidity was estimated by titrating a known volume of the sample against standard 0.1 N Sodium hydroxide (NaOH) solution using phenolphthalein indicator till the end point (pink colour). The titratable acidity was expressed as per cent (%) malic acid.

$$\text{Titratable acidity (\%)} = \frac{\text{Titre value} \times \text{Normality of alkali} \times \text{Volume made up} \times \text{Eq. wt of acid}}{\text{Weight of sample taken for estimation} \times \text{Aliquot taken for estimation}} \times \frac{\text{X}}{1000} 100$$

Total soluble solids (Ranganna, 2009) [12]

The Total Soluble Solids (TSS) of samples were determined with the help of hand refractometer of (Model ERMA).

Sugars (Ranganna, 2009) [12]

For sugar estimation, a known amount of crushed sample (25 g/ml) was taken and dissolved in 100ml water. Solution was neutralized with 1 N sodium hydroxide and 2ml of 45 per cent lead acetate was added to it and kept for 10 min. 2ml of 22 per cent potassium oxalate was added after it and the solution was filtered and clear filtrate was used for estimation of reducing sugars by titrating against Fehling's A and Fehling's B solution using methylene blue indicator (Lane and Eynon, 1923). Reducing sugars were estimated thereafter and calculated as given below:

$$\text{Reducing sugars (\%)} = \frac{\text{mg of invert sugar x Dilution}}{\text{Titre value x Wt. or volume of sample}} \text{ x } 100$$

However, total sugars were estimated by addition of 5g of citric acid to 50ml filtrate from the reducing sugar estimation and heating it for 10min, then similarly neutralizing it with 1N NaOH using phenolphthalein indicator and total sugars were estimated as given below:

Total sugars as invert sugars (%)	:	Calculated as in (a) making use of titre value as obtained in the determination of total sugars after inversion
Sucrose (%)	:	(% total invert sugars-% reducing sugars) x 0.95
Total sugars (%)	:	(% reducing sugars + % sucrose)

Functional parameter's analysis of *pathernakh* pear

Crude fiber (AOAC, 2000) [3]

One gram of sample was taken in crucibles for fiber determination through 'Fiber Tech Analyzer (Velp Scientifica)'. Then, crude fiber was determined by continuously washing with sulphuric acid, hot water and potassium hydroxide (KOH) and again with hot water followed by cold water and acetone solution (25ml). Thereafter, crucibles contained fiber content were dried in oven at 105 ˚C for an hour up-to constant weight. This weight represents crude fiber with ash content (F_1). After that, crucibles were placed in muffle furnace and heated up-to 550 ˚C for 3 hour. Reweigh the samples after cooling in dessicator (F_2) and crude fiber was calculated by using following formula:

$$\text{Crude fiber (\%)} = F_1\text{-}F_2/ F_0 \times 100$$

Total phenols (Bray and Thorpe, 1954) [5]

The amounts of total phenols in the sample were determined with the Folin-Ciocalteu Reagent (FCR) using catechol as a standard. One gram of sample was taken and crushed with 10ml of 80 per cent ethanol and centrifuged at 10,000 rpm for 20 min and then filtered. Filtrate was evaporated in oven up to dryness and residue was dissolved in 5ml distilled water. From that, aliquot of 0.2 and 0.4ml was taken in separate test tubes and volume was made up to 3ml with water. After that, 0.5ml Folin-Ciocalteu Reagent (FCR) was added and

incubated for 3 min. Twoml of Sodium carbonate was added to it. Test tubes were placed in boiling water bath for one min and then cooled and OD of the sample was recorded at 650 nm.

Ascorbic acid (AOAC, 2000) [3]

The ascorbic acid content was estimated as per AOAC method using 2, 6-dichlorophenol indophenol dye. Results were expressed as mg per 100g of sample and calculated by using the following formula:

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up}}{\text{Aliquot of extract taken} \times \text{Weight of sample taken}} \times 100$$

Minerals' analysis of *pathernakh* pear (Rajasekaran *et al.* 2005) [11]

The dry ashing method was used for mineral quantification. Ashing was done to free all of the samples from the organic materials. Two gram of ash was digested with a mixture of hydrochloric acid (HCl) and nitric acid (NO_3) in the ratio of 1:3. The digested samples were dissolved in 50ml of distilled water and used for the estimation of mineral content through atomic absorption spectrophotometer.

Results and Discussion

Physico-chemical characteristics

The physico-chemical characteristics of *pathernakh* pear are presented in Table 1, 2 and 3. The length, breath and weight of fruit were observed 59.00 ±0.15mm, 58.70 ±0.10mm and 148.00 ±4.02g, respectively. The moisture content determines the freshness of fruits and were found 84.95±0.10 percent. The minerals content expressed as ash content, total soluble solids (TSS), titratable acidity, ascorbic acid and fiber content that determine the fruit quality were recorded 1.90 ±0.01 percent, 13.00 ±1.05 ^{0}B, 0.34 ±0.01 percent, 4.50 ±0.20 mg/100g and 6.02 ±0.25 percent in fruits, respectively. Sugar also an important component of fruits that correlated with sweetness, aroma, texture and flavor were reported 8.77 ±0.14 percent, respectively. Similar findings have been reported by Yim and Nam (2015) [15] in sand pear. However, in pear, total phenolic content (150.33 ±0.16mg/100g) were observed. The results were in conformity with the findings of Abaci *et al.* (2015) [1].

