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INFLUENCE OF PROCESSING METHODS ON THE NUTRIENT CONTENT OF ASPARAGUS SPEARS

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ABSTRACT

Changes in the nutrient contents of the asparagus (*Asparagus officinalis*, L.) spears were determined in order to investigate the influence of the blanching, pressure cooking and microwaving on spears. Standard AOAC methods were used for the analysis of parameters selected for the study. The data obtained during the study revealed a significant ($p>0.05$) decrease in the content of fat, dietary fibre, carbohydrate and ash in all the samples. However, pressure cooking resulted in increase of 1 % in fat content in the sample. Moisture and protein content increased to a level of 13%-15% and 6% to 18 % respectively in all the processed samples. Results revealed that percentage reduction of nutrients was least in blanched sample as compared to pressure cooking and microwaving. The present research suggests blanching as the most suitable technique for processing of asparagus spears for optimum nutritional advantage.

KEYWORDS: Processing, Blanching, Nutrients, Benefit.

1. INTRODUCTION

Fruits and vegetables known to be one of the perishable products are considered as major portion of our diet as they not only contain appreciable amount of major and minor nutrients but are also rich in some of the other constituents significant for the proper functioning of the organisms. Many of these substances take part in processes that prevent or limit the oxidation of cell constituents, protecting organisms against degenerative diseases. The diet rich in certain vegetables has been scientifically proved to be favourable for various disease conditions due to their bio-active components. There are epidemiological studies which report that having a diet consisting of these of these foods is strongly related with reduction of possibility of various common diseases such as cardiovascular disease, Alzheimer disease, diabetes, cancer, cataracts and age linked functional decline (Yahia et al, 2019).The disease-preventing action of vegetables dwells in the evidence that they have surplus amount of nutritional compounds, and also enormous amount of antioxidants. They contain natural antioxidants such as ascorbic acid and phenolic compounds that contribute to major defence against oxidative stress. The phenolic metabolites concentrated in these foods such as "tocopherols, flavonoids, phenolic acids, alkaloids, chlorophyll derivatives and carotenoids have high antioxidant activity and therefore possess significant health benefits" (McDermott, 2000). Asparagus is one of the most important perennial vegetables in the world which has recently received interest worldwide because of its unique taste, having high nutritive value and the presence of bioactive components.

Asparagus has traditionally gained popularity for its exquisite organoleptic characteristics, is also valued for its nutritional and functional property. It gives fewer calories, around 22 Kilo calories per 100 g, However, it is considered a major determinant of valuable components, such as proteins, amino acids and dietary fibre. Spears, which is an edible part of asparagus contains as high as 92 % moisture. Therefore, the percentage of macro-elements, proteins and fibre concentrated in asparagus, does not increase to 3-4%. . The proteins of asparagus are considered of high quality because of their content of essential amino acids, and the amount of fibre is of great interest for its chemical and functional characteristics (Fuentes-Alventosa, 2013). Additionally, the spears are also an excellent source of different vitamins of fat soluble and water soluble category. It is also a said to be very good source of varied macro and micro nutrient. In fact, it is regarded as one of the twelve healthiest vegetables. It is well documented that vegetables are nutritionally stable and they have received enormous attention as they have known to exert positive role on the health of human beings, which could be related to the antioxidants that are concentrated in them.

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Though, asparagus is very rich in nutritional and important bioactive constituents, it is considered as most unstable product which has a very short shelf life and thus has to be consumed within 2-5 days after it is harvested. It has a high respiration rate which leads to its high metabolism and in turn faster deterioration. "Postharvest deterioration of asparagus is associated with physiological changes such as an increased reduction of vitamin C, total solids, soluble carbohydrates, water content and protein and amino acids (Sun et al, 2007)". Various processing techniques have been developed over the centuries to make asparagus more useful for human masses. Vegetable processing and cooking is said to effect the composition, bioavailability of antioxidants, natural antioxidants for eg. ascorbic acid and yield in asparagus. (Amin et al, 2006)

2. MATERIAL AND METHODS

Fresh Asparagus officinalis spears were collected from the producers in Rajasthan and were transported to the lab for further preparation. The spear samples were intensively cleaned with aqueous solution, drained, and dried with paper towels to expel the water. The spears were then processed by three processing techniques of blanching, pressure cooking and microwave cooking.

In blanching a weighed amount of sample was immersed in hot water, 98ºC for 4 minutes. The proportion of water to the sample was adjusted to 5:1 by weight. After the treatment the sample was cooled in cold water and kept on sieves for 30 min, drained and kept in frozen condition, until analysis.

In pressure cooking the spears were cooked in water by adding 2% sodium chloride, the proportion of water and sample was adjusted to 1:1 by weight and then was put to boiling in a pressure cooker for a period of 5 minutes. After the treatment the material was kept on perforated sieves and cooled, drained and kept in frozen condition, until analysis.

For microwaving the sample was cooked in microwave, 80° C for 4 min and then cooled, homogenized and kept at low temperature, until analysis.

