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Impact Of Different Cooking Methods On Micronutrient Retention Of Peas And Potatoes

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Abstract

Vegetables are the most important source of several vital food ingredients which are required by the human body for the development, maintenance, growth, and repair of human body tissue to keep them fit. According to the report released by the World Health Organization (WHO), per capita consumption of vegetables must be within the range from 130 to 135 grams on daily basis. While in Pakistan, that range of daily intake of vegetables are far less than that of recommendation of WHO, nearly 30-33% lower. Cooking methods plays an important role in nutrient retention of vegetables. The current study was planned to check the influence of different cooking methods and cooking time on the nutritional profile of vegetables (Peas & Potatoes). Boiling, steaming and microwave cooking approaches were used in present study for determination. Microwave heating was determined to be a better option since it preserves the nutritional safety and quality of the veggies while also being cost effective. According to the

findings, it is best to eat vegetables after moderate cooking, or just after the vegetable tissues have softened, for optimal digestion and health advantages.

Keywords: Vegetables, Micronutrient, Peas, Potato, Health

Introduction

Globally, the vegetables are too much important from human health point of view. To avoid from the decontamination and contaminating the vegetables, the quality, consumption and distribution among the consumer is commanded by the food safety terms according to Prabhakar in 2010. The department of food safety has attained numerous importance in terms of production of food, transporting the vegetables, consumption by the consumers, disposing the vegetables and handling the vegetables. The problem of food safety occurs due to the major reasons of being the utilization of pesticides, the use of sewage sludge, use of industrial effluents and wastewater. The big threat now a day to the vegetable is the use of metal enriched pesticide and the use of contaminated wastewater that contains a number of pollutants injurious to the human health as they enter the food chain (Ashraf et al., 2011). Lack of awareness and lack of proper storage abilities are the week points behind deteriorating the stuff and making them unfit for the future use by storing. That is the reason food free from the contaminants is the need of the hour.

Fresh, canned, and frozen vegetables are all consumed. These veggies are a good source of vitamins and antioxidants that can be found in human meals. Minerals, vitamins, and phytochemicals are all present in fresh veggies, making them nutritionally beneficial. Vegetables, on the other hand, are exceedingly perishable. The nutritional quality of vegetables, on the other hand, is determined by the method of handling vegetables and various processing procedures. When vegetables are heated, they undergo significant changes that affect their nutritional content and lower their antioxidant activity. Even while simple treatments, such as blanching, have a significant negative impact on the nutritional quality of vegetables (Bureau et al., 2015).

Solanum Tuberosum (potato) is a cruciferous green vegetable. It is classified as a root vegetable. It's high in dietary fibre, salt, potassium, vitamin K, and other essential elements. The roots of potatoes include around 86–89 percent water, 0.7–0.9 percent protein, 0.2–0.5 percent fat, 6–10.6 percent carbs, 1.2–3.6 percent dietary fibre, and 1.2 percent ash. Harvesting has a negative impact on pea quality, as sweetness and carotenoids levels are reduced, and bitter taste and odour develop owing to oxidation processes. Pea's physical features, like as colour and firmness, are also affected by storage conditions. As a result of the low quality, the consumer's acceptance is reduced (Sharma et al., 2012).

The potato is widely regarded as a staple meal across the world and is accessible in a variety of forms in all nations; nonetheless, many consumers are unaware of the tubers' health benefits. When compared to cereals, it contains a higher proportion of dry matter and protein per unit growing area (Brewer et al., 1995). Despite this, consumers perceive those potatoes have a high calorie and fat content when compared to other carbohydrate alternatives such as rice or pasta; insensitive consumption since potatoes have little fat and a low energy density like legumes (Koch et al., 2020). In terms of minerals, the potato is well recognised as a good source of dietary potassium, which is crucial for acid-base control and

fluid balance, as well as the optimum functioning of the heart, kidneys, muscles, neurons, and digestive system. Hypokalemia, osteoporosis, high blood pressure, stroke, inflammatory bowel disease (IBD), kidney stones, and asthma are among disorders that may be prevented by eating enough potassium. A high potassium intake combined with a low sodium consumption has been suggested to reduce the risk of stroke (Swain et al., 2008).

