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Biochemical composition of potato biowaste of popular North Indian cultivars

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Potato is among the top processed vegetables, and its demand is continuously on the rise. Moreover, by the unit that peels are produced, significant issues associated with managing substantial volumes of solvents, impractical astounding scale drying out functions, in addition to lowering capital expenses render these remedies unfeasible. Additionally, isolation of helpful metabolites from potato are bound on the usage authorized as food quality applications. The current study's objective was to estimate the peel biochemical composition of potato cultivars suitable for cultivation in the Ranch district of Jharkhand state in India. The highest amount of chlorogenic acid (1.13 mg/g FW) and dry matter (17.90%) was determined in the variety Kufri Sindhuri. The chlorogenic acid content and the peel dry matter were determined to be significantly correlated with each other. The highest value for the phenolic content of the potato peel was determined for the variety Kufri Lalima. Simultaneously, the reducing sugars were most elevated in the peel of variety Kufri Pukhraj and starch content in the peel of variety Kufri Purkhraj. Overall, our work highlights the biochemical composition of potato peel and this information can be targeted on the potential usage of potato peel usage for industrial products formulation.

Keywords: Chlorogenic acid, Peel, Phenolics, Potato, Tuber

Potato (*Solanum tuberosum* L.) is among the topmost vegetables for human consumption and the processing industry[1]. Due to its high demands and production potential, the potato cultivation is also getting popular in India's non-traditional areas. Although potato is generally cool seasonal crop, some varieties can adapt to moderate climate regimes. In Jharkhand, especially in the Ranchi district potato cultivation is getting popular[2]. Potato cultivation is ideal for marginal and small farmers as it's labour intensive, good nutrition value and features high yields, with regular cash income[3].

Moreover, expanding potato production is going to enhance the incomes of growers and even boost countryside employment. Potatoes tend to be peeled during processing and production losses in potato peel waste are regular[4]. Potato peel is discarded and is considered as a zero-benefit by-product that is produced in significant amounts[5]. Moreover, based on the end product requirement and the peel method applied, the potato peel can vary from 15 to 40% of the original product mass. This waste creates a problem of its degradation and leads to a significant amount of food.

Furthermore, there's a vast opportunity for potato the peel extracts as an antioxidant in food systems because of its increased phenol content[6,7]. Steam peelers are lightweight and make lesser product losses but demand top purchase and also operating costs[8]. Potato peel is an inexpensive by-product it has a significant amount of starch, polyphenols, lignin, no starch polysaccharides, small amount and protein of lipids. This helps it be a cheap and beneficial base material for extraction of useful items (such as natural antioxidants, biopolymers, dietary fibre, *etc.*) and fermentation processes[5]. Therefore, the current study's objective is to estimate the peel biochemical composition of potato cultivars suitable for cultivation in the Ranch district of Jharkhand state in India.

Material and Methods

Crops of six varieties of potato viz., Kufri Lalima, Kufri Sindhuri, Kufri Jyoti, Kufri Chandarmukhi, Kufri Pushkar, and Kufri Pukhraj were raised during late October 2019 to early February 2020 under open field conditions at the Department of Botany, Ranchi University, Ranchi, Jharkhand, India in a randomised block design with three replications. Field of 7 × 9 M was ploughed at a depth of 15-20 cm thoroughly for proper aeration. Then, an almost 3 cm layer of sterilized soil sand mixture was evenly distributed.

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Farmyard manure and organic waste were added composing 25% of water content. All of agronomical practices and the plant protection measures were taken as defined elsewhere[9].

Sampling and biochemical analysis

After 90-100 days based on each variety's maturity timing, tubers were cultivated and processed for estimating the biochemical parameters. Later, tubers were left in the ground for skin cure and thickening before their use for the analysis. The tubers of identical shape size were used for the peeling and also for further analysis. A random sample of 15 potato tubers with almost identical shape and size were taken from each replication for the analysis. After cultivation, all potato tubers were washed under tap water and then air-dried, the peel was removed using hand peeler. After peeling, peels were subjected to various biochemical analysis (chlorogenic acid, Dry Matter, reducing sugars, phenolics and starch content) were determined. Potato peel was generated using the hand peeler. For determining dry matter content, peels samples were first oven-dried, and percentage of the change in the weight is taken as the dry matter content.

Chlorogenic acid content was estimated by using 0.2 g of sample (potato peel) weighed and added 100 mL of distilled water then boiled for 5 min while stirring, after cooled down solution was filtered with 0.45 μM filter paper and finally, this filtrate with some dilution was used for HPLC analysis as defined elsewhere in detail[10,11]. For estimating reducing sugars, Nelson Somoyogi method was used. Briefly, peels were precipitated with saturated potassium oxalate solution and then with lead acetate solution, then centrifuged to get supernatant. In 0.2 mL of supernatant alkaline copper tartrate, the reagent was added was takes and the content was boiled for 10 min, cooled and 1 mL of arsenomolybdate reagent was poured, which turns the solution to blue. It was then photometrically measured at 620 nM using a UV-Vis. Spectrophotometer (Specord- 205 Analytik Jena AG, Jena, Germany)[12].

