*IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*
*e-ISSN: 2319-2402,p-ISSN: 2319-2399.Volume 10, Issue 7 Ver. I (July2016), PP33-38*
*www.iosrjournals.org*

# Effect of Cabbage Powder on Physico-Chemical Properties of Biscuits

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***Abstract:*** *This study was conducted to prepare biscuits by the addition of cabbage powder with refined wheat flour at different levels viz. 0, 5, 10, 15, 20% in the standard formulation. The aim of this study was to find out better formulated biscuit on the basis of sensory characteristics, nutritional composition and the physical properties of prepared biscuits. Biscuit prepared by the addition of cabbage powder with refined wheat flour at the level of 10% was found to be more acceptable from sensory point of view. The nutritional compositions such as moisture, ash, carbohydrate, vitamin-C, calcium, magnesium, potassium, phosphorus of 10% cabbage powder formulated biscuit were 2.40%, 1.29%, 64.86%, 11.56 (mg/100 gm), 0.40%, 0.388%, 0.10% and 0.00125% respectively that was higher than the control level. But the nutritional composition such as protein and fat of same formulated biscuits were 7.52% and 23.93% that was lower than the control level. On the other hand, physical parameters (weight, thickness) were increased gradually with the increasing of cabbage powder percentage with refined wheat flour and physical parameters (diameter, spread ratio) were decreased gradually with the increasing of cabbage powder with refined wheat flour.*

***Key words:*** *Cabbage Powder, Physico-chemical properties, Product development, Biscuit*

## I. Introduction

Cabbage (*Brassica oleracea* ) is a leafy green or purple biennial plant having a globose head consisting of a short stem and tightly over lapping green to purplish leaves (Singh *et al*., 2006). Nutritionally, cabbage contains vitamins such as A, B, C and E. It also contains some minerals such as irons, manganese, folate, thiamine (vitamin $B_1$), riboflavin (vitamin $B_2$), calcium, magnesium, potassium, zinc etc. Moreover, cabbage is an important source of dietary fiber, antioxidant and various anti carcinogenic compounds (Adeniji *et al*., 2010; Meena *et al*., 2010; Hasan and Solaiman, 2012). The main constituents of cabbage are carbohydrates (90% of the dry weight), where approximately one third is dietary fiber and two third are low-molecular-weight carbohydrates (LMWC) (Wennberg *et al.*, 2006). Cabbage has been used as a hangover cure, to treat abscesses, to prevent sunstroke, or to cool body parts affected by fevers. The application of cabbage also include treatment of constipation, headache, skin disorders, eczema, jaundice, scurvy, rheumatism, arthritis, gout, eye disorders, heart diseases, aging, Alzheimer's disease (Tanongkanto *et al.,* 2011), peptic ulcers (Cheney, 1949)warts, pneumonia, appendicitis (Hatfield, 2004). Fresh cabbage that included in many commercial weight-loss diets (Samec *et al*., 2011), improves the bio available content of nonheme iron (Chiplonkar *et al*., 1999), as well as alternative therapies for cancer patients (Maritess *et al*., 2005; Wennberg *et al*., 2006).

The total loss due to poor post-harvest processing of agricultural products in Bangladesh when valued in monetary terms reflects a tremendous loss in economy. The main factors responsible for these huge post harvest losses are lack of proper packaging, appropriate storage techniques (Akhter, 2006; Chowdhury, 1996) and improper handling and marketing facilities of this large production. Such a situation does not only reduce the national income but also lead to malnutrition and socioeconomic problems in the country (Hossain, 1997; Islam, 2000; Mowla, 1998). To get rid of this situation there is an urgent need to increase the preservation and storage facilities. Alternatively, the produce may be utilized industrially for the production of value added products that is available throughout the year. For this purpose an appropriate post-harvest technology along with the new formulation for a new product is essential (Naher, 1998; Sultana, 2005). Although the utilization of cabbage in many types of products such as in salads, curries, soups, sauces, pickles etc are popular in many countries. However, information on the use of cabbage in bakery products such as biscuits and breads is very scantly. Due to the acceptability in all age group, longer shelf life, better taste and position as snacks biscuits are considered as a good product for fortification and other nutritional improvement (Hulya gul *et al.,* 2013). Development of biscuits incorporating cabbage powder will improve the nutritional quality as well as increase

its usage. Thus this study was aimed to develop biscuit fortified with cabbage powder and to find out better formulated biscuit on the basis of sensory characteristics, nutritional composition and the physical properties.

