Project Report

On

"Studies on white cabbage (*Brassica oleracea*) powder prepared by three different drying techniques"

Supervised By

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Submitted By

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Date of Submission

20 June 2019

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CERTIFICATE APPROVAL

This is certify that the research work embodying the results reported in this project "Studies on white cabbage (Brassica oleracea) powder prepared by three different drying techniques" submitted by Shah Md. Imtiaj (152-34-417) has been carried out under our collective supervision in Department of Nutrition and Food Engineering, Daffodil International University, Bangladesh and Fish Technology section, Institute of Food Science & Technology (IFST), BCSIR, Dhaka, Bangladesh. It is further certified that the research work presented here is suitable for submission for partial fulfillment of the degree Bachelor of Science in Nutrition and Food Engineering.

.....

Professor Dr. Md. Bellal Hossain

Head

Department of Nutrition & Food Engineering

Daffodil International University

.....

Professor Dr. Ahmad Ismail Mustafa

Dean

Faculty of Allied Health Sciences

Daffodil International University

LETTER OF TRANSMITTAL

Date: 20th June 2019

Professor Dr. Md. Bellal Hossain

Head

Department of Nutrition & Food Engineering

Daffodil International University

Subject: Submission of Project report

Dear Sir,

I would like to take this opportunity to thank you for the guidance and support you have provided me during the course of this report. Without your help, this report would have been impossible to complete. Daffodil International University has many more respective persons, for providing me all most supervision during my thesis in the organization.

To prepare the report I collected what I believe to be most relevant information to make my report as analytical and reliable as possible. I have concentrated my best effort to achieve the objectives of the report and hope that my endeavor will serve the purpose. The practical knowledge and experience gathered during report preparation will help me in my future professional life. I request you to excuse me for any mistake that may occur in the report despite of my best effort.

I would really appreciate if you enlighten me with your thoughts and views regarding the report.

I therefore, would like to place this report to your judgment and suggestion. Your kind advice will encourage me to perform better planning in future.

Sincerely Yours,

Shah Md. Imtiaj

ID no: 152-34-417

Department of Nutrition and Food Engineering

Daffodil International University

LETTER OF AUTHORIZATION

20June 2019

To

Ahmad Ismail Mustafa

Dean

Department of Nutrition & Food Engineering

Faculty of Allied Health Sciences

Daffodil International University

Subject: Declaration regarding the validity of the Project Report.

Dear Sir,

This is my truthful declaration that the “Project Report”, I have prepared is not a copy of any thesis report previously made any other students.

I also express my honestly confirmation in support to the fact that the said thesis report has neither been used before to fulfill my other course related not it will be submitted to any other person a authority in future

Sincerely yours

……

Shah Md. Imtiaj

ID: 152-34-417

Department of Nutrition and Food Engineering

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DECLERATION

This Dissertation entitled "Determination of **Studies on white cabbage (*Brassica oleracea*) powder prepared by three different drying techniques** is being submitted to the Department of Nutrition and Food Engineering, Faculty of Allied Health Sciences, Daffodil International University Dhaka-1207, Bangladesh as a part of partial fulfillment of the requirements for the degree of Bachelor of Science in Nutrition & Food Engineering. This project report is unique and done by Shah Md. Imtiaj's authentic hard work.

Submitted by

Shah Md. Imtiaj

ID NO: 152-34-417

Department of Nutrition & food Engineering

Daffodil International University

Supervised by

Supervisor	Co-Supervisor	Co-Supervisor
Professor Dr. Ahmad Ismail Mustafa Dean Faculty of Allied Health Sciences Daffodil International University	**Nasima Akther Mukta** Lecturer Department of Nutrition & Food Engineering Daffodil International University	**Mohajira Begum** Senior Scientific Officer Fish Technology Research Section INSTITUTE OF FOOD SCIENCE & TECHNOLOGY Bangladesh Council of Scientific & Industrial Research (BCSIR), Dhaka.

Acknowledgement

At first, I would like to express my gratitude to my creator the almighty Allah for enabling me the strength and opportunity to complete the report in time successfully.

I am grateful to my parents without whom I cannot be here. Without the support of my parents, I could not be able to achieve my objectives and goals.

My Deep gratitude and sincere thanks to the honorable Dean, Faculty of Allied Health Science, **Professor Dr. Ahmed Ismail Mostafa ,my project supervisor** for his kind cooperation and to accept this Degree.

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Finally I wish to express immense gratitude & humble convey my heart-felt respect.

Dedication

I dedicated this report to my beloved parents and all of teachers in my education life.

Abstract

Cabbage is highly nutritious vegetable abundant in Bangladesh. In winter season vast amount of cabbage grown in Bangladesh. In this study three methods were taken for cabbage preservation such as oven drying, solar drying and freeze drying. Nutritional characteristics such as moisture, ash, fat, protein, carbohydrates and energy contents of samples (white cabbage powder) obtained from the methods were compared. Phenolic constituents along with antioxidant activities of the samples were also ascertained. Minerals such as calcium, phosphorous and iron percentages were also determined. The moisture content of white cabbage powder prepared by oven drying, solar drying and freeze drying methods were 19.60%, 17.85% and 15.3% respectively. The protein content of white cabbage powder prepared by oven drying, solar drying, freeze drying methods were 12.04%, 9.68% and 15.62% respectively. The fat content of white cabbage powder by oven drying, solar drying, freeze drying methods were 15.45%, 14.35% and 7.57% respectively. The ash content of samples by oven drying, solar drying, freeze drying methods were 4.99%, 5.58% and 4.41 % respectively. The Carbohydrates contents of resultant powder by oven drying, solar drying, freeze drying methods were 47.92%, 52.54% and 57.90 % respectively. The energy content of samples by oven drying, solar drying, freeze drying methods were 415 kcal/100gm, 386kcal/100gm and 370kcal/100gm respectively. The calcium percentage of white cabbage powder obtained from oven drying method was 9.50mg/100gm which was higher than that of the samples prepared by solar drying (7.79mg/100gm) and freeze drying (8.44mg/100gm). Sample prepared by freeze drying method were of high iron content (17.577mg/100gm) than the other samples such as oven drying (11.939mg/100gm) and solar drying (15.456mg/100gm). Highest (22.352mg/100gm) phosphorus was detected in powder prepared by solar drying method. Phosphorus in samples of oven drying method and freeze drying methods were 14.630mg/100gm and 11.480mg/100gm respectively. Samples obtained from oven drying method exhibited high total phenolic contents (393.1 mg and 366.3 mg gallic acid equivalents/100gm cabbage powder sample respectively. Total antioxidant activity was determined as 8.73 µg AAE/mg fw in sample of oven drying method and 10.59 µg AAE/mg fw in sample of freeze drying method.

