FUNCTIONAL PROPERTIES OF FLOURS PREPARED FROM GLUCOSINOLATE – RICH VEGETABLES: ALUGBATI (*Basella rubra*)

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Abstract: This study was carried out on flour prepared from leaves of alugbati (*Basella rubra*). The material promises to be a potential functional food and had previously been shown to be rich in glucosinolates which are precursors to compounds with potential medicinal value. The functional properties of alugbati and wheat flours as well as a 1:1 composite of alugbati and wheat flours were compared. Water absorption and fat absorption capacities, swelling capacity, solubility, foaming and emulsification capacities were found to be highest in alugbati flours and lowest in wheat flour. The addition of alugbati to wheat flour resulted in significant enhancements in these properties. A 6% mixture of alugbati flour and water was seen to form a stable gel while much higher concentrations (17%) were required for wheat flour. Bulk densities decreased in the order wheat, wheat – alugbati composite, alugbati flour. The leaves of alugbati are rich sources of compounds with potential biological activities and health benefits to humans. This study showed that the flour prepared from them also possesses functional properties that can be useful in various preparations. The applicability of alugbati flour in food preparations can best be based on its high hydration, fat absorption and emulsifying capacities as well as its ability to form aggregates resulting in gel – like networks.

Key Words: alugbati; glucosinolates; functional properties

1. INTRODUCTION

Flour prepared from leaves of alugbati (*Basella rubra)* was investigated for functional properties to evaluate its possible application in food products. The plant is a readily available food source and grows in all kinds of soil. The leaves are rich in ascorbic acid and minerals like potassium and calcium. They have also been found to contain significantly high levels of glucosinolates, sulfur - containing secondary metabolites that are precursors to biologically active products that have the potential to inhibit, block and prevent the proliferation of cancer cells (Garza and Talento, 2011).

The solubility, water – absorption, swelling, foaming, emulsification, gel formation, fat absorption capacities and bulk density of alugbati flour were compared with those of wheat flour.

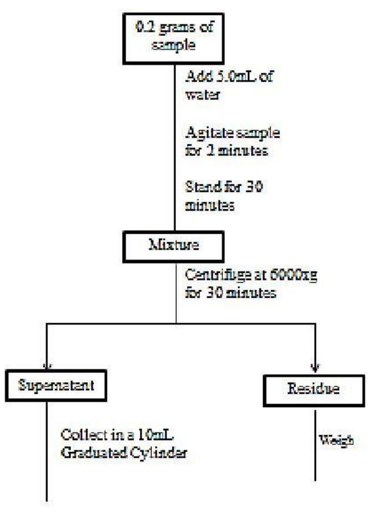
2. METHODOLOGY

Sample Preparation

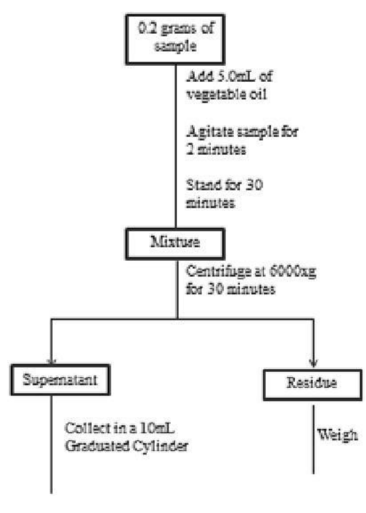
Alugbati leaves obtained from plants grown in a backyard garden were washed with water to remove adhering oils, dirt and extraneous materials. The leaves were then freeze dried and milled using an electrical grinder producing a flour. The fine flour was used in the determination of functional properties along with commercial wheat flour and a 1:1 mixture of alugbati - wheat flour.