## II. Materials And Methods

Wheat flour, egg, sugar, salt, hydrogenated fat (delta), baking powder and other ingredients were procured from Karwan Bazar, Dhaka. Distilled water was used for the preparation of analytical reagents. Chemical and solvents used in the study were of analytical reagents grade.

### *2.1. Collection and preparation of cabbage powder*

Sound, mature and fresh cabbages were selected from local field of Thakurgaon district, Bangladesh. After harvesting they were transported to laboratory in the same day. They were washed with clean water to remove dirt and other field-damaged portion and cut in to slices (dimensions of 3 mm × 3 mm) with knife. The slicing cabbages were dried by convectional method at 60 °C for 17 ± 2 hr until moisture content decreased to 10-12%. Finally, dried leaves were ground into a grinder to form powder. The powder was then sieved in an 80 mesh sieve. Samples were packaged in airtight polyethylene bags and stored in a freezer at -18 °C for cabbage based biscuit preparation.

### *2.2. Formulation of biscuits*

The standard formula of biscuit was used for the preparation of cabbage based biscuit. Basic formulation comprised 100 g wheat flour, 25 g sugar, 30 g fat, powdered milk 5 g, salt 0.1 g, 1 Nos. egg and 2 g baking powder. Five formulations of cabbage biscuit were prepared. Only the main ingredient wheat flour was replaced with the cabbage powder at 0, 5, 10, 15 and 20% concentrations (Table 1).

**Table 1:** Ingredients for cabbage powder based biscuits

| SL. No. | Ingredients (g) | $T_0$ | $T_1$ | $T_2$ | $T_3$ | $T_4$ |
|---|---|---|---|---|---|---|
| 01 | Wheat flour | 100 | 95 | 90 | 85 | 80 |
| 02 | Cabbage outer layer powder | 00 | 05 | 10 | 15 | 20 |
| 03 | Fat | 25 | 25 | 25 | 25 | 25 |
| 04 | Sugar | 50 | 50 | 50 | 50 | 50 |
| 05 | Egg | 27 | 27 | 27 | 27 | 27 |
| 05 | Oil | 20.83 | 20.83 | 20.83 | 20.83 | 20.83 |
| 06 | Milk powder | 10 | 10 | 10 | 10 | 10 |
| 07 | Baking powder | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |

*Note.* $T_0$ = 0% replacement of cabbage powder with refined wheat flour; $T_1$ = 5% replacement of cabbage powder with refined wheat flour; $T_2$ = 10% replacement of cabbage powder with refined wheat flour; $T_3$ = 15% replacement of cabbage powder with refined wheat flour; $T_4$ = 20% replacement of cabbage powder with refined wheat flour

### *2.3. Preparation of biscuits*

Depending upon the ratio, cabbage powder and refined wheat flour was weighed in advance. Ingredients are wheat flour, sugar, salt, baking powder, milk powder and fat. Hydrogenated fat and powdered sugar was mixed together until the sugar dissolved. Required quantity of refined wheat flour, cabbage powder and milk powder was sieved on the dish. They were uniformly mixed to obtain consistent dough. By adding water, dough was made and the dough was kneaded until it softens. The dough was then sheeted to 3.00-3.5 mm thickness and then moulded by biscuit moulder. The moulded biscuit doughs were arranged on a greased tray and baked on a preheated baking oven at 400 °F for 10-15 minutes. The well-baked biscuits were cooled at room temperature and packed in high density polyethylene bags with hermetic sealing for further proximate and sensory analysis.

### *2.4. Evaluation of baking quality of biscuit*

According to AACC (2000) method, weight, thickness, diameter and spread ratio were measured to evaluate the baking quality of cabbage based biscuits. Five pieces of biscuits from each formulation were weighed simultaneously and the average weight (W) of each piece was noted. They were then placed to measure the diameter (D) and thickness (T) in cm by Vernier's caliper respectively. The spread ratio of biscuits was derived from diameter and thickness measurements. Spread ratio is equal to Diameter (cm) / Thickness (cm).

