DETERMINATION OF SOME NUTRITIONAL PARAMETERS OF POTATO PEEL - PRELIMINARY RESEARCH

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Abstract. *The potato peel waste, a by-product resulting from the processing of potato tubers, contains available amounts of nutritional and biologically active compounds essential for the health of the human body. The analyzed potato peel powder contains important amounts of nutritional compounds, especially increased amounts of carbohydrates, total mineral content, sufficient protein and fiber content and reduced amounts of moisture and fats. Previous research on the proximate analysis composition reveals that this by-product is an excellent resource of nutritional and bioactive compounds such as minerals, carbohydrates, proteins, dietary fibers, reduced fat content, and other valuable phytochemicals. This paper presents the preliminary results obtained from the analysis of potato peels obtained by peeling potato tubers sold in the local agro-food markets from Timisoara city. The results obtained: 4.78-6.82% moisture, 5.11-6.57% ash, 9.54-12.86% protein, 1.02-1.92% fat, 12.11- 14.95% fibers, and 59.64-68.71% carbohydrates suggests the use of peel powder as a natural additive in food with added value or as an alternative source in animal feed ingredients. In addition, the superior utilization of this by-product as food products, pharmaceutical ingredients, low-value animal feed or as agricultural fertilizer can reduce the load of potato peel waste on the environment pollution and serve the pharmaceutical and food sectors businesses.*

Keywords*: potato peel, by-product, potato peels powder, nutritional parameters*

INTRODUCTION

The potato (*Solanum tuberosum* L.) is a vital agricultural product, widely cultivated and consumed throughout the world (ESPINOZA-GARCIA et AL., 2023). It is an important source of nutrients for people and animals, being mostly used in food production due to their short growing time and their potential for use, as well as their ability to adapt to different climatic conditions (ABEBAW, 2020). Potatoes are precious food rich in protein, carbohydrates, starch, minerals, vitamins and fibers, alkaloids, flavonoids, phenolic compounds and reduce fats (COZMA et AL., 2023; ABEBAW, 2020).

The proximate composition and mineral content of raw potato (*Solanum tuberosum* L.), according to Frida fooddata dk., shows the following values: 2 % protein, , 6.76 mg/100 g Ca, 20.40 mg/100 g Mg, 17.30% carbohydrate, 1.40% dietary fiber, 0.30% fat, 20.50 % dry matter, 0.90% ash, 7.00 mg/100 g Na, 414 mg/100 g K, 0.05 mg/100g Cu, 0.30 mg/100 g Zn, 0.23 mg/100 g Mn, 0.27 µg/100 g Se, 55.20 mg/100 g P, 1.20µg/100 g I, 5.75µg/100 g Ni, 0.28µg/100 g Hg, 1.39 µg/100 g As, 1.03 mg/100 g Fe , 2.07 µg/100 g Cd, 0.60 µg/100 g Cr, 0.81 µg/100 g Pb .

Potato peel as a by-product of the potato processing industry represents a totally cheap, valuable and accessible raw material for the production of economically important substances, also for value addition and product extraction, including dietary fibers, biopolymers, natural antioxidants and natural food additives. This by-product with a large nutritional potential contains fiber and bioactive compounds that have been shown to have health benefits (JIMENEZ-CHAMPI et AL., 2023; GOUDA, 2017).

The application of potato peel utilization in food and nonfood purposes, notify that the chemical composition of raw potato peel includes: 83.3–85.1 g/100 g water, 1.2-2.1 g/100 g protein, 0.1-0.4 g/100 g total lipids, 8.7-12.4 g/100 g total carbohydrate, 7.8 g/100 g starch, 2.5 g/100 g dietary fibre, 0.9-1.6 g/100 g ash, 1.02-3.93 g/100g total phenolic content, 0.51- 0.96 g/100 g.02–2.92 total flavonoids (JAVED et AL., 2019). There are numerous studies that recommend the use of potato peel to improve the physical and chemical properties of food, including their content in bioactive compounds and extending the shelf life (JIMENEZ-CHAMPI et AL, 2023; ESPINOZA-GARCIA et AL., 2023; AL-WESHAHY & RAO, 2012; GOUDA, 2017; ZOAIR et AL, ABEBAW, 2020).