Determination of Functional Properties

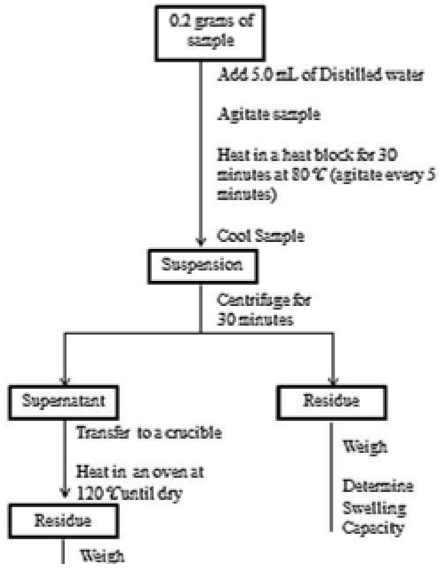
Flours were analyzed for water absorption (Scheme 1), fat absorption (Scheme 2), swelling capacity and solubility (Scheme 3), foaming capacity and foam stability (Scheme 4), emulsifying capacity (Scheme 5), bulk density (Scheme 6) and gel formation (Scheme 7) using modified methods based on literature (Adeleke and Odedeji, 2010).



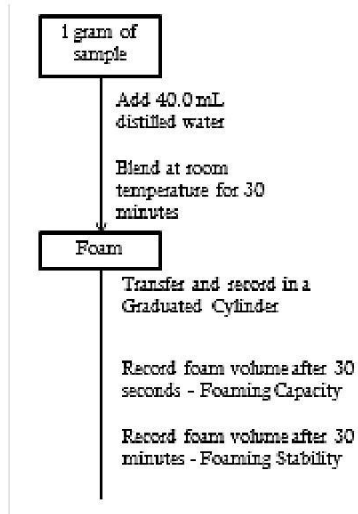
Scheme 1. Water absorption capacity



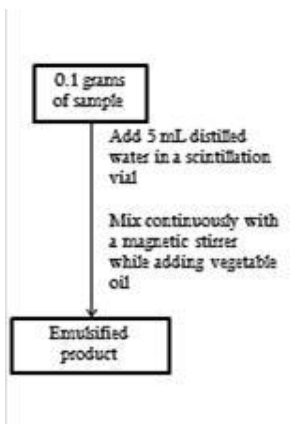
Scheme 2. Fat absorption capacity



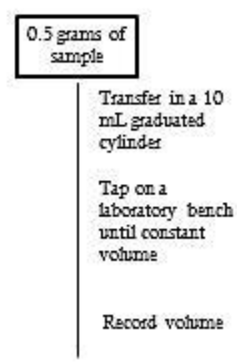
Scheme 3. Swelling capacity and solubility



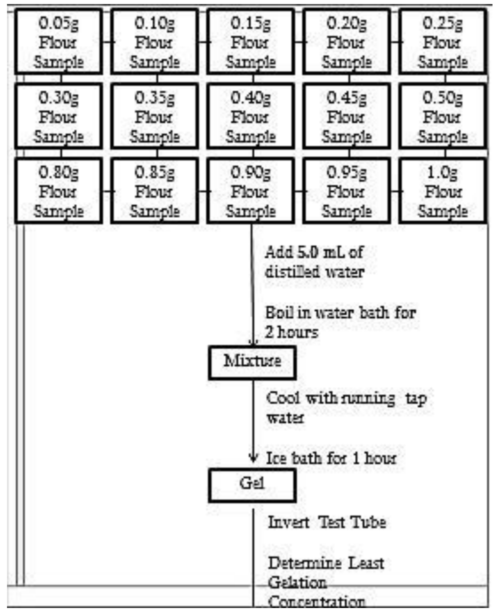
Scheme 4. Foaming capacity and stability



Scheme 5. Emulsifying capacity



Scheme 6. Bulk density



Scheme 7. Gel formation capacity

3. RESULTS AND DISCUSSION

Alugbati flour, wheat flour and a blend consisting of a 1:1 mixture of wheat and alugbati flours were analyzed for their functional properties. Mean values were obtained for various functional properties of the flours and a summary is given in Table 1.