### *2.5. Sensory evaluation of cabbage powder incorporated biscuits*

Sensory quality characteristics of biscuits were evaluated by a panel of 10 semi-trained members using a 9-point hedonic scale. Before starting analysis, panellists were made well acquainted with the sensory attributes. The biscuits were evaluated for their color, appearance, flavor, texture, taste and overall acceptability. The panellists asked to rate the given sample a 9 point hedonic scale with the ratings of : 9 = Like extremely, 8 =

Like very much, 7 = Like moderately, 6 = Like slightly, 5 = Neither like or dislike, 4 = Dislike slightly, 3 = Dislike moderately, 2 = Dislike very much and 1 = Dislike extremely.

### *2.6. Proximate composition*

Moisture, crude fat, protein (using the factor 6.5 x N), ash and crude fiber content in different biscuit samples were determined as per standard methods (AOAC, 2004). Total carbohydrates value was obtained by subtracting the total of moisture, protein, fat, crude fiber and ash content from 100. Vitamin C content was determined by the method of Ranganna (1992). This method is based on the reduction of 2,6-dichlorophenol indophenol by ascorbic acid and those based on the reaction of dehydro ascorbic acid with 2,4-dinitrophenylhydrazine. The dye which is blue in alkaline solution and red in acid solution is reduced by ascorbic acid to a colourless form. The reaction is quantitative and practically specific for ascorbic acid in solutions in the pH range 1-3.5. Mineral contents such as Calcium, Phosphorus, Magnesium and Potassium were determined in accordance to the AOAC (2000) method.

### *2.7. Data analysis*

The data was evaluated by analysis of variance (ANOVA) and Duncun's Multiple Range Test (DMRT) procedures of the statistical analysis system using IBM SPSS V20.

## III. Results And Discussion

### *3.1. Proximate composition of fresh cabbage and dehydrated cabbage powder*

Proximate compositions of fresh cabbage and dehydrated cabbage leaves are showed in Table 2. The moisture content of fresh cabbage leaf was 90.57%. Fresh cabbage contained between 86.8 and 91.2% moisture (Swaminathan and Bhagavan, 1972; Tanmoy *et al.*, 2014). Drying seems to reduce moisture content by approximately 93% of total moisture presented in fresh cabbage. Hence, the moisture content of dehydrated cabbage leaf was 8.23 %. The value was higher than Tanmoy *et al.* (2014) who reported 8.33 %. The ash content of fresh cabbage leaf was 0.62 % (Table 2), which is higher than Tanmoy *et al.* (2014) who reported 0.60% ash content. On the other hand, the ash content of dehydrated cabbage powder was 6.37 %, which is lower than Tanmoy *et al.* (2014) who reported 9.43 %. Higher protein content was observed in dehydrated cabbage powder (9.45%) than fresh cabbage (1.67 %). The same trends was observed by Tanmoy *et al.* (2014) who reported that 1.77 and 17.3 % protein in fresh and dehydrated cabbage respectively. Table 2 showed that the fat and carbohydrate content of fresh cabbage (0.12 and 7.02% respectively) was significantly lower than that of dehydrated cabbage powder (3.21 and 72.74% respectively). This result is in accordance with Tanmoy *et al.* (2014) and Swaminathan and Bhagavan (1972). The vitamin C content of fresh cabbage leaf was 43.23 mg/100gm which is lower than Tanmoy *et al.* (2014) who reported 46.3 mg/100 g. On the other hand, the vitamin C content of dehydrated cabbage powder was 15.78 mg/100 g which is significantly higher than fresh cabbage. The variation in the composition of fresh cabbage leaf might be due to difference in variety, soil property, growing condition, harvesting period and maturity stage etc.

