Nutritional Composition of Some Common Species of Striga Grass *(S. Gesnerioides, S. Hermonthica and S. Aciatica)*

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ABSTRACT

This study explores the nutritional values of Striga grass, typically known as a parasitic plant. Simple proximate compositional analysis method was used to determine the macronutrients while atomic absorption spectrophotometry was employed to test for the mineral elements. The research findings reveals a moisture content of all the species within the range of 5.3 g/100g to 3.15 g/100g; ash content 22.6 g/100g to 4.8 g/kg in *S. gesneriodes* root and *S. Asiatica* stem respectively. Protein and lipid concentrations ranged from 14.36 g/100g to 9.1 g/100g, and then 2.2 g/100g to 0.34 g/100g respectively; NFE 69.2 g/100g and the lowest is 45.6 g/100g in *S. asiatica* stem and *S. generoides* root respectively. Highest concentration of potassium was 1715 mg/kg in the bulb of *S. gesneroides* and lowest of 426 g/kg in *S. asiatica* leaves, while that of Sodium is between 964 mg/kg and 78 mg/kg in *S. hermontheca* roots and *S. asiatica* leaves respectively. While *S gesneroides* roots and bulb have high nutrient composition, *S. asiatica* leaves contained the lowest values. Striga grass is rich in fiber, protein, and other micronutrients and therefore could be a better supplement for animal feed as well as beneficial for digestion, muscle development, and immunity.

Keywords: Striga, nutrition, parasitic plant, economic loss, agriculture

INTRODUCTION

Striga grass, also known as witch weed, is a plant parasite that primarily impacts crops like cereals and legumes, resulting in significant financial losses [1,2,3,4]. These parasites are indigenous to various regions in Asia, Africa, and Australia, where they have diverse species. In order to grow and germinate, the parasites typically need a living host [5,6].

According to Gethi and Smith (2004), some types of *Striga* do not harm plants [6]. However, the most damaging species are *Striga* asiatica, S. gesnerioides, and S. hermonthica [7]. These species typically cause significant damage to crops taking advantage of poor-quality soil [4,8]. Maize production in sub-Saharan Africa for istance, faces *S. hermonthica* parasite challenges which necessitates several control measures such as cultural practices, biological control, and chemical use and recently prompting interest in eco-friendly alternatives [9].

Conventional methods struggle to control *Striga* damage due to limited and ineffective management options [2,10]. Nevertheless, Faisal (2011) found that *Striga* hermonthica has medicinal benefits in traditional medicine, such as treating dermatosis and diabetes and possessing antibacterial and anti-plasmoidal properties [11].

This research investigates the nutritional composition of various sections of three (3) distinct *Striga* species (*Striga* asiatica, S. gesnerioides, and S. hermonthica). A simple nutritional analysis was employed to determine the mineral composition as well as moisture, ash, lipid, protein, and carbohydrate contents [12,13].

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MATERIALS AND METHODS

Study Locations

Kukar Gadu town where susceptible plant/crops are planted was selected as study locations. The village is located on 11.5465° N, 10.9920° E, Fika Local Government Area of Yobe State, Nigeria. The farm lands include farms within the town and some other farms along Bauchi road, Fika LGA Yobe State.

Sample Collection, Preparation and Analysis

Three (3) different species (*Striga asiatica*, *S. gesnerioides*, and *S. hermonthica*) were collected. Random sampling technique was employed to collect the Samples during rainy season from various farm lands within Kukar Gadu town and its environs where susceptible crops were planted

The samples were collected by digging dip down the ground close to host plants' root and removing the *Striga* from the hosts root. Immediately after which the *Striga* plant were washed with distilled-deionised water, separated into leaves, stem and root and then transported. The samples were air-dried and stored in a drying cabinet (under controlled humidity) prior to analysis.

Figure 1: Sample collection (*Striga gesneriodes* attacking beans root)

Sample Pre-Treatment/Digestion

The samples were allowed to dry using hot oven (Model 30GC lab oven) and then ground into fine powder using a porcelain mortar and pestle. The grounded samples were kept in a zip lip bags before digestion.

Determination of Macronutrients (Nutritional Analysis)

The nutritional composition; moisture, ash, crude fibre, crude protein, crude lipid and nitrogen free extract content of the plants was determined by the methods of AOAC (2003) as adopted by Nwinuka (2005) with little modification [14,15].

