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Comparative proximate analysis of whole seed sesame, dehusked sesame and sesame husk

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ABSTRACT

The proximate composition (protein, ash, moisture, fiber and carbohydrate) of whole seed sesame, dehusked sesame and sesame husk were estimated using the association of official analytical chemist methods and carbohydrate was determined by difference. The seed had about 49% oil content determined by soxhlet extraction with n-hexane as solvent. The mean value for ash in whole grain, dehusked and husk was 34.7 ± 0.42, 34.5 ± 0.71 and 22.0 ± 0.71, respectively. The mean value for protein in whole seed was 9.85 ± 0.07, 1.30±0.14 for dehusked and 3.75 ± 0.07 for the husked sample. The result also shows the mean value of fiber for whole grain, dehusked and husk to be 13.65 ± 0.49, 6.85 ± 0.21 and 8.35 ± 0.21, respectively. The mean value for moisture in whole grain was 49.25±1.06, while dehusked and husk recorded 61.85 ± 0.92 and 24.7 ± 0.42 respectively. The mean value for carbohydrates in whole grain was 90.65 ± 0.63, 93.8 ± 0.42 for dehusked and 140.1 ± 0.85 for husked. From the result obtained, it was concluded that there is a significant difference in ash, moisture, fibre, protein and carbohydrate content between the three groups (sesame whole grain, sesame dehusked and sesame husk). The protein and fiber content decreases, moisture and carbohydrate content increases while ash content remains relatively the same after the dehusking process which shows depletion of some nutrients.

Keywords: Sesame, proximate, husk, dehusked, whole seeds.

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INTRODUCTION

Sesame (*Sesamum indicum*) belongs to the family of Pedaliaceae, it is among the oldest oil seed crops used by humankind globally due to its easiness of extraction (El Khier et al, 2008). It is known as Simsim in Arabic and Ridi in Hausa, besides being a source of oil, it also serves as a source of income (Bedigian and Van der Maesen, 2003). Sesame is grown in many parts of the world on over 5 million acres (20,000 km^2). The top 5 producers of the crop in 2021 were Myanmar, India, China, Sudan, and Tanzania. Seventy (70) percent of the world's sesame crop is grown in these 5 top countries (HL Agro, 2021). The presence of secondary metabolites makes sesame to be highly medicinal; sesame oil shows the highest resistance to rancidity when it is used as an olive oil substitute. In ethno-medicine, oil is used for the treatment of hair, skin, teeth, bone, and lung-related problems (Hansen, 2011). Oil is used in products like hair oils, perfumes, cosmetics such as skin conditioning agents and moisturizers (Patil et al., 2015). Besides medicinal importance, it is also used in industries for making sweets and other baked products (Bedigian, 2004). It is believed that sesame originated in Africa and then spread through West Asia, India, China and Japan. Because of its low production, sesame ranks ninth (9th) among the top thirteen oilseed crops in the world (Adeola et al., 2010). *Sesamum indicum* is an annual plant, which varies in height from 0.5 to 2 m, it has a large taproot and a diverse surface mat of feeder roots, which makes it resistant to drought. The seeds are very small and have no endosperm; the seed can either be white, grey, brown, or black (Adeola et al., 2010). The oil extracted from the seeds could be used for cooking, massage and health treatment of the body (Adeola et al., 2010). It is cultivated in tropics and temperate zones throughout the world. The largest commercial producers of sesame are India, China and Mexico (Morris, 2002).

Dehusking of whole grains like fonio, corn and maize has become a day-to-day activity in our local communities, during food processing some individuals may like to use the whole seed while others may like to dehusk it before being processed.

Nigeria as a country is faced with the problem of feeding its teeming population; therefore, it is important to explore local biodiversity such as millet which is at present underutilized. In many developing countries such as Nigeria, malnutrition is an endemic dietary problem characterized by protein-energy malnutrition and micronutrient deficiency.

The determination of the nutritional composition of wholegrain sesame, dehusked sesame and pearl sesame husk will go a long way in providing information (nutritional data) which in turn will create awareness about the underlying potentials of this underutilized oil seed, hence increasing utilization of both industrial and household levels, thereby going a long way in achieving the core objectives of this country in feeding its teeming populace with safe and nutritious food. The aim of this research therefore is to investigate the proximate composition of whole-grain sesame, dehusked sesame and sesame husk. The study will justify whether or not dehusking leads to a reduction of vital nutritional contents that are of uttermost importance to one's health.