**Table 2:** Composition of fresh cabbage and dehydrated cabbage powder

| Composition | Fresh cabbage | Dehydrated cabbage powder |
|---|---|---|
| Moisture (%) | $90.57 \pm 0.41^a$ | $8.23 \pm 0.22^b$ |
| Ash (%) | $0.62 \pm 0.03^a$ | $6.37 \pm 0.08^b$ |
| Protein (%) | $1.67 \pm 0.15^a$ | $9.45 \pm 0.15^b$ |
| Fat (%) | $0.12 \pm 0.03^a$ | $3.21 \pm 0.04^b$ |
| Carbohydrate (%) | $7.02 \pm 0.05^a$ | $72.74 \pm 0.08^b$ |
| Vitamin C (mg/100 g) | $43.23 \pm 0.20^a$ | $15.78 \pm 0.27^b$ |

*Note.* The values are mean ± S.D of three independent determinations. The values with different superscripts in a row differ significantly ($p < 0.05$).

### *3.2. Sensory evaluation of cabbage powder incorporated biscuits*

The colour, texture, flavour, taste and overall acceptability of the cabbage based biscuits were evaluated by a panel consisting of 10 well trained judges. The members were asked to rate their likings for colour, flavour, texture and over all acceptability of the products by scoring points. The responded scoring point was tabulated and analyzed statistically. The analysis of variance showed that there was no significant difference among the samples with respect to colour, flavour, texture and overall acceptability at 5% level of significance ($P < 0.05$). The degree of difference among the samples was evaluated by Duncan's Multiple Range Test (DMRT). From DMRT it was observed that, from the biscuits made with cabbage powder incorporation, $T_2$ was the best cabbage powder incorporated biscuit in respect of flavour, texture, taste and overall acceptability.

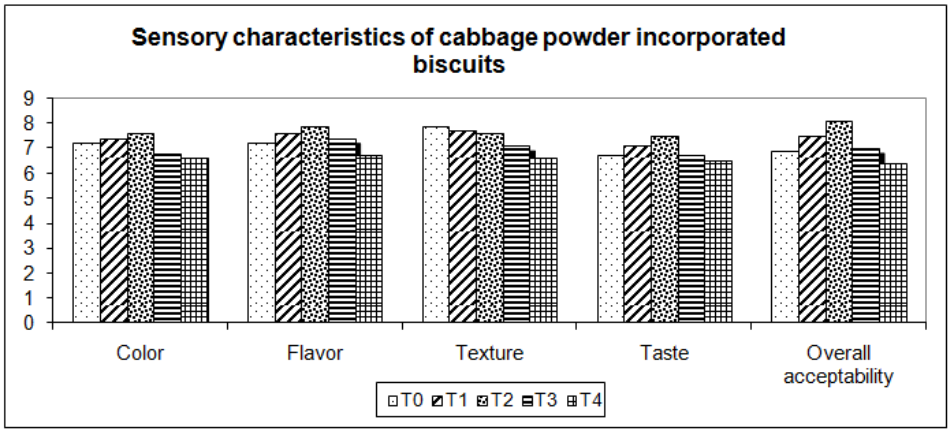


**Figure1.** Sensory characteristics of cabbage powder incorporated biscuits

The result of colour of five types of biscuit was shown in figure 1. Colour differ significantly ($p < 0.05$) among biscuits. The mean score for colour varied from 6.6 to 7.6. It was observed that the biscuit sample prepared by replacing refined wheat flour at 10% cabbage powder scored the maximum score of 7.6 and high over the control. Increase in replacement level of refined wheat flour with cabbage powder beyond 10%, reduced the likeness of biscuit with colour point of view as the colour became gradually darker due to enzymatic browning with drying cabbage powder turned to brownish colour, thus addition of this brownish powder to wheat flour also decreased the brightness of biscuits. Flavour differ significantly ($p < 0.05$) among biscuits. The mean score for flavour varied from 6.7 to 7.9. $T_2$ formulated biscuit was high score of 7.9 and $T_4$ was lower score of 6.7. The mean score for texture varied from 6.6 to 7.9 (Figure 1). Biscuit prepared from the control level was the best texture scored of 7.9 than other replacement group. Increase in replacement level of refined wheat flour with cabbage powder at 5%, 10%, 15% and 20% beyond control level the texture of biscuit became inferior and fragile may be due to increasing fiber contents and scored of 7.7, 7.6, 7.1, 6.6 respectively. $T_2$ formulated biscuit was high score of 7.5 and $T_4$ was lower score of 6.5. Increasing replacement of cabbage powder with refined wheat flour resulted bitterness that was unacceptable. The mean score for overall acceptability varied from 6.4 ($T_4$) to 8.1 ($T_2$). 10% cabbage powder with refined wheat flour biscuit was high score of 8.1. Overall acceptability was gradually decreased with the increase of replacement level of cabbage powder with refined wheat flour. For cabbage powder based biscuits, 10% secured the highest score in respect colour, flavour, taste and overall acceptability; control also secured the highest score in respect of texture (Figure 1).