Peas have around two-thirds the protein content of canola, twice the protein of barley, half the protein of soybean meal, and about 40% of the crude protein that rumen bacteria consume. Peas also provide roughly 80% of the starch content of barley grain, whereas other protein supplements like canola meal and soybean meal have very little or no starch. In comparison to cereal grains and most oil meals, peas have a higher protein content (7.4% crude protein). However, as compared to other diets, the methionine concentration is low, even though canola meal is one of the best sources of methionine. As a result, the combination of pea and canola protein may produce a beneficial amino acid balance for lactation cows. Peas have a high net energy content, like soybean meal but slightly less than barley grain. Peas are high in antinutritive compounds (Koch et al., 2020).

Pea seeds have a protein content of 22-23 percent. Globulins and albumins make up most pea proteins, accounting for around 80% of total seed protein composition. Albumins make about 18–25% of total proteins, while globulins make up 55–65%. (21). All globulins and certain albumins are storage proteins that serve as nitrogen sources for new embryos following seed germination. Legumin, vicilin, and convincing are globulins that account for 65-85 percent of total proteins in peas (23). These components, particularly protein, are divided into two groups based on sedimentation properties: 7S (vicilin, convincing) and 8S (vicilin, convincing) (Ogliari et al., 2020).

Because of its high speed, the microwave cooking technique allows you to save water and improve your thermal processing skills. Volumetric heat is created by converting electromagnetic energy to heat, as opposed to heat transmission by convection and conduction. Microwave processing application tools for the process of thermal treating low acid foods have increased in recent years because of technical advancements and validated product perfections. Microwave drying/boiling is one of these large-scale procedures for vegetables and fruits, in which the temperature of the item reaches the boiling point of water fast, increasing vapour pressure, reducing micronutrient and vitamin loss, and reducing cooking time (Swain et al., 2012).

It is known that cooking produces the major changes in chemical composition, reducing the amount of vitamin C and other thermo-labile compounds that may endure oxidative breakdown or be leached into the water during home cooking procedure and industrial processing as well. The destruction of food stuff is resulted to processing problems that creates several serious issues regarding food safety (Roy et al., 2009)

Research indicates that the quality of nutrients is highly dependent on the cooking protocols. Several vegetables are being consumed in most part of the country. Mostly important nutrients are lost during the process of cooking especially direct boiling of the fresh vegetables. That is the reason to plan the present study to check he nutritional status of vegetables “Peas and Potatoes” after subjecting them to different cooking methods. The main objectives of the present study include.

1. To check the nutrient status of vegetables after exposing them to different cooking techniques.
2. To check the influence of cooking procedures on the physio-chemical properties of vegetables as well as on the sensory attributes.
3. To find the best cooking method among all the selected cooking methods for maximum retention of nutrient profile of vegetables (Peas and Potatoes).

Materials and methods

An experiment was planned to check the influence of different cooking methods on micronutrient retention of peas and potatoes. Peas and potatoes were collected from local market. After initial processing of handling, washing, dicing, and peeling, vegetables were subjected to different cooking methods including conventional, microwave cooking and steam cooking. The purpose was to check the nutrient retention of vegetables. After cooking from all these methods, vegetables were subjected to different physical, chemical, and mineral analysis. Physical analysis like color (Mazzeo et al., 2015), texture (Maria et al., 2015) and chemical analysis like ash content, moisture content and crude fiber content were determined (AOAC, 2006). Most importantly, mineral analysis and sensory evaluation were also carried out (AOAC, 2006). The collected data were subjected to statistical analysis using statistics 8.1. and treatment means were compared.

Results and discussion

Physical Analysis

In Table I, mean values for L*(lightness), a*(redness), and b*(yellow-ness) of several treated vegetables are shown. The L*a*b* value was extremely substantially impacted by variances in cooking procedures at varied cooking time lengths, as shown by the findings. The statistical results in Table I showed that the force measured for texture analysis of the processed vegetables varies greatly between cooking regimes. After T0, the vegetable that had been microwaved for 15 minutes (T6) had the maximum shear force (Newton), followed by the vegetable that had been microwaved for 10 minutes (T5). After microwaving, the vegetable that had been boiled for 15 minutes (T2) had a lower shear force. The vegetable that had been steamed for 15 minutes had the lowest shear force (T4). Shear force values for raw and cooked samples are shown in Table 4.9. The degree of softening caused by the various cooking methods. For all three cooking techniques, cooking vegetables resulted in a decrease in the power required to shred the vegetable, indicating a decrease in stiffness and, as a result, softening of the vegetable. In comparison to boiling and microwave samples, steamed samples had a much lower shear force value (greater degree of softening).