The contents of moisture, protein, fat and ash of raw and processed samples was estimated by Standard methods (AOAC)**.** The content of moisture in the samples was analysed by hot air oven method in which 10g of the spears was dried in a hot air oven at a temperature of 100°C for 4 hrs was obtained (AOAC, 2009). Ash content was determined according to AOAC (2009) method of dry ashing of the sample in muffle furnace at 600°C until grey ash was obtained. Protein was analysed by micro-kjheldhal method (AOAC, 2011) which consists of digestion, distillation and titration, then multiplying the nitrogen % with protein factor. Crude fat was determined using the soxhlet apparatus with petroleum ether as solvent (AOAC, 2009). Dietary fibre in the sample was estimated by enzymatic gravimetric method (AOAC, 2007) in which sample was treated in autoclave with heat stable amylase, amylo-glucosidase and protease to remove starch and protein and Carbohydrate was calculated by difference method (AOAC, 1990).

Data analysis

The data obtained was subjected to analysis of variance (ANOVA) and reported as mean ± standard deviation of triplicate readings. Means were separated by LSD post hoc test using SPSS software, version 20.

3. RESULTS

The proximate components of processed sample (blanched, cooked and microwave) has been illustrated in Table 1 and 2.

The mean moisture content in raw and processed (blanched, cooked and microwave) asparagus was found to be 81.29±0.01g/100g in raw and 93.71±0.02g/100g, 92.27±0.01g/100g and 93.53±0.03 g/100g, respectively. All the three processing techniques led to significant increase in moisture content as compared to unprocessed. The percentage increase of moisture content in the samples was in the range of 13.05-15.27 %. Protein content in raw and processed samples differed significantly where blanching and microwaving resulted in 17.90% and 5.67 % increase in protein content whereas cooking brought 17.03% decrease. Crude fat content in unprocessed sample was 2.21% however processing treatments resulted in 1% - 26% loss in fat content. Mean separation showed significant difference ($p<0.05$) among the paired groups except between raw and cooked samples which

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showed non-significant difference ($p<0.05$). All the three treatments influenced the dietary fibre content in asparagus. The result in the present study showed 3.89% of dietary fibre and after processing with different methods the content were 1.71% -2.56%. The result showed that there was 34.19% - 56 % decrease in dietary fibre content when compared with raw. Ash content decreased after processing in all the samples as compared to unprocessed asparagus. The percentage decrease was from 47.24% - 58.27% in the samples. Carbohydrate content showed significant difference among groups. All the procedures resulted in decrease of the content.

Table 1: Proximate composition (g/100 g) of raw and processed asparagus spears

Nutrients (%)	Raw (Mean± SD)	Blanched (Mean± SD)	Cooked (Mean± SD)	Microwave (Mean± SD)
Moisture	81.29±0.01^{bcd}	93.71±0.02^{acd}	92.27±0.01^{abd}	93.53±0.03^{acc}
Protein	2.25±0.02^{bcd}	2.7±0.01^{acd}	1.9±0.01^{abd}	2.42±0.02^{abc}
Fat	2.21±0.07^{bd}	1.72±0.02^{acd}	2.23±0.03^{bd}	1.62±0.01^{abc}
Dietary fibre	3.89±0.01^{bcd}	2.56±0.01^{acd}	1.71±0.01^{ab}	2.19±0.01^{ab}
Total carbohydrate	7.46±0.04^{bcd}	3.3±0.05^{acb}	3.71±0.05^{abd}	3.5±0.11^{abc}
Ash	2.90±0.01	1.33±0.01^{acd}	1.53±0.03^{abd}	1.21±0.01^{abc}

***Each data is the mean ±SD of three replicates.*Different letters at different columns of each parameter denote significant differences between means (LSD test, P<0.05).**

Table 2: Percentage gain/ loss of Nutrients by vegetable Asparagus submitted to different processing treatments as compared to raw

Nutrients	Blanched	Cooked	Microwave
Moisture	15.27	13.50	15.05
Protein	17.90	-17.03	5.67
Fat	-22.17	1.00	-26.69
Dietary fibre	-34.19	-56.04	-52.44
Total carbohydrate	-55.76	-50.26	-53.08
Ash	-54.13	-47.24	-58.27

(-) negative values indicate percent decrease in nutrient content

4. DISCUSSION

The analysis of proximate composition in asparagus gives the knowledge of the basic chemical constituents of food, All the three processing techniques (blanching, pressure cooking and microwaving) led to significant increase in moisture content (Table 1 and 2) as compared to raw sample. The amount of moisture is a measure of water activity in foods. The increase in moisture in processed samples as compared to raw could be due to the result of absorption of water by the fibres and due to chemical component of the vegetables (Ajala, 2009).

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Asparagus officinalis stem is found to be a good source of protein (2.25 %) as per the result found (Table 1) in the present study. When the sample was analysed on dry basis the value of protein was 32.39%. Similar value (32.69%) on dry basis was reported by Abermound, 2010; Aberoumand and Deouke, 2009. Processing techniques namely blanching and microwaving produced significant increase in protein content with respect to their raw sample. "Higher levels of protein after processing can be linked to the breakdown in tannin which is well known to form complexes with protein thereby, inhibiting protein availability in raw sample (Onu et al, 2001)". Okibe et al, (2016) reported that rise in temperature could result in severe protein denaturation in food which might cause destruction of amino acid to complete racemization.