CHAPTER-01

INTRODUCTION

1.1 Introduction

Brassica vegetables, including cabbages, have been accounted for to contain high measure of dietary fiber (DF) and different bioactive specialists with high cancer prevention agent movement. For instance, the primary constituents of white cabbage (Brassica oleracea var. capitata) are starches, containing almost 90% of the dry weight, where roughly, 33% is dietary fiber and 66% are low-atomic weight starches (Wennberg et al., 2004). Moreover, white cabbage additionally has critical measures of cancer prevention agents, for example, ascorbic corrosive, phenolic mixes and tocopherols (Kim et al., 2004; Wennberg et al., 2004; Singh et al., 2006). Much of the time, be that as it may, up to 40% of external leaves and center of cabbages are disposed of and treated as squanders and may just be utilized for manure or creature feed. Handling these deposits, which contain dietary fiber and cancer prevention agents, could along these lines increase the value of the items.

Jon garoonta prang see et al. (2007) created high dietary fiber powder from external leaves of cabbage and detailed that the powder contained around 41–43% complete dietary fiber (dry premise). In addition, the powder had high water holding limit and swelling limit making the product attractive for some nourishment applications. Nevertheless, the impacts of pretreatment and drying on the cell reinforcement movement were definitely not decided.

To amplify the estimation of cabbage buildups, the generally speaking preparing steps must be all around characterized to get the ideal physical and healthful quality. Drying, as a standout amongst the most significant strides to create dietary fiber powder, can frequently harm products of the soil quality, particularly their cancer prevention agents. Drying can result in oxidation, warm debasement what's more, different occasions, for example, breakdown of microstructure that lead, legitimately or by implication, to bring down dimensions of cell reinforcements or their Bio accessibility in handled products of the soil. Notwithstanding drying, pretreatments with synthetic substances or whitening to hinder different unwanted enzymatic responses might be required to improve the last nature of the item. Whitening normally makes a few changes tangible also, nourishing characteristics of the items. Loss of dissolvable dietary fiber and solubilization of basic polymers such as protopectin may happen amid whitening of such high-fiber items as cabbage (Maté et al., 1998). Additionally, insoluble DF may debase into littler parts and, as a result, be lost to the whitening water (Wennberg et al., 2004).

Regarding drying, clearly drying temperature influences essentially the different bioactive mixes in natural products also, vegetables, including cabbage. Femenia et al. (1999) found that drying temperature influenced basic and utilitarian properties of cauliflower dietary fiber. Larrauri et al. (1997) noticed that high drying temperatures (100 and 140 ◦C) essentially decreased both all-out extractable polyphenols and the cancer prevention agent movement of red grape pomace strips. McLaughlin what's more, Magee (1998) found that nutrient C in potato corrupted exponentially amid drying and the rot rate expanded with the drying temperature. Negi and Roy (2000) announced that carotenes in Savoy beet corrupted by free extreme oxidation instrument and the level of oxidation relied upon the drying temperature. In this work, the impacts of high temp water whitening and tourist drying temperature on the proximate syntheses, TPC, nutrient C content just as the cancer prevention agent movement (as surveyed by the -carotene blanching technique) of dietary fiber powder acquired from cabbage external leaves were researched.

Vegetables of the cabbage gathering have for some time been utilized in human nourishment because of their high dietary benefit. They additionally have the favorable position to be developed in moderately chilly zones where different vegetables cannot be created. The most significant explanation behind the expanding enthusiasm for cabbage and cabbage results in the ongoing a long time is identified with their defensive impacts against disease (Gül et al., 2013). The fundamental constituents of white cabbage external leaves are starches, though 1/3 of them are made out of dietary flame and 2/3 of low-sub-atomic weight mixes. These leaves have a very low fat content, ie ~1% (Gül et al., 2013; Nilnakara et al., 2009). In expansion, all out radical searching exercises of 2.4-5.4 mmol Trolox counterparts g-1 (dry weight) were accounted for usingthe DPPH examine. These days, the vast majority of the external leaves and center of cabbages (up to 40%) are considered as squanders, which can be just utilized as a manure or creature feed. Numerous examinations have shown that cabbage squanders are potential wellsprings of dietary flame and cancer prevention agents, which could be recuperated and reutilized, including an incentive in various items. For example, Jon garoon taprangsee et al.

(2007) delivered powder from cabbage external leaves containing 41 to 43% of all out dietary flame (dry issue premise). On the other hand, Nilnakara et al. (2009) explored the impacts of high temp water whitening and sightseeing drying temperature amid the creation of the dietary flame powder from a similar source. They reasoned that the whitened example ried at 80oC could hold the most elevated all out polyphenol content, nutrient C, and all out cancer prevention agent movement. Even more as of late, Tanongkankit et al. (2012) researched the impact of handling steps ie cutting, whitening, and drying, on the quality furthermore, substance of glucosinolates and dietary flames of cabbage external leaves. Gül et al. (2013) assessed the

impacts of got dried out white cabbage side-effects supplement in treats by assessing their concoction, physical, dietary, and sensorial qualities, customers acknowledgment, and buy purpose. As per their results, external leaves and dried results of white cabbage could be used for readiness of treats with improved practical and nutraceutical properties. Without a doubt, various examinations have detailed the expansion of practical segments, ie fires, cancer prevention agents, furthermore, oligosaccharides, in wipe cakes (Kim et al., 2012; Lu et al., 2010; Ronda et al., 2005; Santos et al., 2013).

Drying is the most widely recognized technique for conservation of sustenance materials. This procedure improves the sustenance steadiness, since it lessens extensively the water and microbiological movement of the material and limits physical and synthetic changes amid its stockpiling. The customary technique, which is utilized in drying of natural products what's more, vegetables through daylight, isn't normal these days it requires greater investment prompting a low quality item with microbial development and low process capacity. From the opposite side

Convective sight-seeing drying is the most generally utilized strategy for the generation of dried out natural products what's more, vegetables. The primary disservices of this established drying process are the low drying out limit of the dried materials and the material shading changes amid drying. For better quality of dried leafy foods, vacuum solidify drying procedure is utilized. In any case, the freeze-drying procedure has two noteworthy disservices: enormous vitality request, lengthily drying time and subsequently high generation costs. Expanding worry for item quality and the requirement for limited handling and vitality costs prompted a increasingly nitty gritty investigation of drying of sustenance materials.