Determination of Moisture Content

The moisture content was determined using the thermal drying method. A 1.0g portion of the sample was measured in a cleaned, oven-dried, and pre-weighed crucible, placed in an oven, and dried at 105°C for three hours. After cooling in a drying cabinet, the sample was reweighed. The process was repeated until a constant weight was achieved. The percentage moisture content was calculated using the following formula;

$$\%Moisture\ Content = \frac{\text{Mo}}{\text{Mi}}$$

Where W_o = loss in weight (g) on drying and W_i = initial weight of sample (g)

Determination of Ash content

The ash content percentage was measured using a muffle furnace through the ignition method. Samples weighing 1.0g each were placed in triplicates into a clean, preheated crucible and then placed into the muffle

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furnace. The furnace was set to heat to about 550°C, and the ashing process continued for a period of three hours at this temperature. Once completed, the crucible was taken out of the furnace, allowed to cool in a drying cabinet, and then weighed again. The ash content percentage was calculated using a specific formula.

$$\%Ash\ Content = \frac{\text{Ma}}{\text{Ms}}$$

where M_a = Mass of ash (g) and M_s = Mass of sample used (g)

Determination of Crude Protein Content

The crude protein content was analyzed using the micro-Kjeldahl method, which measures total organic nitrogen. Each sample, weighing 1.0g, was weighed in triplicate, along with a blank, and placed in digestion flasks. To each flask, anti-bumping agents and around 3.0g of a copper catalyst mixture (composed of 96% anhydrous sodium sulfate, 3.5% copper sulfate, and 0.5% selenium dioxide) were added, followed by 20 cm3 of concentrated sulfuric acid. The flasks were then heated on the micro-Kjeldahl digestion unit at 250 ^{0}C for 2 hours.

The digestion process continued until a clear solution was achieved. The resulting digest was filtered and adjusted to a volume of 100cm3 with distilled water. 20cm3 of the diluted digest was then transferred into distillation flasks for the distillation and titration procedures.

The flask was placed in the micro-Kjeldahl distillation/titration unit, which is connected to a 40% NaOH tank, Boric Acid, and a cool water inlet. The water inlet is connected to an internal condenser submerged in 20cm3 of 2% Boric Acid in the receiving flask. 40% sodium hydroxide (30 cm3) was added to the flask to distill off the ammonia formed. The distillate was collected in a conical flask with boric acid and screened methyl red indicator until the indicator changed from purple to greenish-yellow. The mixture (ammonium borate complex) was then titrated with 0.1M HCl until reaching a colorless endpoint. The total organic nitrogen (TON) was calculated accordingly.

$$\%\ TON = \frac{\text{TV x NE x } TVd\ x\ 100}{\text{Ms x Vd}}$$

TV = Volume of HCl, NE = molarity of HCl (mg nitrogen equivalent), TV_d = total volume of diluted digest, M_s = sample weight (g) and V_d = volume of digest distilled and TON = Total Organic Nitrogen

% Crude protein = 6.25 **x** % TON

(The general factor suitable for most products where specific proteins contents are not well defined is 6.25).

Determination of Crude Lipid Content

The lipid content in the three samples were determined by using the exhaustive solvent extraction method known as Soxhlet extraction with petroleum ether (boiling point range 40^{0}C - 60^{0}C). 20g of the sample was placed in triplicate into an extraction thimble and placed inside a 250 cm^3 Soxhlet extractor. The sample was then extracted into a 250 cm^3 round-bottomed flask that was pre-weighed and contained petroleum ether. After extraction, the solvent was recovered and the percentage of crude lipid was calculated using a specific formula.:

$$\%Crude\ Lipid\ Content = \frac{\text{Mex}}{\text{Ms}}$$

Where M_{ex} = Weigh of extract (g) and M_s = Sample weigh (g)

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Determination of crude fibre:

2-gram sample was weighed and boiled in a flask containing 3.0 M sulfuric acid solution for 30 minutes, then filtered. The residue was rinsed with hot water. Sodium Hydroxide solution was added, boiled under reflux, filtered again, and residues cleaned until neutral. The residues was dried in an oven at 115°C and weighed (A), then heated in a muffle furnace at 550°C for 2 hours to determine final weight (B).