MATERIALS AND METHODS

Sample collection and treatment

The sample under study was bought from the central market of Sokoto State Nigeria, comprising several sesame seeds with their hulls or husks. The seed samples were divided into two, one portion containing the husks and seeds was ground into fine powder in a wooden laboratory mortar with a pestle and the other half was dehusked or de-hulled and then ground to powder, the removed husks were used as the third set of sample. The dehusking was done by gentle pounding of the whole seeds in a mortar with a pestle and then put in a tray from which the separation of husk from the seeds was done by winnowing. Hence, there were three sets of samples: seed + husk sample, seed only sample, and husk samples. All samples were shade-dried for 5 to 7 days and packaged in polyethylene bags for proximate analyses.

Determination of oil content

This determination is by the soxhlet extraction technique which employs an extracting solvent which is n-hexane mixed with the ground dried sesame seeds set up in a reflux system. The solvent is recovered using the rotary evaporation technique.

Determination of ash content

1.0 g of the sample was accurately weighed in a platinum crucible and recorded as W_1, this was transferred to a muffle furnace at the temperature of 550°C for 8 h until a white ash was obtained. The platinum crucible was removed and placed in a desiccator to cool and then weighed, the value was recorded as W_2. Percentage ash was calculated as:

% ash = (W_1-W_2/weight of sample used) × 100

The analysis was done in triplicate and the mean value was then calculated.

Moisture

5 g of the sample was weighed in a Petri dish and dried in an oven at 105°C temperature for 6 hours until a constant weight was obtained. The sample was weighed after cooling in a desiccator.

Moisture (%) = [Loss in weight / Weight (g) of sample] × 100

The analysis was done in triplicate and the mean value was then calculated.

Determination of crude fibre

2 g of the sample was placed in a conical flask and 20 ml of distilled water and 10% H_2SO_4 were added and then fixed to boil for 30 min. The sample was filtered with a muslin cloth and rinsed with warm water. The sample was scrapped into a flask with the aid of a spatula. 20 ml of 10% NaOH was added and placed on a heater again to boil for 30 min. The sample was filtered using muslin cloth and ethanol was used to rinse the sample once again, it was allowed to drain and the residue was scrapped into a crucible. The crucible was then placed in an oven to dry at 105°C for 1 h after which weight was taken (W_1). The weight of the crucible and the fresh sample gives W_2. The crucible with the fresh sample in it was then placed in a muffle furnace to ash for 2 h at 550°C and allowed to cool in a desiccator and weighed again (W_3). Percentage fiber was then calculated as:

$$\% \text{ crude fibre} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

The analysis was done in triplicate and the mean value was then calculated.

Crude protein

1 g of each sample was weighed into a digestion flask.

10 g of potassium sulphate, 0.7 g mercuric oxide and 20 ml of concentrated sulphuric acid were added to the sample in the digestion flask. The flask was heated gently at an inclined angle until frothing subsided and boiled until the solution became clear. This was continued for half an hour. When the frothing was in excess, a small amount of paraffin wax was added. On cooling, 90 ml of distilled water was added and mixed. A small piece of pumice was added to prevent bumping. 80 ml of 2 M sodium hydroxide solution was added while tilting the flask so that two layers were formed. The condenser unit was rapidly connected, and heated and the distilled ammonia was collected in 50 ml boric acid / methyl red indicator. 50 ml of the distillate was collected and titrated against 0.1 M hydrochloric acid solution.

The percentage nitrogen content percent was calculated thus:

$$\% \text{ N} = \frac{(\text{Volume of acid} \times \text{Molarity of standard acid}) \times 0.014}{\text{Weight of sample (g)}} \times 100$$

Crude protein = Mineral nitrogen × 6.25

The factor 6.25 is based on the assumption that proteins in animal feeds contain about 16% nitrogen on average.

The analysis was done in triplicate and the mean value was then calculated.

Carbohydrate determination

The carbohydrate content of the samples was estimated as the difference obtained after subtracting the values of organic protein, ash content, fat or oil, crude fiber, and moisture content from 100. That is: 100 - (protein + ash + oil + crude fiber + moisture content).