In ongoing years, far-infrared drying strategy is very mainstream elective strategy for drying of assortment sustenance materials. During the time spent infrared radiation drying, the vitality as electromagnetic wave is ingested legitimately by the item without misfortune to the earth prompting impressive vitality investment funds, uniform temperature circulations in the item amid drying, and a diminished need for wind current crosswise over and keeping great item quality . The utilization of infrared radiation in drying forms, has more points of interest looked at to sight-seeing convective drying, for example, high vitality proficiency, uniform warming of material, speeding up of drying procedure or diminishing of drying time and improved dried item quality . Albeit infrared radiation can quicken drying process, heat-touchy materials, for example, rural materials and nourishments could be harmed or on the other hand debased alongside the quality diminishing, if radiation power is not appropriately connected. Since most products of the soil are heat-touchy in nature and effectively corrupt at the nearness of oxygen, it is attractive to have the option to dry at low temperature. Lack of hydration tasks are significant

strides in the compound and sustenance handling enterprises. The fundamental goal in drying nourishment items is the evacuation of water in the solids up to a specific dimension, at which microbial decay and weakening synthetic responses are enormously limited. The wide assortment of dried out sustenance's, which today are accessible to the customer (snacks, dry blends what's more, soups, dried organic products, and so forth.) and the intriguing concern for gathering quality particulars and vitality protection, underscore the requirement for an intensive comprehension of the drying procedure. Regular air-drying is the most every now and again utilized lack of hydration task in nourishment and substance industry. In this case, the drying energy is extraordinarily influenced via air temperature and material trademark measurement, while all different procedure factors apply essentially unimportant impact (Kiranoudis, Maroulis, Tsami, and MarinosKouris, 1997).

Dried items are described by low porosity and high clear thickness (Krokida and Maroulis, 1997). Huge shading changes happen amid air-drying (Krokida, Tsami, and Maroulis, 1998), and most every now and again the dried item has low sorption limit (Maroulis, Tsami, and Marinos-Kouris, 1988).

1.2 Origin of the study

Thesis or project report is a graduation requirement for all university students. Daffodil International University & Department of NFE provide thesis opportunity for students in the university laboratory.

Purpose of this study about Cabbage Powder is as follows:

1. To find out unique information about white cabbage powder.
2. To find out the drying kinetics of white cabbage.
3. Determine the proximate analysis of white cabbage powder.
4. Differentiate about oven drying, solar drying & freeze-drying method by using white cabbage powder.
5. To learn about kjeldahl method.
6. To learn about Soxhlet method.

7. To fulfill graduation requirements

8. To learn about apparatus related to this project.

9. To learn how to use theoretical knowledge in practical,

1.3 Objective of the study

Two types of objectives are required for this study

1. General objectives

2. Specific objectives

General Objectives

It is a universal call to develop National Food Composition Database. National food Composition table of Bangladesh is incomplete. As a result, food scientist works for several years to enrich the table. Therefore, study about white cabbage powder will help to fill up gaps of the food composition table. Different institute organizes many investigations about newly foods. White cabbage powder content will enrich the National Food composition table of Bangladesh.

Specific Objectives

Specific objectives of the study are following

1. To analyze proximate nutrient profile.

2. To estimate protein and fat of White cabbage powder.

3. To know about oven drying, solar drying &freeze drying mechanism.

1.4 Limitations of the Study

Everything has some limitations. Therefore, this study also has some limitations.

Main limitation was time. Because of insufficient time, it was not enough to conduct the research properly. To make a perfect and clear research high technology and machineries required.

CHAPTER-02

REVIEW OF LITERATURE

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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 B1), riboflavin (vitamin B2), 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 nowhere iron (**Chiplonkar et al., 1999),** as well as alternative therapies for cancer patients (**Maritess et al., 2005; Wennberg et al., 2006).**

Demand for health-oriented products, which have high fibre and natural antioxidant and low calorie contents and are sugar-free, is increasing because of their beneficial effects to overcome health problems such as some types of cancer, cardiovascular diseases, hypertension, diabetes, gastrointestinal disorders and weight gain. Weight gain is inversely associated with high fiber intake of whole-grain foods but positively related to the intake of refined grain foods, which indicated the importance of distinguishing whole-grain products from refined grain products to aid in weight control. Changing nutritional habits in favor of the consumption of more fresh fruits, vegetables, whole grains and nuts would be an effective and practical approach to prevent chronicle diseases. **Bravi et al**. Reported that an inverse relationship between stomach cancer risk and various types of fiber derived, in particular, from vegetables and fruit.

Changing nutritional habits in favor of the consumption of more fresh fruits, vegetables, whole grains and nuts would be an effective and practical approach to prevent chronicle diseases. **Bravi et al**. reported that an inverse relationship between stomach cancer risk and various types of fiber derived, in particular, from vegetables and fruit.

Vegetables are good sources of natural antioxidants and dietary fiber. Among vegetables, white cabbage has been used for years in human nutrition due to its high antioxidant, polyphenol,

dietary fiber and mineral and low calorie content. The main constituents of white cabbage are carbohydrates, and around 1/3 of these carbohydrates composed of dietary fiber and 2/3 low-molecular weight carbohydrates. **Nilnakara et al**.

In the industrial process of cabbage, outer leaves are generally discarded and these wastes are used as either animal feed or fertilizer. Cabbage wastes are potential sources of dietary fibers. **Jongaroontaprangsee et al.**

Cabbage (Brassica oleracea var. capitata) is one of the important vegetable grown worldwide. It has been reported to contain high amount of DF and various bioactive compounds with high antioxidant activity such as vitamins including ascorbic acid, alpha-tocopherol and beta-carotene (Prior and Cao, 2000) and phenolic compounds such as flavonoids, isoflavone, flavones, anthocyanin, catechin and isocatechin (**Wang et al., 1996).** The cabbage leaves powder contains approximately 41-43 per cent total DF (TDF) on dry weight basis (**Jongaroontaprangsee et al., 2007).** Calcium content of cabbage is 45 mg/100 gm on fresh weight basis (Weaver and Heaney, 1999) and may increase the amount of calcium in meat products, as meat is deficient in it. Moreover, the powder possessed high water holding and swelling capacity, making it attractive for many food applications (**Nilnakara et al., 2009)**

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CHAPTER-03

METHODS & MATERRIALS

3.1 Collection of Sample

The research conducted on white cabbage grown in Bangladesh to estimate the proximate composition (Such as Moisture content, Protein, Fat). The experimental sample were collected from New Market, Dhaka, Bangladesh.