Sucrose content (reducing sugar) was analysed through Anthrone method. In this method, 0.1 mL of the 80% ethanol extract 0.1 mL of 30% aqueous potassium hydroxide was added and kept in a boiling water bath for 10 min. The samples were cooled, and 3.0 mL of an throne reagent was added and kept at 40°C for 10 min thereafter absorbance at 620 nM using sucrose of determined concentration as standard[13]. On the other hand, starch content was also determined by the Anthr one method using ice-cold acid hydrolysis by perchloric acid, sulphuric acid and glucose and ethanol. At last, absorption was taken at 630 nM with the help of a UV-Vis. Spectrophotometer (Specord- 205 Analytik Jena AG, Jena, Germany)[14]. Potato peel was treated with 80% ethanol to extract phenols, that was centrifuged, and the supernatant was evaporated to dryness, and the final volume was made to 1 mL. To this 1 N Folin Ciocalteau reagent was added followed by 2 mL 20% sodium carbonate which then appears to the blue color that was then measured for its absorbance at 650 nM with the help of using a UV-*Vis*. Spectrophotometer against a reagent blank[12].

Statistical analyses

Using complete randomized block design, statistical analysis was performed in three replicates. The data was analyzed using SPSS (11.5 version) software package[15]. According to Duncan test, the significance of differences was calculated using least significant differences (LSD) P & lt; 0.05. Pearson's correlation coefficients and the path analysis were performed using the JASP statistical software program version 0.12.2[16].

Results and Discussion

Significant differences were determined for the biochemical composition in the peel of the potato varieties (Table 1). The highest chlorogenic acid content was determined in the variety Kufri Sindhuri (1.13 mg/g FW), followed by Kufri Chandarmukhi, and Kufri Lalima (Table 1). Kufri Jyoti and Kufri Pukhraj were determined with the least amount of chlorogenic acid. The highest dry matter was determined in the peel of Kufri Sindhuri (17.90%), followed by Kufri Lalima and Kufri Jyoti (Table 1). The maximum peel phenolics content was determined in the variety Kufri Lalima (182.05 mg/100 g FW), and the lowest value was determined for the variety Kufri Pushkar (Table 1). Whereas, the reducing sugars were maximum in the Kufri Pukhraj (115.36 mg/100 g FW) were more than double than the lowest determined value for the reducing sugars in the variety Kufri Lalima (40.30 mg/100 g FW) (Table 1). In contrast, the highest starch content was determined Kufri Jyoti, followed by Kufri Chandarmuki and Kufri Pushkar (Table 1).

Table 1 — Biochemical composition of peel content in the different potato varieties for chlorogenic acid, dry matter, phenolics, reducing sugars and starch

Varieties	Chlorogenic acid (mg/g FW)	Dry Matter (%)	Phenolics (mg/100g FW)	Reducing sugars (mg/100 g FW)	Starch (mg/100 g FW)
Kufri Lalima	0.84±0.12^{b}‡	16.73±0.82^{ab}	182.05±11.52^{a}	40.30±1.95^{f}	9.56±0.87^{d}
Kufri Sindhuri	1.13±0.18^{a}	17.90±2.30^{a}	178.00±10.04^{a}	58.73±1.54^{c}	10.50±0.65^{c}
Kufri Jyoti (KJ)	0.44±0.85^{d}	15.63±0.75^{ab}	163.02 ±10.07^{ab}	44.40±0.95^{e}	15.30±0.88^{a}
Kufri Chandarmukhi	0.96±0.07^{ab}	13.36±3.63^{c}	156.05 ±14.730^{b}	50.80±1.48^{d}	14.98±1.14^{a}
Kufri Pushkar	0.63±0.13^{c}	13.26±1.74^{d}	126.70 ±7.54^{c}	88.476±1.971^{b}	12.30±1.07^{b}
Kufri Pukhraj	0.54±0.84^{c}	15.38±2.02^{ab}	175.02 ±12.52^{ab}	115.36±4.97^{a}	10.23±1.05^{c}
ANOVA	1.72	2.64	10.18	407.27	20.33
LSD ($P\leq 0.05$)	0.191	3.48	20.07	4.50	1.67

±- Standard deviation; ‡- values in column followed by the same letter are not significantly different; $P\leq 0.05$- LSD (least significant difference test); FW- fresh weight

Pearson's correlation coefficients were determined for the estimation of the correlation among the different biochemical traits estimated in the potato peel (Fig. 1). Surprisingly the only significant correlation was determined between the phenolics and the dry matter content (Fig. 1). At the same time, starch content was negatively correlated with the chlorogenic acid, dry matter, reducing sugars, phenolics, and the potato peel (Fig. 1). While, no-correlation was determined between the chlorogenic acid and the potato peel phenolics. Path analysis determined the patterns of impact among the different biochemical traits. In this direction, the path analysis kept the traits like starch, phenolics and the dry matter content in the in component 1 (RC1) whereas, the reducing sugars and the chlorogenic acid were in component 2 (RC2) (Fig. 2).

