CHEMICAL COMPOSITION OF SEEDS, CAKES AND HULLS OBTAINED FROM PUMPKIN SEEDS (*CUCURBITA MAXIMA*) AND ROSELLE SEEDS (*HIBISCUS SABDARIFFA*)

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ABSTRACT
In the search for alternative feed sources, some seed cakes are treated with enzymes or are cooked, fermented, roasted or bleached without any effect on reducing feed costs. The aim of this study was to determine the chemical composition of seeds, cakes and hulls obtained from pumpkin seeds (Cucurbita maxima) and roselle seeds (Hibiscus sabdariffa). Pumpkin and Roselle seeds were collected, roasted until lightly golden brown, shelled and then ground with a hammer mill. The ground pastes were then pressed to extract the oil. The residue was heated to harden it and extract more oil. The residue was described as pumpkin seed cake (PSC) and roselle seed cake (RSC). Chemical analyzes were performed on whole seeds, PSC, RSC and hulls. The results showed that in both pumpkin and roselle, the fat content was higher in the whole seed. The protein content was higher in the cakes, while the crude fiber content was higher in the hulls. It can be concluded that as the protein content of the cake increases, the proportion of cake in the diet will be higher than that of whole seeds.
Keywords: Pumpkin, Roselle, seeds, cake, diets.

INTRODUCTION

Oilseeds are seeds that are primarily grown to produce of edible oils. The world's main oilseeds are soybeans, sunflowers, safflower, coconuts, oil palm, rapeseed, peanuts, and cotton, but we also have non-true oilseeds such as maize and rice bran. The continuous increase in prices of conventional feed has forced Animal Nutritionist to look locally for alternative feed resources to save the livestock in Nigeria (Obadire *et al*., 2022). Otherwise, achieving the national goal of providing protein to a large population would be a mirage. It is not good to rely excessively on importing food that can normally be produced. Soy is the best protein of all the plant sources and is not left to livestock or humans, but is urgently needed in biofuels and cosmetics. By-products of sunflower, safflower, coconut, oil palm, rapeseed, peanuts, and cotton by-products are known substitutes for soybeans, but the feeding problem has not been addressed because their seeds and by-products are in high demand in other sectors of the global economy. Recently, attention has been focused on the less used oilseeds of the 'Cucurbitaceae' and 'Malvaceae' families as replacements for soybeans in feed. Some examples are roselle seeds, okra seeds, kenaf seeds, pumpkin seeds, etc. Their feed content is low to significantly reduce feed costs as they contain anti-nutritional factors that mimic nutrient availability to the animals. They are subjected to one after another treatment (such as fermentation, cooking, roasting, alkaline treatment and enzymatic treatment) before their use, and even after the treatments they do not have much effect. However, it is a known fact that when the fat is removed from oilseeds, the protein content in the by-product increases (Arrutia *et al*., 2020; NIAS, 2021) as shown in table 1. Various authors, Teh and Bekhit (2015) and Arrutia *et al*. (2020) argued that oilseed byproducts are more valuable to animals than the whole seeds due to their high protein content. The aim of this study was to determine the chemical composition of seeds, cakes and hulls obtained from pumpkin seeds (*Cucurbita maxima*) and roselle seeds (*Hibiscus sabdariffa*).

Table 1: Protein content of some selected oil rich seeds (%)

Items	Seeds	Cake
Groundnut	22-26	40.0
Sunflower	18-20	34.1
Sesame	15-18	35.6
Soybeans	37.00	42.0

Sources: Faqir *et al*. (2012), Nagendra *et al*. (2012); Arya *et al*. (2016) and NIAS (2021).

MATERIALS AND METHODS

Pumpkin and roselle seeds were collected from farms immediately after harvesting and processing. The pumpkin fruit was opened to extract the thick flesh, pulp and seeds separately, and the seeds were dried. After the roselle fruits were harvested, the calyxes were removed and then the encapsulated hard shells were dried on tarpaulin for three days, then the seeds fall off and were collected. Both seeds were lightly roasted until golden brown and then shelled to separate the hulls and endosperms, and the endosperms were ground with a hammer mill. The ground pastes were then pressed to extract the oil. The residue was heated to further extract the oil and hardening. They were called pumpkin seed cake (PSC) and roselle seed cake (RSC). To extent the shelf life of the cakes, they were dried inside for 7 days. Chemical analyzes were performed on PSC, RSC and hulls. The proximate composition was determined using the method described by AOAC (2005) at the Department of Animal Science, Animal Nutrition Laboratory, Federal University, Gashua, Yobe State, Nigeria. The nitrogen-free extract value was calculated as follows: 100- (crude protein + total ash + crude fiber + crude fat + moisture content). Results were reported as percentage and standard deviation.