The analysis was done in triplicate and the mean value was then calculated.

Statistical analysis

Mean ± standard deviation was calculated for all the parameters analysed and was compared by one-way analysis of variance (ANOVA) using SPSS version 20. *P*-value < 0.05 indicates a significant difference.

RESULTS AND DISCUSSION

Table 1. Proximate composition of sesame.

S/N	Parameters	Whole grain	Dehusked	Husk	P value
1	Ash	34.7 ± 0.42	34.5 ± 0.71	22.0 ± 0.71	0.00
2	Protein	9.8500 ± 0.07	1.30 ± 0.14	3.75 ± 0.07	0.00
3	Fibre	13.65 ± 0.49	6.85 ± 0.21	8.35 ± 0.21	0.01
4	Moisture	49.25 ± 1.06	61.85 ± 0.92	24.7 ± 0.42	0.00
5	Carbohydrate	90.65 ± 0.63	53.8 ± 0.42	40.1 ± 0.85	0.00

Note: values are expressed as mean± standard deviation and p value <0.05 is considered significantly different.

Ash content

Ash content gives a rough estimate of the amount of minerals present in food. The mean value for ash in whole grain, dehusked and husk was 34.7 ± 0.42, 34.5 ± 0.71 and 22.0 ± 0.71, respectively with p-value < 0.05 which shows a significant difference between the three groups and the ash content of sesame remain the same after dehusking process. (Figure 1)

Protein content

Proteins provide amino acids (for building and maintenance of the body) and energy occasionally. They are also used to produce nitrogen-containing substances such as antibodies and enzymes which are important for normal body functions (Adeniyi and Ariwoola, 2019). The mean value for protein in whole grain was 9.85 ± 0.07, 1.30 ± 0.14 and 3.75 ± 0.07 for dehusked and husk respectively with a p-value < 0.05 which shows a significant difference between the three groups, the mean value of protein decreases after dehusking process. The present study reports a lower protein value than that of Adeola et al. (2010) where 17.1 ± 0.25 and 11.6 ± 0.15 were reported for whole grain sesame and dehusked, respectively. (Figure 2)

Fibre content

Crude fiber contains cellulose and hemicellulose that are of utmost importance to humans and other animals, fiber increases water retention capacity during the passage of food along the gut. A diet rich in crude fiber is considered healthy because it helps in producing larger and softer feces (Capuano, 2017). The mean value for fiber in whole grain was 13.65 ± 0.49 and 6.85 ± 0.21 for dehusked and 8.35 ± 0.21 for husked with a p-value < 0.05 which shows a significant difference between the three groups. The results indicate a decrease in fiber content after the dehusking process. The present study reports higher fiber content than that of Adeola et al. (2010) where they reported 4.6 ± 0.03 and 2.6 ± 0.02 for whole grain sesame and dehusked, respectively. (Figure 3)