Sample: White Cabbage

Figure: 3.1. Fresh white cabbage

This sample was collected as fresh as possible and used in both NFE Lab and BCSIR for sample preparation and analysis.

3.2 Preparation of Sample

Fresh white cabbage sample peeled to remove its outer membrane. Then it washed properly and sliced into small pieces. These small pieces of cabbage dying in three different method, this are oven drying, solar drying & freeze-drying.

Oven drying : It's a continuous process it takes 10 hours to dry the fresh cabbage .This process takes in 60 and 80 degree Celsius temperature .Then the drying sample are grinding in the blender mixer. After that weighted the sample and preserved it on the Ziploc bag.

Solar drying: It is a natural process .Direct sunlight is the main source of this method. Fresh cabbage samples were taken place in the solar dryer machine. It takes almost 16-20 hours to dry the cabbage. This process takes in 35-40 degree Celsius temperature in natural sunlight .Then the drying sample are grinding in the blender mixer. After that weighted the sample and preserved it on the Ziploc bag.

Freeze-drying: Freeze dryer machine was used for this method. Sample were in the freeze dryer in for 1 day at -21 degree Celsius temperature. After that, it was drying again at -17 degree Celsius temperature for 1 day. After that, drying samples were ready for work. Then the drying sample are grinding in the blender mixer. After that weighted the sample and preserved it on the Ziploc bag.

3.3 Proximate Nutrients of White Cabbage and their function

Main proximate nutrients of white cabbage are protein, fat and carbohydrate. These nutrients provide energy. They works for growth and metabolism. Protein is essential for building and repairing tissues. These nutrients also regulate the body processes.

Protein

For daily calories intake we need to take 15-20% from protein containing food. Cabbage can be a great source for protein. Because it contain 2-3% of protein.

Fat

Fat is another essential nutrient, which we need to take every-day through fat, containing food. We should consume 30 % or less than 30% calories daily. Fat has different types such as saturated fat, polyunsaturated fat and monounsaturated fat. Saturated fat increase the blood cholesterol level, which is bad for our health. However, polyunsaturated fat decrease the blood cholesterol level. Monounsaturated fat also decrease the LDL cholesterol. LDL (Low-density lipoprotein) which is known as bad cholesterol. Because it increase the risk of heart attack.

Carbohydrate

Carbohydrate provides fuel and energy to our body. It is necessary to carry our daily activities. Carbohydrate requires our body to perform its function continuously. Purple-fleshed sweet potato has great amount of carbohydrate. Therefore, we should take it regularly.

3.4 Materials

Fresh white cabbage were collected from New Market, Dhaka Before experiments, initial moisture content of white cabbage was measured immediately using AOAC.

(1995) treatment by putting the leaves in an air circulating oven for 10 h at 60 & 80 °C. The initial moisture content of

White cabbage was 92% (w.b).

3.5 Drying of white cabbage

White cabbage distributed uniformly on a tray in an oven at 60 and 80 °C temperature. A digital balance with accuracy ± 0.001 g (Gikuru and Olwal, 2005) was used to measure the mass of samples. Leaves were dried until the readings became constant. The readings were taken in three replicates and average values were used for further analysis.

3.6 Determination of moisture:

Determination of moisture content of the raw as well as dried cabbage powder was conducted by AOAC method (AOAC, 1979).For this intention washed some of cabbage and weighted taken. The sample was allowed to dry into the oven dryer at 104 degree Celsius for 24 hours in order to remove the moisture from the cabbage sample. Drying, cooling, and weight was recognized. Moisture content was calculated by using following formula:

Calculation of moisture (%)

$\%of\ moisture =$ Weight loss /original weight of the sample taken ×100

Procedure of the moisture estimation:

a) Cut the small pieces of the sample.
b) Weighted the sample.
c) Placed into the oven.
d) Heated into the oven.
   Determination of Ash:

3.7 Determination of Ash

The fresh raw dried cabbage sample (5-6grams) were minced, weighted & ignited into the crucible. Then it transferred into the muffle furnace held at the dark side of the furnace at a rate of 550-600 degree Celsius for 6-8 hours. Until the residue was white. Finally, the percentage of the ash content was calculated.

$$\%of\ ash = weight\ of\ the\ dry\frac{sample}{original} weight\ of\ the\ sample\ taken \times 100$$

Procedure of the ash estimation:

a) Taken the small pieces of the sample.
b) Sample weight taken.
c) Heated on gas stove up to burn the sample.
d) Kept it on the furnace for 6-8 hours.
e) Sample after furnace ash weight recorded.

3.9 Determination of proteins:

Proteins are complex nitrogenous substances formed by the sub unit of amino acid through peptide linkage. Protein occupies a central position in the architecture and functioning the living matter. The crude protein of the cabbage was determined by micro kjeldhal method (pearson, 1999) . The basic principle of the method involves the conversion of nitrogenous protein into ammonium sulphate (NH_4SO_4). When boiled with sulphuric acid (H_2SO_4). Ammonium sulphate was distillation with sodium hydroxide (NaOH) gave ammonia (NH_3) which was absorbed in boric acid solution containing methyl red.The amount of nitrogen (N_2) absorbed in the boric acid was determined by titration with N/70 H_2SO_4 procedure.

Preparation of digestion Solution:

Some pieces of ash less filter paper taken and weighted in the electrical balance. The experimental cabbage sample were taken into each filter paper and they were weighted. A record was kept for the identification of the various types cabbage sample with the ash less filter paper were taken into the washed and dry 50 ml kjeldhal flask.

A mixture of BUCHI digestion unit was prepared by adding 20 ml concentrated H_2SO_4 (20%) with the traditional digestion mixture (a white powder).These were kept in the digestion unit until the mixture become clear. Thus, a watercolor digestion solution prepared.

Preparation of sample solution:

The digestion solution was made into 100ml in volumetric flasks with distilled water 5ml of sample was transferred in a micro kjeldhal distillation unit. The solution was kept for about 50 mints .Distillation was collected in access of 2% boric acid solution with indicator and was titrated by NH_4SO_4. After titration, the initial green color changes into pink color.