RESULTS AND DISCUSSION

Table 2 shows the proximate composition of pumpkin (*Cucurbita maxima* L.) seeds, cakes and hulls. The seeds contain the highest values of moisture and ether extract and the lowest values of nitrogen-free extract and dry matter. Cakes contain the highest values of crude protein and dry matter and lowest values of moisture, ether extract, crude fiber and total ash. The hulls contain the highest values of crude fiber, total ash and nitrogen-free extract and the lowest values of crude protein only. Overall, there were large differences in crude protein, ether extract and nitrogen-free extract between seeds, cake and hulls, and small differences in moisture and dry matter.

Table 2 Proximate composition of pumpkin (*Cucurbita maxima* L.) seeds, cakes and hulls (%)

Items	Seeds	Cakes	Hulls	SD
Moisture	11.53	8.89	9.15	1.45
Crude protein	18.16	41.41	16.57	13.91
Ether extract	26.35	7.00	7.61	14.46
Crude fiber	17.38	16.4	18.00	4.02
Total ash	8.12	6.57	12.78	3.12
Nitrogen free extract	18.46	19.73	35.89	9.72
Dry matter	88.47	91.11	90.85	1.45

Table 3 shows the proximate composition of roselle (*Hibiscus sabdariffa* L.) seeds, cakes and hulls. The seeds also contain the highest amounts of moisture and ether extract and the lowest amounts of nitrogen-free extract and dry matter. The cakes contain only the highest value of crude protein and the lowest values of ether extract, crude fiber and total ash. Hulls contain the highest levels of crude fiber, total ash, nitrogen-free extract and dry matter and the lowest levels of moisture and crude protein. There is a higher standard deviation in crude protein, ether extract and nitrogen-free extract between seeds, cakes and hulls, and a lower one in moisture and dry matter.

Table 3: Proximate composition of roselle (*Hibiscus sabdariffa* L.) seeds, cakes and hulls (%)

Items	Seeds	Cake	Hulls	SD
Moisture	11.53	10.15	10.02	0.84
Crude protein	20.4	41.68	14.12	14.44
Ether extract	34.18	7.52	10.12	14.70
Crude fiber	12.31	8.44	16.76	4.16
Total ash	5.8	4.69	8.14	1.76
Nitrogen free extract	15.78	27.52	40.84	12.54
Dry matter	88.47	89.85	89.98	0.84

In both pumpkin and roselle the fat content is higher in the whole seeds. The protein content in the cakes is higher, while the crude fiber content is higher in the hulls. This supports the reports of Arrutia *et al*. (2020) that protein content increases when oil is removed from oilseeds. This means that if you are looking for an alternative source of protein, you should resort to pumpkin and roselle cakes as their protein content is higher than traditional alternatives such as cottonseed cake (25%), peanut cake (40%), safflower (34%), sesame (35%) and full fat soy (37%) as contain in NIAS National List of Approved Feed Ingredients for Nigerian Feed Mills (2021). This also supports the report by Teh and Bekhit (2015) that removing oil from oilseeds makes them more valuable than the whole seed. The protein contents of these two ingredients are similar to those of sunflower cake (45%), peanut meal (42%), soybean meal (42%) and soybean cake (44%), as reported in NIAS (2021). This finding indicates that the feed contains a higher proportion of PSC or RSC than normal seeds, which reduces feed costs. According to Abro (2012) and Sudik *et al*. (2021) that the higher the proportion of alternative ingredients in a diet, the greater the reduction in feed costs. In addition, using cake eliminates the need for processing and enzymatic treatment. Interestingly, since the cake is created when the oil is removed, hulls are also created. Oils and hulls are feed sources.

CONCLUSION

1. The protein content of pumpkin and roselle seed cake is higher than that of whole seeds.
2. The oil, cake, and hulls present added value in the production of pumpkin and roselle.

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