The development of an ecological approach for the use of potato peel as a food preservative, supply of dietary fiber in bakery products, pharmaceutical ingredients, animal feed, and renewable energy sources to boost ecofriendly food sectors, requires to know the nutritional composition of this by-product. Previous research revealed that potato peel contains important but variable amounts of nutritional compounds, which vary according to the geographical cultivation areas, the composition, variety, color and breed of the potatoes, tubercle peeling procedure, etc. Studying the valorization of potato peel waste as natural additive for use in meat products, it was reported that potato peel powder used to extend the shelf life of pork patties included: 5.27% moisture, 2.26% fat, 9.11% protein, 3.11% ash, 80.25% carbohydrate (ESPINOZA-GARCIA et AL., 2023).

By evaluating diets that incorporate prebiotics extracted from potato skins, it was noticed that potato peel contains 7% moisture, 76% total dietary fiber, 3% soluble dietary fiber, 73% insoluble dietary fiber, 14% protein, and 1% fat (PATIL et AL., 2023).

The analysis of the effect of drying methods on physicochemical, antioxidant and functional properties of potato peel flour showed that the proximate composition of potato peel flour is influenced by the potato peel drying technique: 7.61% moisture, 11.38% protein, 7.23% fat, 9.64% ash, 12.93% crude fiber, 55.43% carbohydrates – of cabinet dried, and 10.27% moisture, 9.33% protein, 6.71% fat, 10.39% ash, 12.40% crude fiber, 50.49% carbohydrates - of sun-dried (AKTER et AL., 2023).

To determine the nutritional and mineral composition of vegetal wastes bark from garlic, onion and potato, it was found the potato wasted peels contains important quantity of nutritional compounds: 2.67% raw protein, 2.53% total dietary fiber, 9.5% carbohydrates (digestible), 1.68% sugars (total), 0.53% sugars (reducing), 84.3% water content, 15.8 g dry matter 0.88% total **(**ZHIVKOVA, 2021).

Analyzing proximate composition and mineral contents from the peel of Irish Potato, the following values were obtained: 4.54% raw protein, 1.65% unrefined fat, 4.81% natural fiber, 9.90% moisture, 67.89% dry matter, 3.67% ash, 0.16 % magnesium, 0.1 % calcium, 0.05% sodium, 0.26 % potassium, 0.21 % phosphorus, 0.87 % chloride, 8.50 mg/kg manganese, 12.40 mg/kg iron (AKINSULIE et AL., 2021). Varieties Lady Rosetta and Lady Claire of potato peel powder presented the highest content of 2.09 and 1.27% crude fat, 11.17 and 12.44% crude protein, 7.24 and 4.83% ash, 6.98 and 4.08% moisture, 72.53 and 77.38% carbohydrates (KUMARI et AL., 2017).

From those presented above it can be stated that the potato peel is an excellent resource of valuable nutritional and bioactive compounds, which allow its use as a food preservative, supply of dietary fiber in bakery products, pharmaceutical ingredients, animal feed and energy sources renewable to stimulate ecological food sectors.

Therefore, it is essential to know the values of these compounds from potato peel waste. Understanding these characteristics would help create environment-friendly methods for applying potato peel.

The purpose of this work was to determine the nutritional parameters: moisture, ash, protein, fats, fiber and carbohydrate of potato peel powder obtained when peeling potato tubers. Domestic potato peel where investigated in order to use it as a source for obtaining products with added nutritional values.

MATERIAL AND METHODS

Potato collection

To carry out the experiment, were used potatoes from the autumn harvest of 2023, sold by local producers from agro-food markets in the city of Timisoara (Romania). Approximately 3 kg of potatoes randomly chosen (of different shapes and sizes) were bought from three different producers, obtaining three batches of potatoes, corresponding to each producer.