Calculation of protein percentage (%) :

The percentage of nitrogen in the sample calculated by the following formula

% N_2=(Titration reading-blank reading)× strength of acid×100/5×100/weight of the sample.

For the routine purpose of the % of protein in the sample was calculated by multiplying the % of N_2 with an empirical factor 6.25 for the Vegetable. Therefore % of protein =% of total N_2 ×6.25.

Estimation of protein % :

a. Pouring the sample in the test tube.
b. Adding H_2SO_4.
c. Kjeldhal machine for titration.
d. After digestion the sample increased in volume
e. Titration with NH_4SO_4.
f. Color changes to pink indicate the end of the titration.

3.10 Determination of Fat content (%):

The determination of fat content of experimental raw cabbage powder accomplished by Bligh and Dryer method. (Bligha and Dryer 1999).Each type of sample were dried into the oven and kept for 24 hours to remove moisture .Oven dried sample were meshed finely and taken into conical flasks a solvent (chloroform: methanol=2:1) was added and kept into air tight condition for 24 hours . Fat content of the cabbage sample react with the solvent and remain the solution .After 24 hours the solution of the flasks was filtered in the another weighted conical flasks .Then the flasks were given in a hot water bath to dry up and remove the solvent .After that the

flasks were last into the oven for an hour to get the actual fat content. Then the flasks were weighted in an electronic balance to get the amount of fat content.

Calculation of Fat (%) :

% of fat=weight of residue /weight of sample taken ×100

Estimation of Fat content:

a. Sample weight taken.
b. Weighted of the blank flasks.
c. Filter the sample solution soaked in solution overnight.
d. Cooling in water bath to evaporate the water.
e. Weighted of the flasks containing sample.
f. Record the weighted fat that getting.

3.11 Preparation of mineral solution for determination of minerals:

For determination of minerals like calcium (Ca), Iron (Fe) and phosphorus (P) a mineral solution was to be prepared first from the white cabbage powder sample. The mineral solution was prepared from the ash of the white cabbage powder sample of 10gms through several steps of treatment with acid, distilled water evaporation etc with and finally the mineral solution adjusted to 100 ml with distilled water. The procedure for preparing mineral solution is narrated here with for a clear idea.

The ash was moisture with a small amount of distilled water (0.5ml), 5ml HCl added were then added, and the solution warmed a boiling water bath then filtered 100 ml volumetric flasks using whatman no. 40 filtered paper. After cooling, the volume was made up to 100 ml and suitable aliquots are used for the estimation Ca, Fe & P. All result of the mineral contents were represented as mg/100g white cabbage sample.

3.11.1 Determination of Calcium (Ca)

Calcium was determined by titration method (Vogel.1978) precipitation it as calcium oxalate and titration the solution of oxalate in dilute sulphuric acid against standard $KMnO_4$ solution.

Reagents:

- Ammonium oxalate 6%
- Strong ammonium (NH_3)

- 2N Sulphuric acid
- N/100 $KMnO_4$ solution
- Calcium chloride solution
- Glacial acetic acid
- Methyl red indicator.

Procedure:

A known volume (20ml) of mineral solution was take in a suitable glassware to which a few drips of methyl red indicator was added and red color develops which were neutralized with concentrated NH_3. The color changes from red to yellow .After that it was heated boiling for few minutes with addition of 10 ml 6% ammonium oxalate. Few drops of glacial acetic acid added until the color changes to pink. The solution kept for half an hour in a warm place and solution of calcium oxalate were filtered out. The solution were transferred to conical flasks with 2N-H_2SO_4 and washed with hot water .The resultant solution at a temperature of 70˚C.

Calculation: The amount of Ca estimated by using the following formula:

1ml of N/100$KMnO_4$ =0.2004mg of Ca.

3.11.2 Determination of Phosphorus (P):

Determination of phosphorus (NIN Manual, 1970) was carried out by measuring colorimetrical blue formed when the solution was treated with ammonium molybdate and phosphomolybdate thus formed was reduced. The developed blue color was then measured at 660nm against a standard solution.

Reagents:

- Ammonium molybdate
- Hydroquinone Solution
- Sodium sulphite and
- Standard phosphate solution.

Procedure:

To an aliquot (0.1ml) of the mineral solution was added .1 ml of ammonium molybdate 1ml of hydroquinone and 1 ml of Na_2SO_3 solution in this order mixed well after each solution. The volume than made of to 40ml solution with distilled water and the solution was thoroughly mixed. After 30 min the optical density of the solution was measured in a photo electronic calorimeter, against a reagent blank (prepared in the same way as the test except that the test solution was omitted) using a red filter 60nm. The phosphorus content of the same is red of from standard phosphate solution (range: 0.01-01mg P) following the same procedure describe above.

3.11.3 Determination of Iron (Fe):

Spectrophotometric ally determined iron (Fe) content by thiocyanate method as described in practical physiological chemistry (Voget, 1978).

Reagent:

- 30%H_2SO_4 A.R
- 40% Potassium thiocynate (KCNS) solution.
- Saturated potassium persulphate A.R solution;
- Standard iron solution 0.7022g A.R

Procedure:

To an aliquots (6.5 or less) of the mineral solution enough was added (if necessary) to make up to a volume of 6.5 ml followed by 1.0ml of 30% H_2SO_4. 1.0 ml of potassium persulphate solution and 1.5 ml of 40% of KCNS solution. The red color that developed was measured within 20mins at 540mn.

3.12 Antioxidant activity assay:

In foods, antioxidants have been defined as substances that in small quantities are able to prevent or greatly retard the oxidation easily oxidisable materials such as fats. In the biological system, the definition for antioxidant has been extended to any substance that, we present in low concentrations compared to those of oxidisable substrate, significantly delays or prevent oxidation of that substrate.

Natural antioxidant, such as those derived from herbs, vegetables other plants have many advantages over chemical antioxidants (and processing procedures) currently used. They are

readily accepted by consumers as considered to be safe not a chemical. Thus no safety taste use required for legislation if a component of food is generally recognized as safe (GRAS). Natural antioxidants may function a) as reducing agent b) as free radical scavengers c) as complexes of per oxidant metals d) as quenchers of formation of singlet oxygen. They can be use in food industry and there is evidence that they exert their antioxidant effects within human body.In response to the growing consumer demand, investigation on antioxidant from natural sources gained interest.