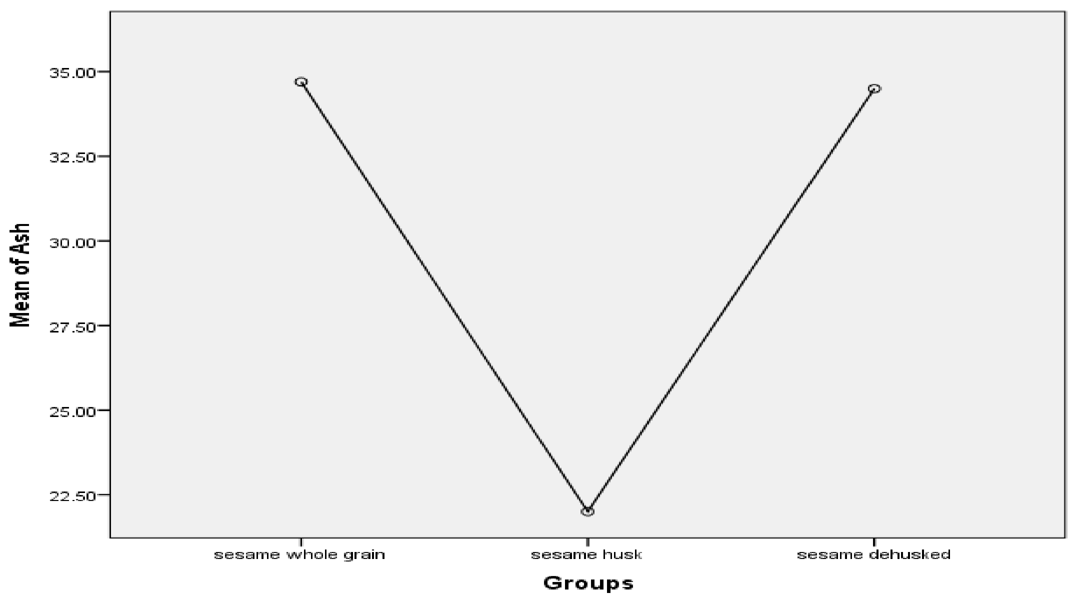

Figure 1. Ash content.

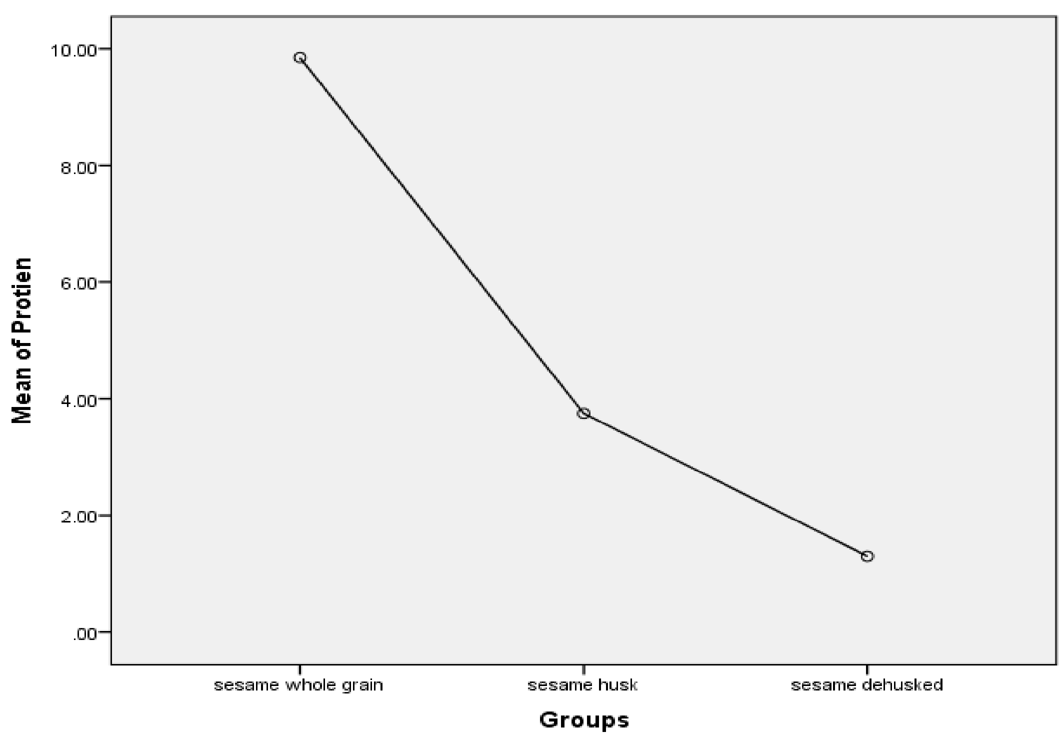

Figure 2. Protein content.