Carmona et al, (2019) investigated that industrial processing i.e. canning resulted in 2.26 % protein which was reported to be slightly lower as compared to the present estimation for blanching and microwaving. "Komolafe and Obayanju, (2003) reported that during heating denaturation of cellular proteins occurs and chlorophyll bind to protein might be released". The chlorophyll which is released is unstable and gets changed to pheophytin, which can increase the denaturation of protein during heating**.** Protein is considered as an essential part of the human diet which is required for the replacement of tissue and for the supply of energy. Deficiency of protein can lead to growth retardation, muscle wasting, oedema, abnormal swelling of the body and collection of fluid in children (Mounts, 2000) .

Fats/lipids are present in vegetables in low amount. The fat content (2.21%) of the present study has been presented in Table 1. Processing treatments resulted in 1-26% loss in fat content. The lowest loss (1%) was observed in pressure cooking as compared to blanching (22.17%) and microwaving (26.69%). Abermound, (2010) reported higher values for lipid (3.44%). Lipids are considered to be a diverse group of molecules which consist of eight general classes for example fatty acyls, sterol lipids, phenol lipids etc. to name a few (Ezeocha and Ojimelukwe, 2012). All the processing methods studied in the present work caused reduction in lipid content in which pressure cooking of asparagus has resulted in the more retention of fat as compared to other two treatments. Blanching and cooking can result in the dispersion of fat in the boiling water that reduces the fat content. Consumption of excess fat is associated with risk of cardiovascular diseases, cancer and ageing. (Tsado et al, 2015).

Dietary fibre is that portion of diet which is resistant to enzymatic digestion. They include "cellulose, noncellulosic polysaccharides such as hemicellulose, pectic substances, gums, mucilage and a non-carbohydrate component like lignin" (Dhingra et al, 2011).Vegetables are said to be a fairly good source of fibre. The result of the present study showed 3.89% of dietary fibre and after processing with different methods the content were 1.71% -2.56%. The result showed that there was 34.19% - 56 % decrease in dietary fibre content when compared with raw. There are studies which have reported of loss of dietary fibre due to cooking of some other vegetable not the asparagus. Tatjana et al, (2002) studied the changes that take place in kidney beans and noted that the solubilisation of polysaccharides shows a reduction in total dietary fibre which results due to the loss in soluble fibres. Apparently the changes in fibre content in vegetables are attributed to the difference in the moisture content (Rickman et al, 2007). On the contrary to the present findings Nyman and Svanberg, (2002) reported an increase in dietary fibre component after in carrots after blanching. They justified the increase may be due to significant loss of dry matter in to the boiling water. The author also reported that addition of salt catalyses the degradation of dietary fibre. The present work also supports this statement as pressure cooking with the addition of sodium schloride led to significant loss in dietary fibre as compared to blanching and microwaving. Puuponen-Pimia et al, (2003) studied the effect of blanching and showed that dietary fibre components were stable during blanching, Carmona et al, (2019) reported that industrial processing resulted in slight decrease in dietary fibre content.

The estimated carbohydrate content in raw asparagus (7.46%) was found to be lower than the values reported by Aberoumand, 2010 (34.67%). Aberoumound, (2009) reported that raw asparagus contain 5% of carbohydrate. All the three processing techniques resulted in significant decrease in carbohydrate content, the percentage loss was found to be 50% -55%. The decrease in the amount of carbohydrate after cooking could be due the increase in temperature that reduced the carbohydrate content of vegetables. On heating the starch changes crystallised starch molecules to gels due to which the granules imbibe water and swell leading to its softness makes it easily dissolve in water. The findings could be explained by the specific treatments that were used, as minor alteration in time and temperature of cooking would have caused significant changes.

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The ash is regarded as a measure of the nutritionally important mineral components that are present is food substances. The ash content of the raw asparagus was found to be 2.90% Aberamound, (2010) reported higher value (10.38%) for ash content for raw sample. Carmona et al, (2019) found that industrial processing such as canning decreased ash content to 1.34% which were in accordance with the present research where the treatments resulted in lower (1.21%-1.53%) average values. Among the three processing techniques taken for the study pressure cooking showed higher loss than blanching and microwaving. The decrease in amount of ash can is linked with the reduction in the supply of essential minerals by the vegetables as they are decreased after cooking. According to Onyelke and Ogulke (2003) the decrease in ash after processing can be due to the absorption of water during the treatment that lead to dilution in the water used during the procedures.

5. CONCLUSION

The study showed that asparagus spears contain an appreciable amount of nutrients. However, processing treatments; blanching, pressure cooking and microwaving showed changes in the retention of components**.** Moisture, Protein and fat content increased while, dietary fibre, ash and carbohydrate contents decreased after processing. The study recommended blanching as the best technique for processing asparagus spears for optimum nutritional benefits.

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