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INVESTIGATION OF PEA POD CHEMICAL CONSTITUENTS RESPONSIBLE FOR WATER TREATMENT

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ABSTRACT

Natural coagulants are considered affordable and efficient substitutes to chemical coagulants for use in developing countries where raw materials such as Cicer arietinum (green pea) are readily available. This study investigates a suitable method of processing Pea pod for application in water treatment and investigates the Pea pod chemical constituents responsible for water treatment. Phytochemical analysis was firstly conducted on the Pea pod of the plant to confirm the presence of Chemical and bioactive constituents of Pea pod that was responsible for the water treatment. The result analysis confirmed the presence of Aspartic/Glutamine Protein (amino acid) as the active agent having phytodisinfectant/antioxidant, phytocoagulant softening property in water purification and constituted the photochemical. It was recommended research should be conducted on the type and extent of these antioxidant and antibacterial substances, on the modes of attack of the Pea pod extracts on microorganisms and other parts of Pea should be investigated to find its chemical constituents.

KEYWORDS: *Pea Pod, Chemical constituents, Water treatment*

1.0 INTRODUCTION

Turbidity in water occurs due to the presence of colloidal particles which can mainly be treated by the use of coagulants. This happens due to the presence of polyelectrolyte, proteins, lipids, carbohydrates and alkaloids containing –COOH and free –OH surface groups in the seeds (National Research Council, 2006). For instance, comparative study on the coagulation property of *M. oleifera* seed and pod extract by Modibbo (2016) reported promising results

Coagulation with extracts from natural and renewable vegetation have been widely practiced (International Crops Research Institute for the Semi-Arid Tropics, 2014).

Coagulation takes place when coagulants contain significant quantities of water-soluble proteins which carry an overall positive charge when in solution. The proteins bind to the predominantly negatively charged colloidal particles. Coagulation happens when the positively and negatively charged particles are chemically attracted together. They can then accumulate to form larger and heavier particles that settle easily, reducing turbidity level of the given water sample (MRWA, 2003). Coagulation may also improve the microbiological quality of water (MRWA, 2003)

Cicer arietinum (green pea) is a legume of the subfamily Faboideae of the flowering plant family (Saha *et al.,* 2014). It is known as gram or Bengal gram

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or Egyptian pea. Ancient people associated pea with medical uses. It is widely grown in India, Turkey, and Nigeria. It is an annual plant with a life cycle of one year. The immature peas are used for vegetable. Fresh, canned or frozen matured peas are used as dry peas or slit peas. It is starchy, high in fiber, vitamins, minerals, proteins and lutein. The dry weight obtained is approximately 1/4 protein, and 1/4 sugar (Saha *et al.*, 2014). Various researches on the nutritional value of pea were conducted by a number of researchers including Meenakshi (2015), and on its coagulating characteristics by Marina *et al.* (2005). In addition, Saha *et al.*, (2014) reported that the presence of bioactive compounds in pea pod is equal to that present in pea cotyledon or seed. As such, this research focuses on investigate the Pea pod chemical constituents responsible for water treatment.

The aim of this research is to investigate a suitable method of processing Pea pod for the application in water treatment and investigate the Pea pod chemical constituents responsible for water treatment

2.0 METHODOLOGY

SAMPLE COLLECTION AND PEA POD SEED EXTRACT PRAPARATION

Some amounts of peas were procured locally from Yankaba market Kano, and the pods were separated from the seeds, dried under the sun for about 7days. The pea seed and pea pods were separately ground to fine powder using the mill of a domestic blender. All ground materials were sieved through 0.4-0.6mm BS membrane sieve, and then fractioned with particle size less than 0.4mm was used in the experiments. Mature pea seed and pea pods showing no signs of discoloration, softening or desiccation were used (Musa, 2016)

PHYTOCHEMICAL ANALYSES OF PEA POD

Complete proximate standard procedure analyses of the pea seed and pod were done in department of animal science and also in biochemistry department Bayero University Kano.
Also chemical composition analysis was conducted at NGS Kaduna as follows:

ANALYSIS

Energy Dispersion X-Ray Fluorescence (EDXRF) spectrometer of model "Minipal 4" was used for the analysis.
About 20g of the powdered sample carefully placed in a sample cup. The cup and the sample were placed in measuring positions on a sample changer of the machine. The following condition sets were made as the machine was switched on.