Table I: Physical analysis of Peas and Potatoes exposed to different cooking methods

Treatment	L*-value	a*-value	b*-value	Texture
Peas				
T_0	57.50±1.75[a]	33.57±1.06[a]	42.41±1.76[a]	151.82±2.16[a]

T_1	42.59±1.17^{ef}	13.63±1.11^{de}	29.64±1.27^{c}	122.48±2.02^{e}
T_2	40.16±1.47^{f}	11.92±1.04^{e}	24.81±1.51^{d}	117.82±2.26^{f}
T_3	48.50±1.38^{cd}	17.05±1.11^{d}	36.41±1.20^{b}	132.48±2.02^{d}
T_4	45.83±1.52^{de}	14.67±1.45^{de}	32.19±1.45^{c}	126.15±2.72^{e}
T_5	54.50±1.75^{ab}	26.17±1.38^{b}	41.81±1.01^{a}	142.82±2.49^{c}
T_6	51.84±1.62^{bc}	22.28±1.72^{c}	38.55±1.37^{ab}	147.48±2.74^{b}
Potato				
T_0	52.82±1.55^{a}	-6.59±0.06^{b}	8.69±0.43^{a}	105.82±2.50^{b}
T_1	35.47±1.23^{e}	-1.64±0.60^{a}	5.36±0.81d^{e}	67.48±2.74^{f}
T_2	31.51±1.11^{f}	-1.53±0.55^{a}	4.86±0.60^{e}	62.41±3.00^{c}
T_3	41.83±1.21^{cd}	-5.93±0.53^{b}	6.69±0.51^{b-d}	77.43±2.01^{d}
T_4	39.68±1.25^{d}	-5.73±0.57^{b}	6.09±0.95^{c-e}	69.67±0.78^{ab}
T_5	45.67±1.08^{b}	-6.53±0.97^{b}	8.23±0.39^{ab}	93.15±2.02^{f}
T_6	43.28±1.04^{bc}	-6.13±0.50^{b}	7.90±0.62^{a-c}	97.27±2.74^{f}

Mean sharing same letter (s) don't differ significantly at p-value<0.05

The findings are consistent with those of (Miglio et al., 2008), who investigated the effects of microwaving and traditional cooking methods on the nutritional profile and textural analyses of several vegetables. The above conclusions are likewise consistent with Maria et al findings (2015).

Proximate Analysis

Table II showed the average value of moisture contents of peas and potatoes respectively in different treatments. Results indicate that the moisture contents were different in different cooking techniques at a different time interval of cooking. Mean values regarding moisture contents of peas given in Table II showed that highest moisture content (90.74%) was observed in T_2 followed by T_1 (89.28%), T_4 (89.10%), T_3 (87.92%), T_0 (86.53%), T_5 (63.43%) and T_6 (55.29%). The lowest moisture content (55.29%) was observed in T_6. Mean values regarding moisture content of potatoes given in Table I showed that the highest moisture content (95.15%) was observed in T_2 followed by T_1 (93.45%), T_4 (91.45%), T_3 (89.06%), T_0 (88.06%), T_5 (70.78%) and T_6 (63.31%). The lowest moisture content (63.31%) was observed in T_6. According to the results, it was clear that maximum moisture percentage of vegetables was obtained in boiling (10 - 15 minutes) trailed by steaming and microwave cooking. The results of the current study regarding moisture contents are like the experimental results conducted by the Khwairakoam and

Balwinder in 2014. They concluded that cooking methods caused an increase in moisture contents of vegetables. The results also linked with the reports of Dragsted et al. (2006) who perceived that the moisture contents of the vegetable were improved from 86.45- 94.34% during different cooking methods.