Table 1: Physical characteristics of *pathernakh* pear fruits

Sr. No.	Parameter	Observations (Mean ±SE*)
1.	Length (mm)	59.00 ±0.15
2.	Breath (mm)	58.70 ±0.10
3.	Weight (g)	148.00 ±4.02

Table 2: Chemical characteristics of *pathernakh* pear fruits

Sr. No.	Parameter	Observations (Mean ±SE*)
1.	Moisture content (%)	84.95 ±0.10
2.	Ash content (%)	1.90 ±0.01
3.	Titratable acidity (%)	0.34 ±0.01
4.	Total soluble solids (^{o}B)	13.00 ±1.05
5.	Reducing sugars (%)	4.12 ±0.20
6.	Total sugars (%)	8.77 ±0.14

Table 3: Functional characteristics of *pathernakh* pear fruits

Sr. No.	Parameter	Observations (Mean ±SE*)
1.	Crude fiber (%)	6.02 ±1.25
2.	Ascorbic acid (mg/100g)	4.50 ±0.20
3.	Phenols (mg/100g)	150.33 ±0.16

SE* Standard Error

Textural (firmness) analysis

Firmness is an important textural component that describes the mechanical properties.

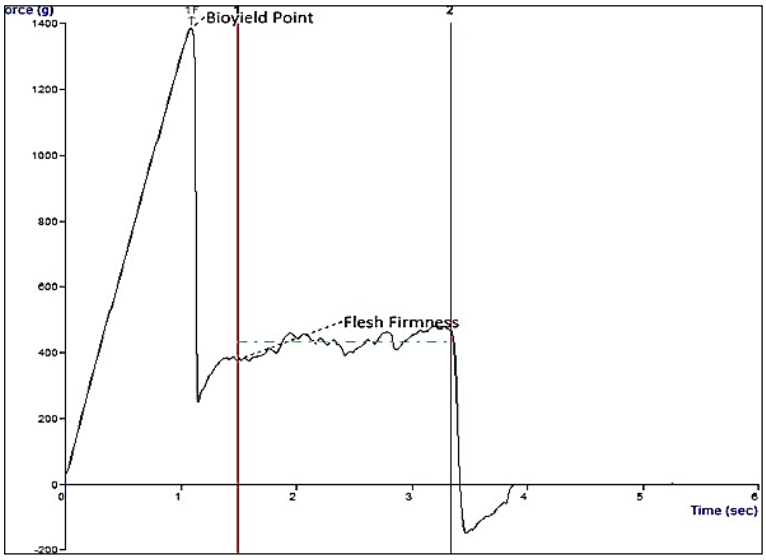

Fig 1: Firmness of *pathernakh* pear

Perusal of data in Fig 1 that fresh apple and pear had firmness value of 443.88 g. However Vega-Galvez *et al.* (2012) [14] and Baniwal and Singh (2017) [4] reported the firmness value of 1.61kg and 3.21Nmm^{-1} in raw pear fruits. This change in firmness value may be owing to varying geographical conditions, maturity stage and varietal difference (Musacchi and Serra, 2017) [9].

Colour analysis

The color is most critical parameter that defines the acceptability of fresh as well as processed products (Pingret *et al.* 2013) [10]. The colour values L*, a * and b * of raw *pathernakh* pear are shown in Table 4. The pear fruits were yellowish green with L* 47.22, a * 2.23 and b * 40.06 respectively.

Table 4: Colour properties (Lab) of the raw materials

Properties	Observations
L* (Lightness)	47.22
a* (Redness-greenness)	2.23
b* (Yellowness- blueness)	40.06

Mineral analysis

Minerals are dietary requirements for wellbeing that exhibit various functional effects. The data presented in Table 5 clearly indicates that potassium (190.01 ±2.35mg/100g) is most abundant mineral in pear followed by sodium (53.80 ±2.09mg/100g), magnesium (12.69 ±0.40mg/100g), calcium (10.34 ±0.15mg/100g), phosphorus (8.13 ±2.21mg/100g) and iron (2.30 ±0.05mg/100g) respectively. However, Chen *et al.* (2007) [7] reported a higher concentration of minerals in pear fruit. The difference in mineral compositions of fruits may be attributed to varying growth conditions, soil properties and geographical environment.

Table 5: Mineral content of the raw materials

Minerals	Observations (Mean±SE)
Potassium (mg/100g)	190.01 ±2.35
Sodium (mg/100g)	53.80 ±2.09
Magnesium (mg/100g)	12.69 ±0.40
Calcium (mg/100g)	10.34 ±0.15
Phosphorus(mg/100g)	8.13 ±2.21
Iron (mg/100g)	2.30 ±0.05

Conclusion

The present study is the evaluation description of the physico-chemical, nutritional, textural as well as functional characterization of the *pathernakh* pear. It was demonstrated that fruit has better physico-chemical properties and high nutritional compounds such as reducing sugars, ascorbic acid, total sugars and various minerals. Also, possess the high fiber content and high amount of total phenolic content. These results cocluded that this, pear cultivar could be best for consumption as fresh or after favourable processing because of excellent product quality and good concentrations of functional and nutritional components.

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