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Estimation of crop residue of cabbage var. Unnathi and their nutritional value

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ABSTRACT: After harvesting of cabbage head, leaves are discarded and treated as wastes and may only be used for fertilizer or animal feed. It is interesting to transform the residue into a value added product so it is important to know the nutritional value of the residue. The study was conducted to estimate the crop residue of cabbage var. Unnathi and to estimate the nutritional composition such as protein, carbohydrates, fat, crude fibre, total carotenoids, vitamin C and total antioxidant activity in fresh and dry powder.

Key Words : Post harvest management, cabbage, nutritional value.

Crop residues are plant materials left behind in the farm after removal of the main crop produce. The remaining materials could be of different sizes, shapes, forms and densities like straw, stalks, sticks, leaves, haulms, fibrous materials, roots, branches and twigs. These residues cannot be completely extracted, because some of them have to remain on the soil to maintain soil quality (i.e., for erosion control, carbon content and long-term productivity). Most agricultural residues are not found throughout the year but are available only at the time of harvest. This makes collection easy, but creates storage problems if the residues have to be saved for use during other months of the year, especially due to its low bulk density. Fruits and vegetable residues mostly contain huge amounts of interesting compounds.

Cabbage represents an important group of plants which produce significantly large amount of biomass consisting of leaves. These assume importance in broccoli, brussels sprouts and cauliflower which have been recognized to have high levels of minerals and protein (Rosa and Heaney, 1996). Cabbage is reported to contain high amount of fibre and bioactive compounds with high antioxidant activity. However, a huge amount of waste (leaves, roots and steams) is generated during harvesting and handling of cabbage. Leaves of cabbage and cauliflower are discarded and treated as wastes which are rich anti-oxidant substances i.e. phenolic content, Vitamin C, total antioxidant activity and β-carotene content (Podsedek, 2007; Sivarin *et al.*, 2009). Not much information is available on field residue of cabbage. Often piling up of cabbage and cauliflower leaves in market is a serious environmental problem in big cities or regional mandies. These residual leaves from fields and those pilled up in the market/ mandies have great nutritional value with high fibre content, protein and bioactive compound.

Materials and Method

The present investigation on "Estimation of field residue of cabbage and their nutritional value" was carried out at the Division of Post-Harvest Technology, Indian Institute of Horticultural Research (IIHR), Hessaraghatta, Bangalore, during the year 2010-11.

Estimation of total biomass and crop residue of cabbage

Cabbage crop var. Unnathi was grown at IIHR research farm in an area of 1250m^2. Planting was taken on 17-07-2010 with spacing of 60 x 50 cm (row x plants) and all the agronomic practices were followed as per the standard package of practices recommended by IIHR. The crop was harvested after three months by judging its maturity. During each harvest, parameters were taken for 50 plants for whole plant weight, head weight, root weight, leaf weight and number of leaves. Totally 6 harvests were done depending on the matu-

Table-1 : Estimation of crop biomass and economic yield of cabbage.

Sl. No.	Parameters	Mean weight (kg)	Crop biomass for 1250 m^2 (tonnes)	Crop biomass for 1Ha (tonnes)	Per centage
1	Plant weight	3.38	6.76	54.06	
2	Head weight	2.44	4.88	38.98	72.10
3	Residue leaf weight	0.82	1.63	13.07	24.17
4	Root weight	0.12	0.24	1.95	3.60
5	Total crop residue	0.94	1.88	15.02	27.78

rity of crop. Mean of each harvest data was taken for calculation.

Preparation of cabbage residue leaf (CRL) powder

After harvesting of cabbage heads, the waste leaves were cut with hand or knife and collected in plastic crates. The leaves were washed gently with water to remove soil particles and chemical residue. The leaves were dried in tray drier (Model no. TD2A4, CM Envirosystems Pvt. Ltd.) at a temperature of 60˚C for 18 hours. The dried leaves were collected and ground to fine powder in a Willey mill. The CRL powder was collected in a polybag and they were stored in airtight plastic containers for further usage. The powder was used for further nutritional analysis.

Proximate analysis

Proximate composition like Moisture content (AOAC, 1990), protein content (Lowry's method – Lowry, 1951), total carbohydrates content (Anthrone method – Hedge and Hofreiter, 1962), crude fat content (AOAC, 1990), crude fiber content (Acid-Alkali method - Maynard, 1970), Total Carotenoids content (Spectrophotometric method), vitamin C content (Volumetric method - Herris, 1935), total antioxidant activity (FRAP method) were analyzed for residual cabbage leaves.