### *3.3. Nutrient contents of cabbage powder incorporated biscuits*

Nutrient composition of wheat flour biscuit (control, $T_0$) and 10% incorporated cabbage biscuit ($T_2$) was analyzed for different parameters like moisture, ash, protein, fat, carbohydrate, vitamin C, minerals (calcium, magnesium, potassium, phosphorus) and the results shown in table 3. There was no significant difference observed in moisture, ash, protein, calcium and phosphorus content in control and $T_2$ formulated biscuits.

**Table 3.** Nutrient content of wheat flour biscuit (control) and 10% cabbage powder incorporated biscuit

| Nutrient content | Wheat flour biscuit (control) | 10% cabbage powder incorporated biscuit |
|---|---|---|
| Moisture (%) | $1.78 \pm 0.06^a$ | $2.40 \pm 0.06^a$ |
| Ash (%) | $1.23 \pm 0.04^a$ | $1.29 \pm 0.05^a$ |
| Protein (%) | $7.87 \pm 0.07^a$ | $7.52 \pm 0.04^a$ |
| Fat (%) | $27.62 \pm 0.07^a$ | $23.93 \pm 0.04^b$ |
| Carbohydrate (%) | $61.50 \pm 0.04^a$ | $64.86 \pm 0.03^b$ |
| Vitamin C (mg/100g) | $5.42 \pm 0.02^a$ | $11.56 \pm 0.01^b$ |
| Calcium (%) | $0.32 \pm 0.02^a$ | $0.40 \pm 0.01^a$ |
| Magnesium (%) | $0.243 \pm 0.02^a$ | $0.388 \pm 0.01^b$ |
| Potassium (%) | $0.075 \pm 0.021^a$ | $0.10 \pm 0.012^b$ |
| Phosphorus (%) | $0.001 \pm 0.0003^a$ | $0.00125 \pm 0.0002^a$ |

*Note.* The values are mean ± S.D of three independent determinations. The values with different superscripts in a row differ significantly ($p < 0.05$).

Fat content of Control and $T_2$ formulated biscuits were 27.62 and 23.93 % respectively which was supported by Kulkarni and Joshi (2013) & Noor and Mohamad (2012). Naik and Narayana (2012) reported that the fat percentage of biscuits prepared from residual cabbage leaf powder ranged from 22.8 to 23.2%. Fat content is decreased with the increase of addition of cabbage powder. Carbohydrate content of control biscuits

and $T_2$ formulated biscuits were 61.50 and 64.86 % respectively. This range is higher than Kabirullah *et al.* (1995) who reported that carbohydrate content of wheat flour biscuit ranged from 50 to 53%. It is also observed that carbohydrate content increased with the increase of addition of cabbage powder. The difference of carbohydrate contents might be due to cabbage powder incorporation in the biscuits. Vitamin C (Ascorbic acid) content of control biscuits and $T_2$ formulated biscuits were 5.42 and 11.56 mg/100 gm respectively which is nearly similar with the value mentioned by Naik and Narayana (2012). They reported 3.68 to 13.45 mg/100 g in residual cabbage leaf powder incorporated biscuits. Vitamin C content is increased with the increase of addition of cabbage powder. Magnesium content of control and $T_2$ formulated biscuits were 0.243 and 0.388% respectively. Magnesium content is increased with the increase of addition of cabbage powder. Potassium content of control and $T_2$ formulated biscuits were 0.075 and 0.10% respectively. Potassium content is increased with the increase of addition of cabbage powder. Potassium content of wheat flour biscuit was higher than the potassium content of Kulkarni and Joshi (2013) who reported 0.06%. On the other hand, Hulya *et al.* (2013) who reported 0.91% in effects of white cabbage powder on cookie quality.