Table II: Proximate analysis of Peas and Potatoes exposed to different cooking methods

Treatment	Moisture %	Ash%	Protein %	Fiber %
Peas				
T0	86.53±2.02b	1.09±0.01ab	0.93±0.11b	2.43±0.42ab
T1	89.28±2.26ab	0.96±0.01d	0.92±0.01b	1.76±0.19b
T2	90.74±2.45a	0.90±0.03cd	0.91±0.01b	1.74±0.06b
T3	87.92±2.61ab	1.04±0.04bc	0.92±0.01b	2.28±0.58ab
T4	89.10±1.15ab	0.97±0.02cd	0.90±0.02b	2.23±0.54ab
T5	63.43±2.73c	1.13±0.09e	0.98±0.06ab	2.94±0.04a
T6	55.29±2.71d	1.20±0.08f	1.10±0.09a	3.20±0.1a
Potato				
T0	88.06±1.62d	0.81±0.01b	2.46±0.35a	4.10±0.40a
T1	93.45±1.50ab	0.74±0.04cd	2.43±0.31a	3.44±0.22ab
T2	95.15±1.85a	0.68±0.01e	2.41±0.30a	3.01±0.27b
T3	89.06±1.25cd	0.78±0.03bc	2.44±0.31a	3.50±0.20ab
T4	91.45±1.39bc	0.76±0.02cd	2.42±0.29a	3.47±0.25ab
T5	70.78±1,35e	0.83±0.02b	2.48±0.35a	4.24±0.41a
T6	63.31±1.58f	0.87±0.02a	2.52±0.35a	4.28±0.46a

Mean sharing same letter (s) don't differ significantly at p-value<0.05

Results depicts that different cooking approaches affect the crude protein contents of vegetables at different rate depending upon the time interval of different cooking methods. Mean values regarding ash content of peas given in Table 4.2 showed that the highest ash content (1.20%) was observed in T_6 followed by T_5 (1.13%), T_0 (1.09%), T_3 (1.04%), T_4 (0.97%), T_1 (0.96%) and T_2 (0.90%). The lowest ash content (0.90%) was observed in T_2. Mean values regarding ash content of potatoes given in Table 4.2 showed that the highest ash content (0.87%) was observed in T_6 followed by T_5 (0.83%), T_0 (0.81%), T_3 (0.78%), T_4

(0.76%), T_1 (0.74%) and T_2 (0.68%). The lowest ash content (0.68%) was observed in T_2. Microwave cooking method was found to be the best method among various cooking approaches to retain the highest percentage of crude protein contents surveyed by the direct boiling and steaming the vegetables for 10-15 minutes. Microwave was the most reliable method. The reason behind the higher contents of ash during microwaving was due to inorganic material reservation, lowering in the moisture contents and nutrient concentration. While during the process of steaming and boiling, most of the water-soluble minerals are leached down.

Mineral-analysis

Sodium content

The average values in Table III indicate the mineral contents sodium (Na) of vegetables subjected to different cooking methods. Results depicts that different cooking approaches affect the Na contents of vegetables at different rate depending upon the time interval of different cooking methods. The results indicates that highest contents of sodium (Na) was found in vegetables subjected to microwave cooking as in comparison with boiling and steaming techniques for a time duration of 10 to 15 minutes. The reason behind that higher concentration of sodium (Na) is observed because there was no heat shock due to the presence of water. In divergence to the water annexation along with heating, results in the leach down sodium (Na) content in case of boiling and steaming.

Potassium content

The average values in Table III indicate the potassium (K) concentrations of vegetables subjected to different cooking methods. Results depicts that different cooking approaches affect the K contents of vegetables at different rate depending upon the time interval of different cooking methods. Microwave cooking method was found to be the best method among various cooking approaches to retain the highest percentage of crude protein contents surveyed by the direct boiling and steaming the vegetables for 10-15 minutes. Microwave was the most reliable method. The reason behind the higher contents of ash during microwaving was due to inorganic material reservation, lowering in the moisture contents and nutrient concentration. While during the process of steaming and boiling, most of the water-soluble minerals are leached down.