- Elemental composition determination
- Nature of the samples to analyzed as press powder (pellet)
- The current used as 14kv for major oxides, 20kv for the trace elements/rare earth metals (oxides).
- Selected filters were "Kapton" for major elements, Ag/Al-thin for the trace elements/rare earth metals.

The selection of filters was guided by a given periodic table used for elemental analysis. Time of measurement for each sample was 100 seconds and the medium used was air throughout.

The machine was then calibrated by the machines gain control, after which the respective samples were measured by clicking the respective positions of the sample changer.

LOI was determined gravimetrically by heating 1g of the powdered sample in a cleaned weighed crucible at 1000^0C. After which the crucible and the content was weighed to get the difference in weight before and after heating.
LOI = ((a-b)/1) x 100% = H_2O^+
Where a = weight of crucible + 1g of the sample before heating
b = weight of crucible + 1g of the sample after heating

3.0 RESULT AND DISCUSSION

A. Table 4.1.1: PROXIMATE ANALYSES OF PEA POD SAMPLES

Constituents	Pea pod sample A (%)	Pea pod sample B (%)
ASH	7.62	7.43
MOISTURE	3.98	4.33
CP	8.49	9.06
CF	20.15	19.77
Ee	1.10	0.97
CHY	33.38	32.90
NFE	62.64	62.77

%ASH: % Ashing
%MOIST: % moisture content
% CP: % Crude protein content

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% CF: % Crude fibre content
% Ee: % Fat content
% CHY: % Carbohydrate content
% NFE: % Nitrogen Free Extra content

Pea pod chemical oxides analysis was done at National Geoscience Research laboratory Kaduna, Nigeria with reference number (LABORATORY REPORT: NGRL/OP/5334/3222). The following chemical oxides of pea pod were confirmed.

B. Table 4.1.2: PEA POD CHEMICAL OXIDES

OXIDE COMPOSITION	% CONTENT
SiO_2	4.00
Al_2O_3	43.20
P_2O_5	5.90
K_2O	32.30
Na_2O	1.08
CaO	ND
TiO_2	ND
Cr_2O_3	ND
V_2O_5	ND
MnO	0.24
Fe_2O_3	1.90
CuO	0.80
ZnO	0.53
Br	ND
SrO	ND
ZrO_2	ND
Ag_2O	ND
As_2O_3	0.08
BaO	ND
effLOI	9.46
PbO	0.51

ND = Not Detected

The result of physiochemical analysis of the pea pod shows the presence of Protein (amino acid) as the active agent having phytodisinfectant/antioxidant, phytocoagulant and softening property in water purification and constituted the photochemical. Photochemical are chemical compounds formed during the plants normal metabolic processes (Musa 2016).

Protein is reported to be the main component responsible for coagulation-flocculation process. Research by Udaya *et al.,* (2013) finds that the extraction of Pea showed the presence of active agents close to masses of Aspartic/Glutamine. Research by Meenakshi (2015) on the chemical analysis of pea pod powder shows almost the same presence of chemical constituents found in the pea pod powder which are responsible for coagulation.

The presence of polyelectrolyte such as proteins and carbohydrates containing –COOH and free –OH surface groups in the pods was confirmed, since most of the particles in water are negatively charged, any positive ion like sodium compound contributes a monovalent ion Na^+, a Calcium compound contributes a divalent Ca^{2+}, Aluminum and Iron compounds contributes trivalent ions Al^{3+} and Fe^{3+} which will neutralize the negative ion in H_2O compounds, bind them together and form heavier turbid particles reducing turbidity level. The mechanism for hardness removal is adsorption and conversion of soluble hardness-causing substances to insoluble products by precipitation while the mechanism of disinfection is ant oxidation.

Bichi (2013) reviews that the active ingredient responsible for coagulation in *M. Oleifera* was polyelectrolyte, and this also applies to other natural coagulants (including pea pod extract).

Similar properties was reported by Yongabi *et al.,* 2010 that *M. oleifera* seeds, *J. curcas* seeds and calyx of Hibiscus sabdariff pocess both phytodisinfectant and phytocoagulant property in water purification.

4.0 CONCLUSION AND RECOMMENDATION

A suitable method was employed for the Pea pod processing and phytochemical analysis confirmed the presence of Aspartic/Glutamine Protein (amino acid) as the active agent having phytodisinfectant/antioxidant, phytocoagulant softening property in water purification and constituted the photochemical.

It was recommended research should be conducted on the type and extent of these antioxidant and antibacterial substances, on the modes of attack of the Pea pod extracts on microorganisms and other parts of Pea should be investigated to find its chemical constituents.

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