Calculation:

$$\%Crude\ Fibre\ Content = \frac{\text{A} - \text{B x } 100}{\text{Sample weigh}}$$

Total carbohydrate content (Nitrogen Free Extract; NFE)

The Nitrogen Free Extract (NFE) percentage for each sample was determined by subtracting the percentages of crude protein, crude fiber, crude lipid, moisture, and ash content from 100.

NFE (%) = 100 – (% moisture + % crude protein + % crude lipid + % ash).

Determination of Mineral Composition

Mineral composition of the samples were analyzed using Buck Scientific Atomic Absorption Spectophotometer (AAS 210 VGP). The samples were first of all dried in an oven (Memert oven) at 105^0C. 1.0g the samples was digested using microwave digester (Master 40) at 180^0C for 30 minutes. The samples were diluted and then the mineral elements were determined by measuring the sample absorbances. Concentrations of the analytes were extrapolated from the standard calibration curve of each element.

Data analysis

Results were expressed as mean ± standard deviation.

RESULTS AND DISCUSSION

This study investigated the nutritional content of three distinct types of *Striga* plants. The tables and figures below displayed the nutritional composition of the *Striga* species. The results presented were the averages of the three replicates of each sample. Tables 1 and 2 presented the proximate compositions, and table 3 revealed the mineral compositions of the *Striga species*, respectively.

Table 1: Proximate composition of S. species showing the percentage composition of moisture, ash and crude lipid

S/No.	Sample Name	Moisture	Ash	Crude Lipid
1	*S. hermonthica* Stem	4.3±0.6	9.1±0.1	1.3±0.1
2	*S. hermonthica* root	4.9±0.6	11.1±0.2	0.8±0.0
3	*S. hermonthica* Leaves	4.0±0.3	15.5±0.1	2.2±0.2
4	*S. hermonthica* Flower	5.3±0.4	10.6±0.3	1.6±0.1
5	*S. asiatica* Stem	3.2±0.2	4.8±0.1	0.6±0.1
6	*S. asiatica* Leaves	4.6±0.8	7.8±0.0	0.6±0.0
7	S *gesneroides* Stem	5.5±0.6	10.3±0.3	0.34±0.3
8	S *gesneroides* Root	3.5±0.9	22.6±1.2	0.4±0.0
9	S *gesneroides* Bulb	4.2±0.2	15.5±0.8	0.5±0.1

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue VII July 2024

Table 2: Proximate composition of S. species showing the percentage composition of fiber, protein and carbohydrates

S/No.	Sample Name	Crude Fibre	Crude Protein	Carbohydrate
1	*S. hermonthica* Stem	8.6±0.4	12.7±1.3	63.9±76
2	*S. hermonthica* root	9.8±0.2	13.0±1.8	56.9±1
3	*S. hermonthica* Leaves	6.9±0.2	9.1±1.5	62.3±8
4	*S. hermonthica* Flower	3.5±0.5	10.8±1.2	68.1±8
5	*S. asiatica* Stem	7.4±0.6	14.4±0.7	69.7±0
6	*S. asiatica* Leaves	9.5±0.6	12.0±0.5	65.4±5
7	S *gesneroides* Stem	10.4±0.6	10.8±2.3	62.6±6
8	S *gesneroides* Root	15.6±0.3	12.1±2.2	45.6±7
9	S *gesneroides* Bulb	11.7±0.9	14.1±1.5	54.2±2

Table 3: Mineral composition (mg/kg) of some species of *Striga* grass

S/No.	Sample Name	Na	K	Zn	Fe
1	*S. hermonthica* Stem	578±20	1021±14	10±1.2	22±3.1
2	*S. hermonthica* root	964±35	1308±85	16±3.0	32±2.5
3	*S. hermonthica* Leaves	517±58	1001±98	8±1.5	22±2.2
4	*S. hermonthica* Flower	330±36	940±82	10±1.7	17±1.8
5	*S. asiatica* Stem	603±65	1311±48	12±2.0	29±2.6
6	*S. asiatica* Leaves	78±7.1	426±35	1±0.2	8±0.8
7	S *gesneroides* Stem	685±71	1409±92	11±1.2	23±2.9
8	S *gesneroides* Root	340±17	995±26	14±1.3	59±4.3
9	S *gesneroides* Bulb	906±55	1715±44	15±2.1	63±5.4