Figure 1 The fresh potato peels and dried potato peel powder

Preparation of potato peel powder

The whole potatoes were individually washed, first under a jet of tap water, then rinsed with distilled water and dried by blotting with filter paper. The peels obtained by manually peeling the potato tubers using a stainless steel knife, were dried in an oven at 60°C, until the constant mass. The dried samples of potato peel were shredded in a crushing machine and stocked in brown globe (at a temperature not exceeding 5°C) for analyses.

Method

Achievement of the nutritional composition of potatoes peel powder was performed according to AOAC Official Methods of Analysis, 2000 and according to the recommendations of VELCIOV et AL., 2022 and ZHIVKOVA, 2021.

For moisture content, dried potato peel powder was dehydrate in an furnace at 105°C to the same mass. The ash (mineral substances) were determined by the calcination method at 550 °C. The protein content was determined by the Kjeldahl method, using a conversion factor for nitrogen of 6.25. The unrafined fat was obtained using the method Soxhlet with hexane as solvent. Crude fibers were determined by using the method of acid base digestion. The carbohydrate content was obtained by difference. Each determination represents the average of three measurements.

RESULTS AND DISCUSSIONS

The results obtained for the determination of the nutritional parameters in the analysis of the potatoes peel powder are shown in table 1.

Table 1

The nutritional parameters of potato peels powder

Specification	Nutritional parameter values, %					
	Moisture	Ash	Protein	Fat	Fiber	Carbohydrate
Limits	4.78 - 6.82	5.11- 6.57	9.54 - 12.86	1.02 – 1.92	12.11- 14.95	59.64 - 68.71
Average values	5.57± 0.89	5.96± 0.62	11.42±1.39	1.36±0.40	13.76±1.20	64.82±3.81

As can be seen from the data presented in table 1, the determined nutritional parameters show different values that vary depending on the origin of the potatoes used to prepare potatoes peel powder and the analyzed parameter.

Moisture content is important for food preservation and in food processing therefore (VELCIOV et AL., 2022). The analyzed potato peel contains relatively low amounts of moisture, within limits between 4.78 - 6.82%. Similar values, in the analysis of potato peels for the similar products, have also been obtained: 6.98% - in powder potato peels, Lady Rosetta variety (KUMARI et AL., 2017), 5.27% - in potato peel waste powder (ESPINOZA-GARCIA et AL., 2023), 4.87% (SELLO, 2011). The average values of humidity (5.57 ± 0.89%) shows that potato peel powder does not present a major risk of degradation over time.

Ash content refers to the inorganic residue left after the complete combustion or oxidation of organic matter in a food product, respectively the sum of the mineral elements that are part of the potato peel powder samples (NIELSEN and MARSHALL, 2010). The analyzed peels contain important amounts of total minerals within limits between 5.11 - 6.57%. Close values of the ash content were also obtained: 6.35% - in potato peel, dry weight (PATHAK et AL., 2018), 6.0% - in dry matter of potato peel (LIANG and MCDONALD, 2014), 5.9% (HOSSAIN et AL., 2018). These values, as well as the average value of the ash content (5.96 ± 0.62%) reveals that potato peels can be considered as a potential source of mineral elements in the form of essential macro and micro elements.

Proteins are important biomolecules for the body's homeostasis. Protein deficiency is closely related to a number of diseases such as Kwashiorkor, Marasmus (energy deficiency), mental disorders, insufficiency of different organs, edema and immune system weakness (KHAN et AL., 2017). The concentration of proteins, essential macronutrients from human nutrition determined in analyzed potato peel has values between 9.54-12.86%. Similar values were obtained: 11.17% - in Lady Rosetta variety and 12.44%- in Lady Claire variety (KUMARI et AL., 2017), 9.11% (ESPINOZA-GARCIA et AL., 2023), 9.33% - in potato peel flour, sun dried and 11.38% - potato peel flour, cabinet-dried (AKTER et AL., 2023). The average value of this nutritional parameter (11.42±1.39%) shows that potato peels have a relatively important protein supply.