Determination of Total antioxidant:

It the method for determination of total antioxidant capacity of the plant extracts. In this method the total antioxidant capacity of the extracts were determined by phospomolybdenium method using acetic acid as standard .Here oxidation state of molybdanium changes form Mo(IV) to Mo(V).

Require Reagents:

- H_2SO_4
- NaH_2PO_4
- Ammonium molybdate
- Acetic acid
- Distilled water.

Required Apparatus:

- Test Tube
- Beaker
- Incubator
- Test tube stander
- Pipette
- Micropipette
- Rough balance
- UV detector
- Vortex
- Rotate evaporator machine

Preparation of H_2SO_4 :

1.7 ml concentration H_2SO_4 from 60% of concentrated H_2SO_4 was taken in a volumetric flasks and distilled water was added to make the volume up to 100ml.

Preparation of NaH_2PO_4:

1.0643g NaH_2PO_4 weighted in a rough balance and then it was taken in a volumetric flasks .Then using distilled water the volume was made up to 100ml. The solution was stirred for 5 minutes using magnetic stirred for preparing homogenous solution.

Preparation of ammonium Molybdate:

0.4943 gm ammonium Molybdate weighted in a rough balance and it was taken in a volumetric flasks .Then using distilled water the volume was made up to 100ml .The solution was stirred for 5 minutes using magnetic stirred for preparing homogenous solution.

Preparation of Phosphomolybdate reagent:

40ml 0.6 M H_2SO_4, 20ml 0.28mM NaH_2PO_4 and 40 ml 4 mM ammonium molybdate solution was mixed together prepare phosphomolybdate reagent .The ratio is to 4:2:4.This solution is further used for determination of total antioxidant capacity of the prepared extracts.

Preparation of standard:

0.1g Gallic acid was weighted in a rough balance and then it a volumetric flask. Then using distilled water the volume was made up to 100ml. The solution was stirred for 5 minutes using magnetic stirred for preparing homogenous solution.

Preparation of sample solution:

0.01g of each extracts were taken in a screw cap test tube and then 100ml of water was added to it. This mixture was homogenized using vortex. This solution is the stock solution. This was stored in future use.

Evaluation of Total antioxidant capacity of prepared extracts:

The total antioxidant capacity was evaluated by the phosphomolybdate method.0.3ml of extract and sub fraction in ethanol, ascorbic acid used as standard (20 to 100ml µg/ml) and blank (methanol, water) were combined with 3 ml of reagent mixture separately incubated at 95˚ C for 90 minutes. After cooling to room temperature, the absorbance of each sample was measured 695nm against blank. The antioxidant activity is expressed as the number of equivalents of ascorbic acid and was calculated by the following equation

$A=(c\times V)/m$

Where , A= Total content of antioxidant compound ,mg/g Plant extracts, in ascorbic acid Equivalents , c= The concentration of ascorbic acid established from the calibration curve, mg/ml, V= The volume of extract (ml), and m = The weight of crude plant extract (g).

Determination of Total Phenolic Content

The total phenolic content of the extracts was determined by the modified folin –ciocalteu method (wolf et al , 2003). In this method using gallic acid as standard total phenolic contents were determined.

Required reagents:

1. Folin –Ciocalteu regent
2. Na_2CO_3
3. Gallic acid
4. Distilled water

Required Apparatus

1. Test tube
2. Test tube stand
3. Pipette
4. Micropipette

5. UV- detector
6. Rough balance
7. Magnetic stirrer
8. Screw cap test tube
9. Vortex

The total content of phenolic compounds plant extracts in Gallic acid equivalents (GAE) was calculated by using by following formula

$C=(c\times V)/m$

Where C= total content of phenolic compounds, mg/g plant extracts, in GAE, c=the concentration of Gallic acid establish form the calibration curve (mg/ml) V=the volume of extract in ml, and m=the weight of crude plant extract in g .

Figure: Preparation of white cabbage powder and analysis

Plate 01: Raw White Cabbage

Plate 02: Cutting for different drying

Plate 03: Oven drying method

Plate 04: Solar drying method

Plate 05: Freeze dryer with sample

Plate 06: prepared Freeze drying sample

Plate 07: Muffle furnace

Plate 08: ash preparation

Plate 09: drying samples

Plate 10: oven drying for getting Fat content

Plate 11: Heated the prepared samples

Plate 12: Heated the prepared samples into Hotplate

Into the Hot plate .

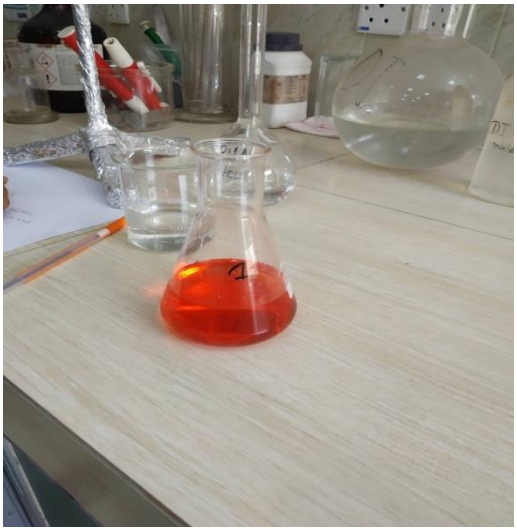
Plate 13: Sample preparation for Ca & Fe

Plate 14: Sample preparation for phosphorus

Plate 15: UV spectrophotometer

Plate 16: khejdhal mixer machine with samples

Plate 17: After heated the sample for 1 hour Plate 18: Khejdhal machine



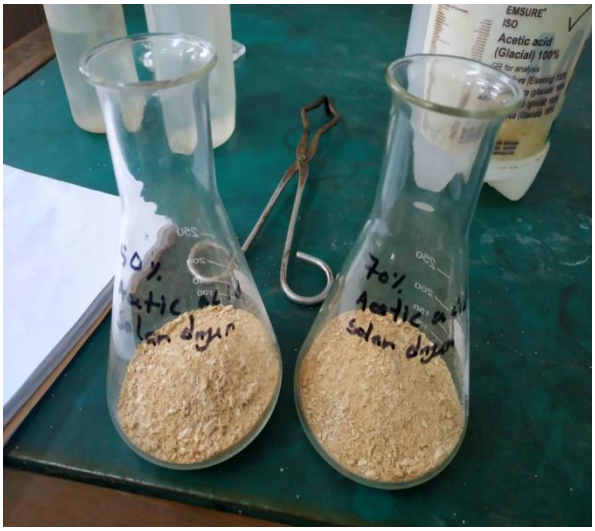


Plate 19: Titrate solution for protein Plate 20: Phenolic compound preparation

Plate 21 : Samples were engulf in acetic acid Plate 22: Rotate evaporator

Plate 23: After evaporated the extracted samples .