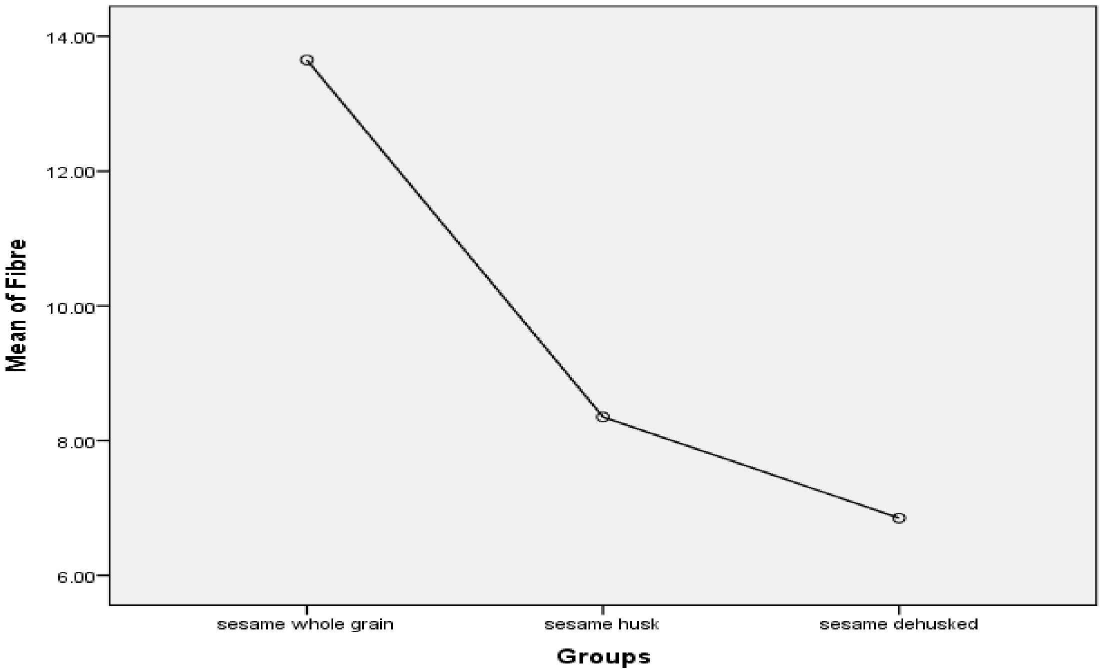

Figure 3. Fibre content.

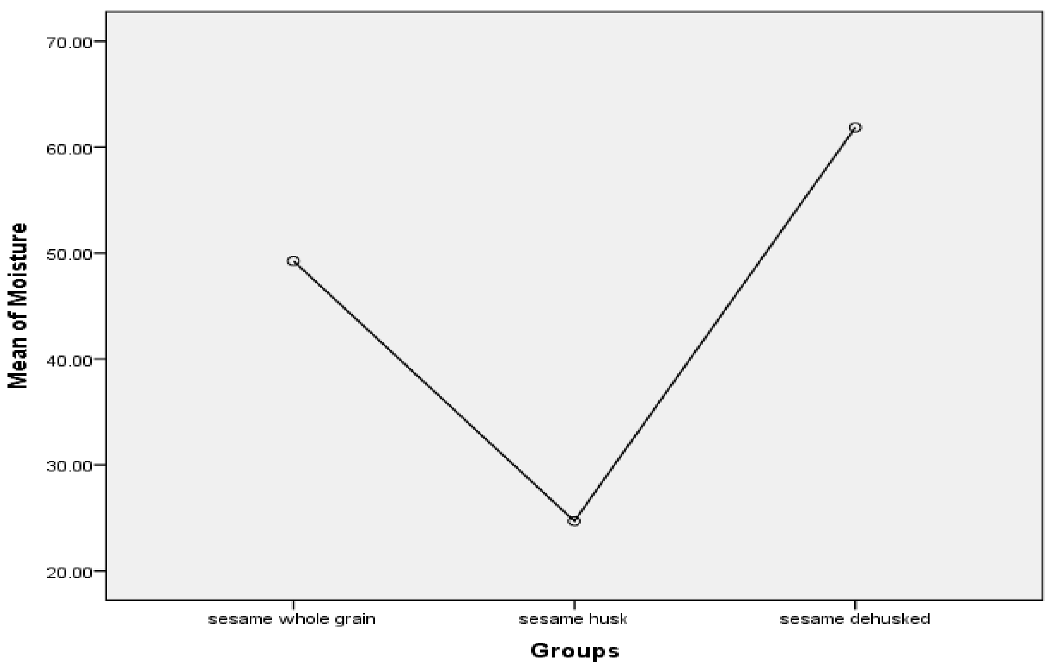

Figure 4. Moisture.