Results and Discussion

Estimation of cabbage field residue

Cabbage cv. Unnathi was grown in the experimental field and data was recorded on the quantity of residues generated. Table-1 reveals that the total cabbage field residue was about 27.78 per cent, of which 24.17 per cent was contributed by cabbage leaves. Waste index has been reported in cauliflower but no report is available on cabbage. The waste index in case of cauliflower is found to be comparatively higher (Kulkarni *et al*., 2001) and was quantified as 48-58 per cent of the total weight (Oberoi *et al*., 2007). In case of cabbage it was found to be 27.78%.

Proximate nutrient composition of CRL and its powder

The physicochemical parameters of fresh CRL and its powder such as moisture content, total solids, TSS, pH, protein, carbohydrates, fat, crude fibre, vitamin C, total carotenoids, and total antioxidant activity were analysed and are presented in Table-2.

Moisture content in fresh and dry CRL was 83.30 and 18.55g/100g, respectively. In comparison cabbage head contains 91. 90-92-40g/100g (Thambhuraj and Singh, 2005) and in case of dried cabbage outer leaves it was approximately 13.63±2.61 (Sivarin *et al*., 2009). The study showed that fresh leaves contained 9.87°B TSS and pH 6.39. Apart from moisture, carbohydrates is the main component which contributes 4.87 and 22.60g/100g in fesh and dry CRL, respectively. The fresh CRL contained 2.63, 0.33 and 1.96 g/100g of protein, fat and crude fibre, respectively. In dried CRL powder protein, fat and crude fibre was estimated

Table-2 : Proximate nutrient composition for 100g of CRL and its powder.

Parameters	Fresh CRL	Dry CRL powder
Moisture (g)	83.30	18.55
Total Solids (g)	16.71	81.45
Protein (g)	2.63	10.07
Carbohydrates (g)	4.87	22.60
Fat (g)	0.33	3.48
Vitamin C (mg)	365.20	535.30
Crude Fiber (g)	1.96	8.91
Total carotenoids (mg)	5.71	64.33
Total antioxidant activity (mg AEAC)	105.27	396.60
TSS ($^{\circ}$B)	9.87	–
pH	6.39	–

10.07, 3.48 and 8.91g/100g, respectively.

Recent studies showed that the phytochemicals in fruits and vegetables are the major bioactive compounds with human health benefits e.g. reduced risk of coronary heart disease and stroke, as well as certain types of cancer. Especially vitamin C, vitamin E, carotenoids and dietary flavonoids can play important roles in human nutrition, and foods rich in these compounds should be involved in an optimal diet (Du Toit *et al*., 2001). The CRL leaves and dried powder contains 5.71 and 64.33mg/100g of total carotenoids respectively. Mosha and Gaga (1999) reported that cabbage head contains 2.0±0.3mg/100g of total carotenoids on fresh weight bases.

Vitamin C helps to maintain the blood vessels flexibility and improves circulation in the arteries of the smokers (Block *et al.*, 1992 and Nagy, 1980). The vitamin C content in fresh CRL and dried powder are 365.20 and 535.30 mg/100g, respectively. Mosha and Gaga, (1999) reported cabbage, collard, turnip, sweet potato and peanut contains 45.1±0.5, 112.7±0.5, 98.3±0.0, 59.3±0.3 and 87.3±0.3 mg/100g vitamin C content, respectively.

Many of phenolic compounds have shown strong antioxidant properties as oxygen scavengers, peroxide decomposers, metal chelating agents, and free radical inhibitors (Nijveldt *et al.*, 2001). In addition they also show antitumoral, antiviral, antibacterial, cardioprotective and antimutagenic activities. Lipid soluble anti-oxidant (carotenoids and Vitamin E) are responsible for upto 20 per cent of the brassica's total anti-oxidant activity (Valentine *et al.*, 2008). The study showed that fresh CRL and its powder contains 105.27 and 396.60 mg AEAC/100g total antioxidant activity.

Cabbage represents an important group of plants which produce significantly large amount of biomass consisting of leaves. Cabbage is reported to contain high amount of fibre and bioactive compounds with high antioxidant activity. Not much information is available on field residue of cabbage. These residual leaves from fields and those pilled up in the market/mandies have great nutritional value. To overcome this problem an appropriate technology is needed to process the crop residue/wastes into value added products.

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