Chapter 4

RESULTS & DISCUSSION

4. Local, English and Scientific Name of White cabbage powder

The research was done to fine out the chemical composition of White cabbage Powder in order to estimate its nutritional value.

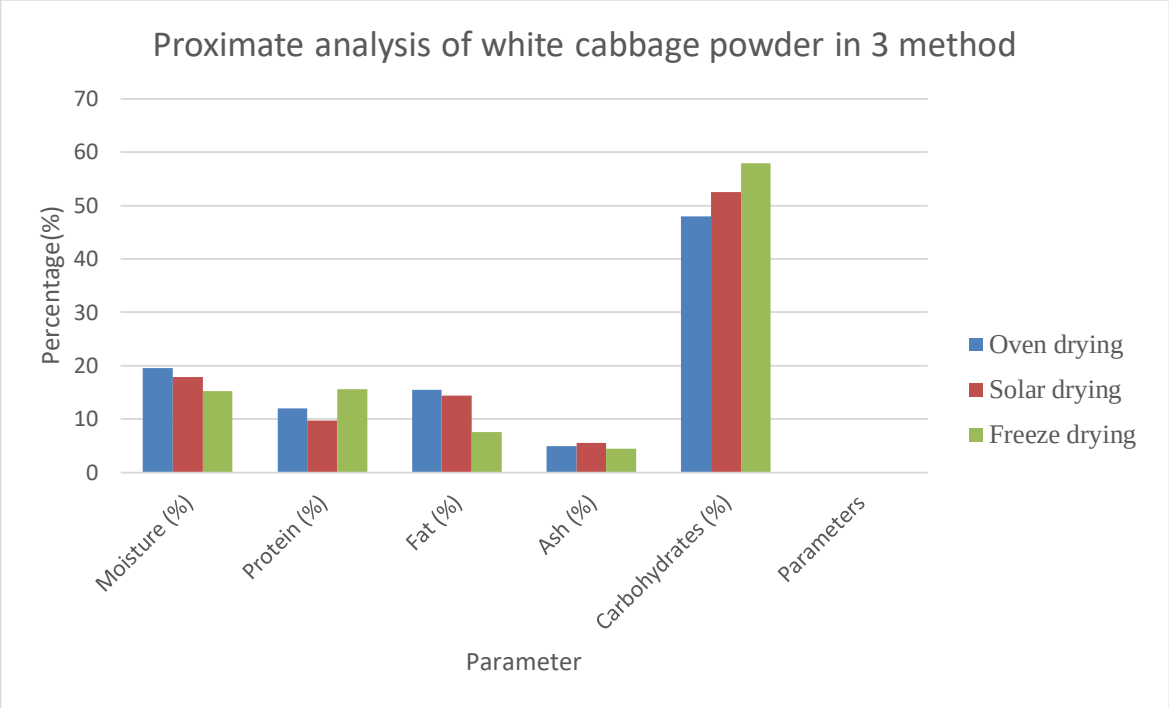
The English name, local name, scientific name of white cabbage powder are shown in table

4.1 Table: The English name, Local name, and scientific name of white cabbage grown in Bangladesh.

English Name	Cabbage
Local Name	বাঁধাকপি
Scientific Name	*Brassica oleracea*

Table4.2: Proximate Analysis of the white Cabbage Powder in three different (Oven, Solar, Freeze drying method) method.

Parameters	Sample (Oven drying)	Sample (Solar drying)	Sample (Freeze drying)
Moisture (%)	19.60	17.85	15.3
Protein (%)	12.04	9.68	15.62
Fat (%)	15.45	14.35	7.57
Ash (%)	4.99	5.58	4.41
Carbohydrates (%)	47.92	52.54	57.90
Energy (Kcal/100gm)	415	386	370



Moisture content

The moisture content of white cabbage powder by oven drying , solar drying, freeze drying method were 19.60%,17.85% and 15.3% respectively (Table 4.2).It proved that 3 different types of drying method given different proportion of moisture content .

Protein content

The protein content of white cabbage powder by oven drying , solar drying, freeze drying method were 12.04%, 9.68% and 15.62% respectively (Table4.2).It showed that cabbage have been containing very high amount of protein content .

Fat content

The fat content of white cabbage powder by oven drying, solar drying, freeze drying method were 15.45%, 14.35% and 7.57% respectively (Table 4.2).So it proved that cabbage is very much vegetable fat content .

Ash content:

The Ash content of white cabbage powder by oven drying, solar drying, freeze-drying method were 4.99%, 5.58% and 4.41 % respectively (Table 4.2)

Carbohydrate content

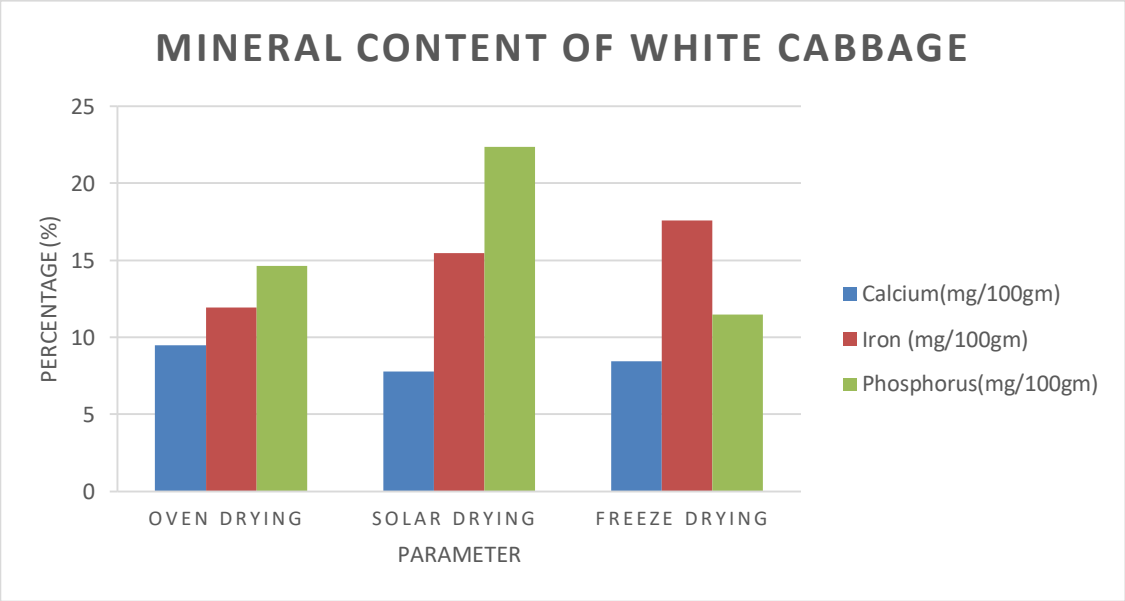
The Carbohydrates content of white cabbage powder by oven drying, solar drying, freeze-drying method were 47.92%, 52.54% and 57.90 % respectively (Table 4.2)