### *3.4. Physical properties of cabbage powder incorporated biscuits*

The biscuits were also evaluated for their weight, thickness, diameter, spread ratio and volume. From table 4, it can be observed that the weights of all cabbage based biscuit were higher than that of the control biscuit (containing 100% wheat flour) weight. Sample $T_2$ had the highest weight which was 12.87 g. This may be due to the replacement of wheat flour with 15% cabbage powder, where the carbohydrate is higher and its moisture content is also higher. The diameter of the prepared biscuits gradually decreased from 4.95 cm to 4.21 cm with the addition of cabbage powder. Formulation $T_0$ had the largest diameter (4.95 cm). Replacement of wheat flour with cabbage powder affected the baking quality of biscuits. The spread ratio significantly influenced by the addition of cabbage in biscuit formulation. Spread ratio of control biscuit (3.72) was higher than those $T_1$, $T_2$, $T_3$ and $T_4$ formulation. The adverse effect of cabbage powder on the spread ratio of prepared biscuits may be due to the gluten reduction effect of wheat flour. There was very insignificant but increasing effect of addition of cabbage powder on the thickness of the biscuits.

**Table 4.** Physical properties of cabbage powder incorporated biscuits

| Treatment | Weight (g) | Diameter (cm) | Thickness (cm) | Spread ratio |
|---|---|---|---|---|
| $T_0$ | $11.84\pm0.46^{c}$ | $4.95\pm0.17^{a}$ | $1.33\pm0.07^{b}$ | $3.72\pm0.28^{a}$ |
| $T_1$ | $12.09\pm0.57^{c}$ | $4.87\pm0.23^{ab}$ | $1.35\pm0.05^{ab}$ | $3.62\pm0.16^{ab}$ |
| $T_2$ | $12.87\pm0.52^{b}$ | $4.68\pm0.12^{c}$ | $1.38\pm0.07^{ab}$ | $3.40\pm0.15^{b}$ |
| $T_3$ | $13.45\pm0.23^{b}$ | $4.28\pm0.11^{c}$ | $1.41\pm0.03^{ab}$ | $3.03\pm0.12^{c}$ |
| $T_4$ | $14.11\pm0.97^{a}$ | $4.21\pm0.06^{c}$ | $1.42\pm0.04^{a}$ | $2.96\pm0.08^{c}$ |

*Note.* The values are mean ± S.D. The values with different superscripts in a row differ significantly ($p < 0.05$).

## IV. Conclusion

In conclusion, this study revealed that the composition of fresh cabbage was 90.52% moisture, 0.62% ash, 1.67% protein, 0.12% fat, 7.02% carbohydrate and 43.23 mg/100 g vitamin C. On the other hand, the composition of dried cabbage was 8.23% moisture, 6.37% ash, 9.45% protein, 3.21% fat, 72.74% carbohydrate and 15.78 mg/100 g vitamin C. Biscuits were prepared by the replacing of cabbage powder with refined wheat flour at different levels viz. 0, 5, 10, 15, 20% respectively. On the basis of sensory attributes 10% replacement cabbage powder with refined wheat flour was found more preferable and acceptable. The composition of 10% formulated biscuit contains moisture 2.40%, ash 1.29%, protein 7.52%, fat 23.93%, carbohydrate 64.86%, vitamin C 11.56 mg/100 g, calcium 0.40%, magnesium 0.388%, potassium 0.10%, phosphorus 0.00125%. Physical properties measurements were revealed that weight and thickness of biscuit increased and the diameter of biscuit decreased with increasing the replacement of cabbage powder. The spread ratio significantly influenced by the addition of cabbage in biscuit formulation. Spread ratio of control biscuit (3.72) was higher than those $T_1$, $T_2$, $T_3$ and $T_4$ formulation. This study demonstrated that there is a good prospect of formulation of cabbage based biscuits as a commercial product. These will be nutritious and healthy.

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