Moisture

Moisture content is an indicator of dry matter a food substance. It is of utmost importance to the farmer and the consumer because it confers quality to food. Grains that contain high moisture content are subjected to rapid deterioration from mold growth and insect damage (Suleiman et al., 2013). The moisture mean value for whole grain was 49.25 ± 1.06, 61.85 ± 0.92 for dehusked and 24.7 ± 0.42 for husked with a p-value < 0.05 which shows a significant difference between the three groups, the moisture content of sesame increases after dehusking process. The present study reports higher moisture content than that of (Adeola et al., 2010) where they reported 6.4 ± 0.04 and 5.2 ± 0.35 for whole grain sesame and dehusked respectively. (Figure 4)

Carbohydrate content

Carbohydrates are one of the most available nutrients found in cereals which are the major source of energy for humans (Chibbar et al., 2004). The results indicate the mean value for carbohydrates in whole grain to be 90.65 ± 0.63, 93.8 ± 0.42 for dehusked and 140.1 ± 0.85 for husked with a p-value < 0.05 which shows a significant difference between the three groups. This is an indication that the carbohydrate content of whole-grain sesame increases after the dehusking process. The present study reports higher carbohydrate content than that of Adeola et al. (2010) where they reported 21.4 ± 0.12 and 29.0 ± 0.25 for whole grain sesame and dehusked respectively. (Figure 5)

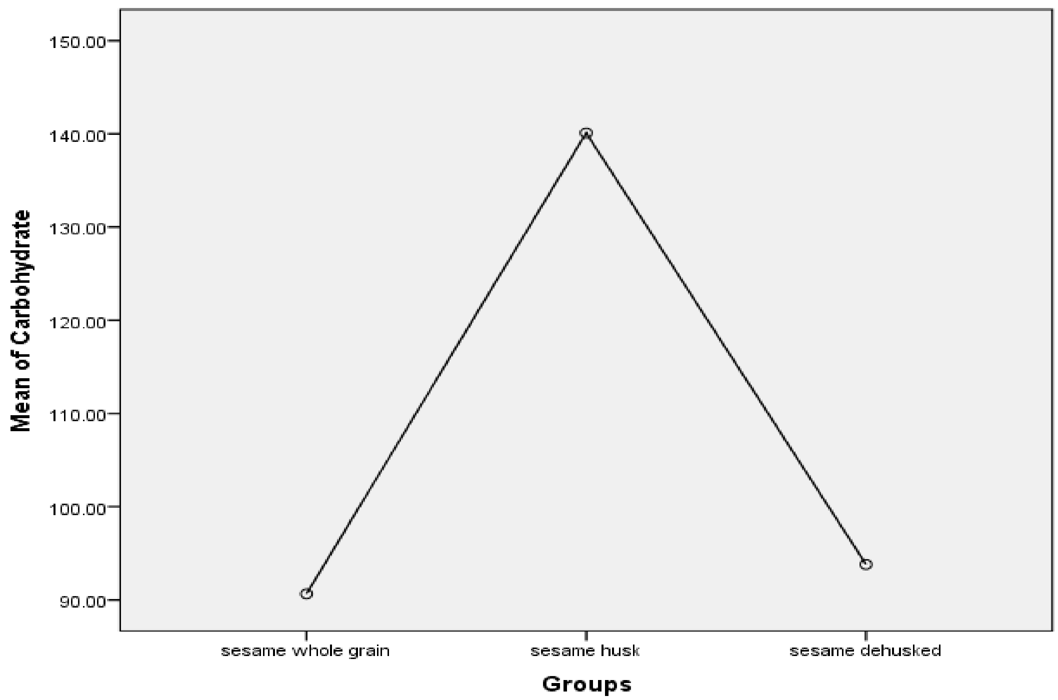

Figure 5. Carbohydrate content.

CONCLUSION

From the result obtained, it is concluded that there is a significant difference in ash, moisture, fiber, protein and carbohydrate content between the three groups (sesame whole grain, sesame dehusked and sesame husk). The protein and fiber content decreases, moisture and carbohydrate increases while ash content remains relatively the same after the dehusking process which shows depletion of some nutrients. It is therefore recommended that: Sesame should be added to our daily food as it contains high nutritional value; whole-grain sesame contains higher fiber content than dehusked sesame which contains low protein content.

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