Energy content

The energy content of white cabbage powder by oven drying , solar drying, freeze drying method were 415 kcal/100gm, 386kcal/100gm and 370kcal/100gm respectively(Table4.2.)

Table 4.3 Mineral Content of white cabbage by three different methods (Oven, Solar and Freeze-drying)

Parameters	Oven drying	Solar drying	Freeze drying
Calcium(mg/100gm)	9.50	7.79	8.44
Iron (mg/100gm)	11.939	15.456	17.577
Phosphorus(mg/100gm)	14.630	22.352	11.480



4.3.1 Calcium content

The calcium content of white cabbage powder found in oven drying method 9.50mg/100gm by highest proportion then solar drying 7.79mg/100gm and freeze drying method 8.44mg/100gm respectively (Table 4.3)

4.3.2: Iron content

The iron content of white cabbage powder is highest in freeze drying method 17.577mg/100gm then oven drying 11.939mg/100gm and solar drying 15.456mg/100gm respectively (Table 4.3)

4.3.3 Phosphorus content

The Phosphorus content of white cabbage powder is highest in solar drying method 22.352mg/100gm then oven drying method 14.630mg/100gm and 11.480mg/100gm.

4.4 Total phenolic content (TPC)

Phenolic constitutes are one of the major group of compounds serving as primary antioxidant, especially as free radical terminators (Marja et al,1999 and Oviasogie et al ,2009). The total phenolic content of the white cabbage powder in oven drying method, solar drying method and freeze drying method extracts 70%, 50% and 30% acetic acid solution & water solution. Fresh white cabbage powder exhibited the highest total phenolic contents (393.1+/-10.8mg and 366.3+/-3.6mg gallic acid equivalents/100gm fresh cabbage powder sample respectively.

Epidemiology studies have demonstrated that consumption of fruits and vegetables with high phenolic content correlated with reduction of cardiovascular, cerebrovascular diseases and cancer mortality (Bravo, 1998). Phenolic compound in cabbage may produce their beneficial effects by scavenging free radicals (Lansky, et al ,1998) .

Phenolic compound will also be helpful for the inhibition of oxidation process initiated in food .phenolic compound have possibility to increase the self-life of the food and foodstuff.

4.5 Total Antioxidant activity (TAC)

The antioxidant activity of white cabbage powder by oven drying , solar drying and freeze drying method was determine by phosphomolybdate assay .All the extracts exhibited high total antioxidant value from 8.73 µgAAE/mg fw in oven drying method and 10.59 µgAAE/mg fw in Freeze drying method. In comparison with our cabbage verities, total antioxidant value was lower than cabbage value used in other study (Raghu et al, 2011).

Chapter 5

Conclusion

The study was conducted in the Laboratory of the Fish Technology of Institute of Food Science and Technology (IFST) at Bangladesh Council of Scientific and Industrial Research (BCSIR). The purpose of this investigation was to extensive study of proximate composition such as moisture, ash , protein , fat , carbohydrates and minerals (Ca, Fe, P) and total phenolic contents and total antioxidant properties in cabbage powder prepared from white cabbage by three different drying methods such as oven drying , solar drying and freeze drying. Comparative study on the nutritive values of samples obtained from different drying techniques can be concluded as sample prepared from freeze drying method contained high value in all considered characteristics. Further studies were required to determine total phenolic contents and total antioxidant properties of all samples. The effect of using the powder in processing of different products should also be considered. The work aimed for an academic research project, which can be utilized for the addition of worth of further work.

Chapter 6

Appendix

Parameters	List of Methods	List of instruments	List of Chemical
Moisture	A.O.A.C (2000)	Moisture analyzer Beaker Spatula	N/A
Ash	A.O.A.C (2000)	Rough balance Fume hood Oven Muffle furnace Burner Crucible Pipette	HNO_3

		Tons	
Protein	Micro kjeldahl	Rough Balance Ash less filter paper Kjeldhal flask Pipette Burner Volumetric flask Test Tube Conical flask Burette	Digestion mixture Sulphuric acid Distilled water Mixed indicator 2% Boric acid 0.02N HCl
Fat	Melenbacher (1960)	Rough Balance Soxhlet apparatus Round Joint Bottle Beaker Measuring Cylinder	N-Hexane Petroleum Benzine
Calcium	Titrimetric	Beaker Measuring cylinder Petri dish Burner Pipette Conical flask Funnel Filter paper	6% Ammonium Oxalate Methyl-red Indicator Dilute Sulphuric Acid Strong Ammonia 0.01N Potassium solution

		Burette Dropper	
Phosphorus	Boltz(1958)	Test Tube Volumetric flask Pipette Beaker UV-spectrophotometer	2.5N HNO_3 Distilled water 10% Molybdate
Iron		Test Tube Pipette Volumetric flask Beaker UV-spectrophotometer	0.1M phosphate Buffer (pH6.7) 1% starch Solution 2N NaOH Dinitrosalic Acid (DNS)
Antioxidant & phenolic compound		Test Tube Beaker Incubator Test tube stander Pipette Micropipette Rough balance UV detector Vortex Rotate evaporator machine	Folin -Ciocalteu regent Na_2CO_3 Gallic acid H_2SO_4 NaH_2PO_4 Ammonium molybdate Acetic acid

		Magnetic stirrer Screw cap test tube	

Chapter 7

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