Lipids are one of the three main macronutrients, along carbohydrates and proteins, essential for life and have multiple roles in living organisms. Essential component of cell membranes, lipids represent the body's most efficient way to store energy and emulsifying agents in the digestive tract. Fats also provide an excellent source of energy, improve the transport of fat-soluble vitamins, isolate and protect internal tissues, and contribute to vital cellular processes. Lipids are also used as food ingredients, improving the texture, taste, and flavor of new products (VELCIOV et AL., 2022). The fat concentration in the analyzed potato peel powder samples has reduce values between 1.02-1,92%. The average value of the fat concentration (1.36±0.40%) shows that analyzed potato peel powder has low value of the fat supply. Reduced values of the fat content in the potato peel were also reported: 1.27% - in

Lady Claire variety (KUMARI et AL., 2017), 0.15% - in potato wasted peels (ZHIVKOVA, 2017), 1.65% - in peel of Irish potato variety (AKINSULIE et AL., 2021). 0.99% (SELLO, 2011), 0.1-0.4% - in potato peel (JAVED et AL, 2019), 1.0% - in dry matter potato peel (LIANG and MCDONALD, 2014).

Dietary fiber refers to the sum of non-starch polysaccharides and lignin. Various fruit by-products from the food processing industry, such as the beverage, canning, puree and juice industries, have been reported to contain significant amounts of cellulose, hemicellulose, pectin, gums and lignin (CHAOUCH, BENVENUTI, 2020). The interest in knowing the dietary fiber content is closely associated with their role in reducing health diseases. Cellulose, hemicellulose and lignin are good absorbents of water and regulation of the intestinal tract, while pectin and gums are important in cholesterol reduction and glucose regulation. In addition, dietary fibers can be widely used when they are inserted into many foods in order to enrich their nutritional and sensory properties (MAURYA et AL, 2015). The concentration of the fibers in the potato peel samples analyzed has values between 12.11–14.95%. The average value of dietary fiber content (13.76±1.20) show that analyzed potato peel could be considered as a source of dietary fiber (AKTER et AL., 2023).

Carbohydrates are the body's main source of energy, being necessary for the normal functioning of muscles and the brain and helping to use fats, protecting cells against external harmful effects. The major metabolic role of carbohydrates in diets is the energy production. Although there are different types of carbohydrates, only total carbohydrates are taken into consideration in food and remains when the protein, fat, moisture and ash of the food have been removed (VELCIOV et AL, 2022). The analyzed samples contain increased amounts of carbohydrates, their concentration being between 59.64-68.71%. The fact that the analyzed potato peel powders can be used as sources of carbohydrates is also confirmed by the average value of their carbohydrate content (64.18±3.81 %). Increased carbohydrate content in potato peel was also identified: 72.53 % and 77.38 % – in potato peel powder of Lady Rosetta, and Lady Claire variety (KUMARI et AL., 2017), 80,25% - in potato peel waste powder (ESPINOZA-GARCIA et AL., 2023), 69.0% (SELLO, 2011), 68.75% - in potato peel, dry weight (PATHAK et AL., 2018), 55.43% and 50.49% - in potato peel flour cabinet-dried, respectively in potato peel flour sun dried (AKTER et AL., 2023).

As can be seen from those presented, the analyzed potato peel powder contains important amounts of nutritional compounds, especially increased amounts of carbohydrates, ash, adequate protein and fiber contents and lower amounts of moisture and fats. Following the research carried out, we can recommend the analyzed potato peels be used as an additive to obtain products with added nutritional value.

CONCLUSIONS

The development of an ecological approach for the use of waste potato peel as an additive in preparation of food products with added nutritional value, or as additives in animal feed, and as a renewable energy sources it is necessary to know the nutritional composition of this by-product.

The analyzed potato peel powder contains important amounts of nutritional compounds, especially increased amounts of carbohydrates, total mineral content, sufficient protein and fiber content and reduced amounts of moisture and fats.

The mean preliminary results: 5.57% moisture, 5.96% total minerals, 11,42% proteins, 1.36% fats, 13.76% fibers and 64.82% carbohydrates, shows that potato peel, a by-product of potato processing, can be used (after a simple and inexpensive preparation) to obtain food products with added value or as an additive to improve animal feed.

In addition, the superior recovery of potato peel wastes can offer a cheap ecological way of reducing environmental pollution with waste from potato processing.

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