Magnesium content

Table III showed the average value of magnesium (Mg) contents of peas and potatoes respectively in different treatments. Results indicate that the Mg were different in different cooking techniques at a different time interval of cooking. Microwave cooking method was found to be the best method among various cooking approaches to retain the highest percentage of magnesium (Mg) contents surveyed by the direct boiling and steaming the vegetables for 10-15 minutes. Microwave was the most reliable method. The reason behind the higher contents of ash during microwaving was due to inorganic material reservation, lowering in the moisture contents and nutrient concentration. While during the process of steaming and boiling, most of the water soluble minerals are leached down.

Table III: Mineral analysis of Peas and Potatoes exposed to different cooking methods

Treatment	Sodium (mg/100g)	Potassium (mg/100g)	Magnesium (mg/100g)	Iron (mg/100g)
Peas				
T0	39.15±1.06b	240.67±2.80c	9.71±0.61c	0.50±0.01a
T1	30.37±1.54d	185.09±2.84f	7.03±0.11e	0.41±0.02c
T2	27.07±1.95e	148.32±2.91g	5.02±0.01g	0.40±0.04c
T3	34.88±1.54c	227.39±2.55d	8.01±0.21d	0.35±0.03d
T4	29.76±1.60de	201.62±2.62e	6.02±0.01f	0.32±0.02d
T5	41.83±2.01ab	270.56±2.30b	10.22±0.23b	0.48±0.02a
T6	45.09±2.90a	275.99±2.03a	11.05±0.24a	0.43±0.02b
Potato				
T0	3.12±0.01b	232.02±5.74c	14.32±1.91b	0.17±0.02a
T1	1.14±0.03e	184.86±3.95e	10.96±2.11bc	0.14±0.01c
T2	1.06±0.03f	172.00±2.93f	9.03±1.94c	0.12±0.03d
T3	2.11±0.05c	194.47±4.55d	11.71±1.76bc	0.13±0.01e
T4	2.03±0.02d	187.63±4.67de	9.66±1.90c	0.11±0.01f
T5	3.14±0.03ab	243.54±6.15b	19.34±2.64a	0.16±0.02a
T6	3.20±0.06a	253.63±6.25a	20.69±2.56a	0.15±0.01b

Mean sharing same letter (s) don't differ significantly at p-value<0.05

Iron content

Table III showed the average value of Fe of peas and potatoes respectively in different treatments. Results indicate that the iron (Fe) were different in different cooking techniques at a different time interval of cooking. The results indicate that highest contents of iron (Fe) contents was found in vegetables subjected to microwave cooking as in comparison with boiling and steaming techniques for a time duration of 10 to 15 minutes. The reason behind that higher concentration of iron (Fe) contents is observed because there was no heat shock due to the presence of water. In divergence to the water annexation along with heating, results in the leach down iron (Fe) contents content in case of boiling and steaming.

Sensory Evaluation

For the development of a product sensory evaluation plays an important part. The most important characters of food product that consumers demand are the good appearance, aroma, flavor, firmness, and good quality. In the current experiment, peas and potatoes were subjected to different cooking methods and then analyzed for sensory evaluation of variable attributes like appearance; aroma, flavor, texture and global acceptability and tallies were noted using a "nine-point hedonic scale" to check the liking and disliking of the panelists.

Appearance

The statistical results in Table IV reveal that the ratings attributed to the appearance of the processed vegetables vary substantially between cooking regimens. After microwaving, vegetables treated to T0 received considerably higher marks for appearance, followed by vegetables subjected to T5 (microwaving for 10 minutes), and vegetables subjected to T1 (boiling for 10 minutes). T4 (vegetables steamed for 15 minutes) had the lowest marks, followed by T5 (vegetables steamed for 15 minutes) and T6 (vegetables steamed for 15 minutes (T3). This is because heat degradation of carotenoids, chlorophyll content, and cellular disruption of vegetable structures causes fading color and softening of vegetable texture. The results are consistent with those of (Joseph et al., 1984), who investigated the influence of cooking techniques on the nutritional profile of several vegetables.