Water holding capacity (WAC) is a measure of flour-water interactions that takes place in a lot of food systems. It depends on the ability of a protein or polysaccharide matrix to absorb, retain, and physically entrap water against gravity(Traynham et al., 2007). It would affect a flour's thickness, viscosity, maintenance of freshness and handling characteristics. Water absorption capacity is also linked to the ability of a flour to produce a viscoelastic dough, which gives rise to the dough's flexibility and capacity to be stretched and molded. A high WAC is an important attribute of an ingredient in food systems that need hydration for their textural and handling properties. The high WAC of alugbati flour and its ability to increase water absorption when added to wheat flour makes it a useful ingredient for food preparations such as soups, dairy products, beverages, coffee creamers, candies, gravies and baked products (Sirivongpaisal, 2008).

Fats and oils have been used since prehistoric times as an ingredient added to modify mouth feel, retain flavor and increase palatability of a food product. They also contribute to a food's aroma, creaminess, plasticity and smoothness. Because of its high fat absorption capacity and its ability to increase fat absorption capacity of wheat flour, alugbati flour can be a desirable additive to food that loses fat when it is processed. These include meats and bakery products such as cakes, sponges, laminated products, biscuits, cookies, pastries, crackers, doughnuts, bagels, and hot plate products (Cauvain and Young, 2006).

Table 1. Functional properties of alugbati flour, wheat flour and alugbati – wheat flour composite

Functional property	***Alugbati Flour***	***Alugbati Flour + Wheat flour***	***Wheat Flour***
Water Absoption Capacity (g/g)	32.530± 1.7536	11.225 ± 0.3606	$1.067 \pm 7.0711\text{x}10^{-4}$
Fat Absorption Capacity (g/g)	33.725 ± 0.06364	30.115 ± 0.502	25.270 ± 0
Swelling Capacity (%)	$1.0973 \pm 2.758\text{x}10^{-3}$	$1.087 \pm 6.293\text{ x}10^{-3}$	$1.077 \pm 4.243\text{x}10^{-4}$
Solubility	23.005 ± 0.8416	19.975% ± 2.0293	9.870% ± 0
Gelation Capacity Least gelling concentration (%)	6%	7%	17%
Bulk Density (g/cm3)	$0.146 \pm 7.0711\text{x}10^{-5}$	0.269 ± 0	0.854 ± 0.01952
Foaming Capacity (%)	54.55%	43.14%	28.89%
Foaming Stability (%)	38.18%	38.78%	19.05%
Emulsifying Capacity (mL/g)	80%± 0	45%± 7.0711	45%± 7.0711

Gelation includes the unfolding or dissociation of polymeric molecules which is followed by aggregation that later forms a gel (Ohr, 2001). Gelation capacity refers to the ability of a food to form heat – induced gels and give texture that is determined by its molecular structure, interactions with other components and other conditions. The results of this work have shown that alugbati flour is capable of forming a gel at much lower concentrations than wheat flour and thus, can be a good gelling agent. Gelling agents sustain moistness, improve texture, thickness and mouth feel of products that are needed in food such as soups, custard, sauces, yogurts, gelatins, ice creams and puddings.

In comparison to wheat flour, alugbati had a much lower bulk density. Bulk density determines the container size and strength of the reconstituted food and alugbati flour would therefore require bigger but not necessarily stronger packaging materials. As food ingredients, flours with lower bulk densities allow incorporation of other additives like fat, protein *etc.*, a property useful in many bakery products.

The foaming capacity of food products is dependent on the distribution of gas bubbles in liquid or semisolid phase. Foaming enhances visual appeal and texture of food. Food systems that require high foaming capacity and stability are cakes, sponges, breads, icing and whipped creams (Atuonwu and Akobundu, 2010). On the other hand, foods that require low foaming capacity and stability are biscuits, cookies, and crackers. The proper application can then be determined for alugbati flour which has been shown to have higher foaming capacity than wheat flour.

Emulsifying capacity involves many chemical and physical factors and depends on the properties of the stabilizer and varies with the type of protein content, concentration, pH, ionic strength and viscosity of the system. Our results show that alugbati flour has a high emulsifying capacity, a property that can be useful in doughs and batters, and in food systems like meat, pancakes, cakes, sponges, biscuits, cookies, pastries, crackers, ice creams, doughnuts and hot plate products (Atuonwu and Akobundu, 2010).

4. ACKNOWLEDGEMENT

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