As a consequence of the extensive processing of potato, a good deal of potato peel as a by-product is produced. Among all of the potato's biowastes, potato peel is the primary item which positions for a key waste disposal problem for the marketplace concerned. Up-grading of this by item to value-added products could be an attractive business[17-20]. Potato peels are mainly obtained by knife peelers, and steam peeling. Generally speaking, abrasive peeling is used for potato chips, whereas steam shedding is used for dehydrated and frozen items. In potato peel, chlorogenic acid is discovered to be very plentiful among all other phenolic acids.

Moreover, its composition can be as high as 90% of the total antioxidant content within the peel[21,22]. Nevertheless, the HPLC analyses disclosed a small quantity of this specific bioactive compound, which varied from 0.44 to 1.13 mg/g and the variety Kufri Sinduri recorded its highest amount. Moreover, a dry

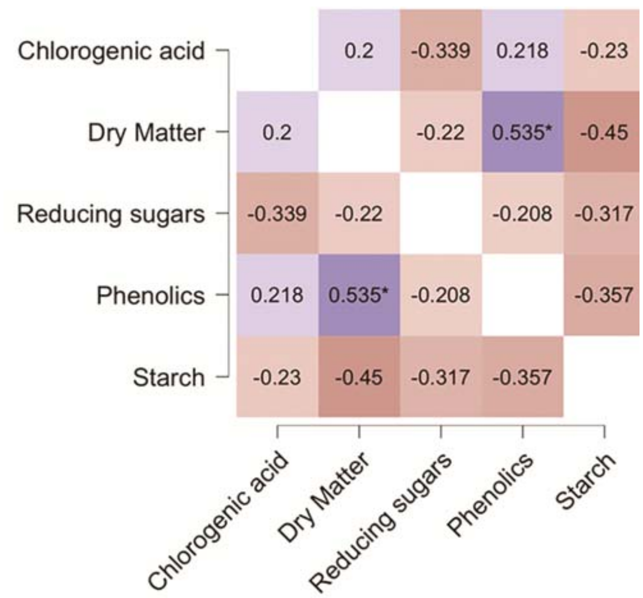

Fig. 1 — Pearson's correlation coefficients for the fruit peel biochemical content in the potato varieties with values capped at $P< 0.05$ (*)

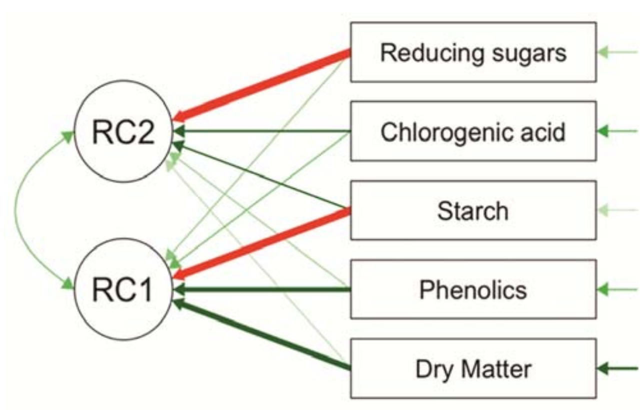

Fig. 2 — The path diagram of the biochemical traits measured in the potato varieties for chlorogenic acid, dry matter, phenolics, reducing sugars and starch

matter content of up to 17.09% was also recorded in the variety Kufri Sindhuri. Previous studies also reported a significant variation in the chlorogenic acid and dry matter content in the potato peel. The elevated temperatures enhanced the fragmentation of complex molecules into small extra soluble components. Moreover, isolation of beneficial metabolites from potato are bound on the use authorized as food-grade products[23,24]. For instance, some of these experiments exact the healing of polyphenolics from grape pomace, pectin from apple pomace, and carotenoids from tomato by-products[25].

Moreover, new technologies for the price effective utilization of the peels should be created. Owing to the functional polar groups (hydroxyl, carboxyl, *etc*.) in gratis style polyphenols and undoubtedly the presence of the sugars moiety in glycosylated elements (*i.e*., glycoalkaloids), they're preferentially recovered under the more polar conditions produced by decreased temperatures of stage one. The sizable temperatures and more significant consequence times favoured the peel mixture, perhaps because of the significant fractionation scope increased[26]. Nevertheless, under insufficient heating circumstances or perhaps maybe shorter effect times, biomass malfunction might have been attenuated, restricting solvent penetration, lessening solubilization of general target and also yields molecules. Likely, these kinds of ingredients came out through the strong matrix by acid-catalysed hydrolysis replies.

Conclusion

Potato is one of the most extensively cultivated and processed vegetables. But the processing of potato comes with an extensive amount of biological waste as potato peel. Moreover, there is an ample amount of phytochemicals present in the potato peel. The present study aims to estimate the peel biochemical structure of popular potato cultivars growing in the Ranch district of Jharkhand state in India. The highest amount of chlorogenic acid (1.13 mg/g FW) and dry matter content (17.90%) was highest in the Kufri Sindhuri. Moreover, we determined that the chlorogenic acid content and the peel dry matter were substantially correlated. Overall, this works highlights the biochemical potential of potato peel that can further be used to extract essential phytochemicals.

Conflict of interest

All authors declare no conflict of interest.

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