Aroma

The statistical results in Table IV reveal that the ratings attributed to the scent of processed vegetables vary considerably between cooking regimens. After control, vegetables microwaved for 10 minutes (T5) had the highest score for scent, followed by vegetables microwaved for 15 minutes (T6), and vegetables microwaved for 10 minutes (T1). Vegetables exposed to boiling for 10 minutes (T1) similarly received better ratings after microwaving. The vegetables steamed for 15 minutes (T4) and vegetable steamed for 10 minutes (T5) had the lowest marks (T3). The oxidation of volatile chemicals caused a decrease in scent when steam cooked vegetables. The findings are consistent with those of (Joseph et al., 1984), who investigated the impact of cooking techniques on food quality.

Flavor

The statistical data shown in Table IV reveal that the taste scores ascribed to processed vegetables varied considerably between cooking procedures. After the control, the vegetable that had been microwaved for 10 minutes (T5) received the highest score for flavor, followed by the vegetable that had been microwaved for 15 minutes (T6). After microwaving, vegetables that had been boiled for 10 minutes (T1) likewise had higher ratings. Vegetables that were steamed for 15 minutes received the lowest marks (T4). The leach down effect and oxidation of flavoring chemicals by thermal degradation under high heat treatment were responsible for the declining trend in flavor in steam cooking. The findings are consistent with those of (Joseph et al., 1984), who investigated the impact of cooking techniques.

Table IV: Sensory Evaluation of Peas and Potatoes exposed to different cooking methods

Treatment	Appearance	Aroma	Flavour	Firmness

T0	8.63±0.11a	6.22±0.56a	7.92±0.41a	12.33±0.57b
T1	7.80±0.42c	6.15±0.34d	5.80±0.12d	7.67±0.49e
T2	7.63±0.21c	6.12±0.65e	5.20±0.76e	6.33±0.43f
T3	7.11±0.16d	5.55±0.12f	4.65±0.53f	9.67±0.52d
T4	7.56±0.12d	5.43±0.32f	4.50±0.33f	8.67±1.48e
T5	8.44±0.23b	6.20±0.22b	6.20±0.15b	11.33±0.57c
T6	8.33±0.31b	6.19±0.31c	6.02±0.37c	13.67±0.49a

Mean sharing same letter (s) don't differ significantly at p-value<0.05

Firmness

The statistical data shown in Table IV reveal that the ratings attributed to the firmness of the processed vegetables vary greatly between cooking regimens. The hardness of vegetables boiled for 15 minutes (T2) received the lowest grade, followed by vegetables boiled for 10 minutes (T1), steaming for 15 minutes, and 10 minutes. Vegetables microwaved for 15 minutes (T6) scored higher than those microwaved for 10 minutes (T5). The lower scores obtained by steam and boiling cooking were attributable to the rupture of cellular structure of vegetables and the solubilization of dietary fibre during high heat treatment. The findings are consistent with those of (Joseph et al., 1984), who investigated the influence of cooking techniques on the nutritional profile of vegetables.

Overall acceptability

Table IV demonstrates that the values allocated to general acceptability of processed vegetables varied considerably between cooking regimes. After microwaving, vegetables microwaved for 10 minutes (T5) had the best score for acceptability, followed by vegetables microwaved for 15 minutes (T6). Vegetables boiled for 10 minutes (T1) similarly received better ratings after microwaving. Vegetables that were steamed for 15 minutes received the lowest marks (T4). The results are consistent with those of (Joseph et al., 1984), who investigated the influence of cooking techniques on the nutritional profile of several vegetables.

Conclusion

Most of the important nutrients are present in vegetables such as vitamins, carotenoids, phenolic compounds, and protein. These all nutrients are important from human health point of view that is the reason the vegetables are the important food group. A deficiency of any of these nutrients can lead to serious ill-health effect on human being like muscle fatigue, cancer, heart attack and disease related to cardiovascular. To maintain the perfect health, at least recommended doses of these vegetables are very important on daily basis. Most of the nutrients are lost through the process of harvesting and cooking methods especially boiling. Such losses should be prevented by adopting most reliable, economical, and

convenient method for preserving these nutrients. Microwave cooking, steaming, and boiling are the methods which are to be followed during cooking. According to the results, microwave cooking is the best and most suitable method. Maximum benefits can be obtained by cooking vegetables for shorter period. For the retention of maximum nutrient profile avoid the overheating of vegetables.

Conflicts of interests

The authors declared that they have no conflict of interest.

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