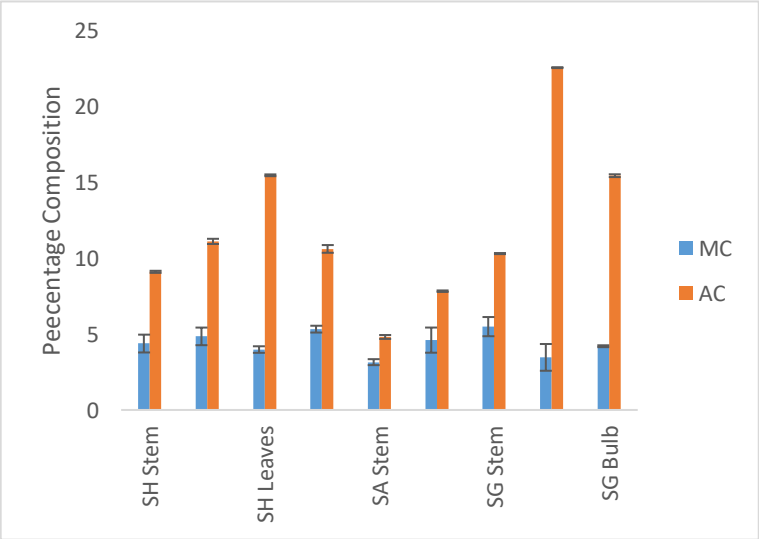

Figure 2: Moisture and Ash content (g/100g) of various parts of *Striga* species

Figure 2 shows the moisture and Ash content of stems, roots, leaves and flowers of the three species of *Striga* grass. The research findings on the nutritional values of the three different species of *Striga* revealed a range of ash content from 22.6 g/100g to 4.8 g/kg in *S. gesneriodes* root and *S. Asiatica* stem respectively.

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Moisture content falls within the range of 5.3 g/100g to 3.15 g/100g. Ash content in plant samples is crucial for assessing nutrient composition and mineral status, however this can be affected by factors like soil moisture, nitrogen fertilization, and ash distribution [16].

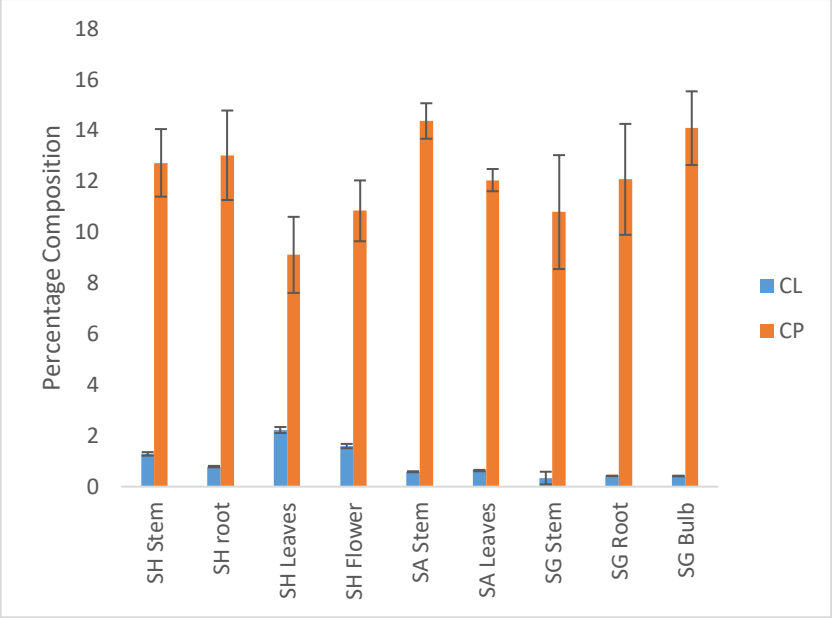

Figure 3: Protein and Lipid contents (g/100g) of various parts of *Striga* species

Crude protein and Lipid compositions of the samples were shown in figure 3. The results showed the protein and lipid concentrations ranged from 14.36 g/100g to 9.1 g/100g, and then 2.2 g/100g to 0.34 g/100g respectively. Both proteins and lipids are indispensable for plant survival, growth, and adaptation. Analyzing the protein and lipid content of plant samples can provide valuable insights into the nutritional and physiological status of the plant.

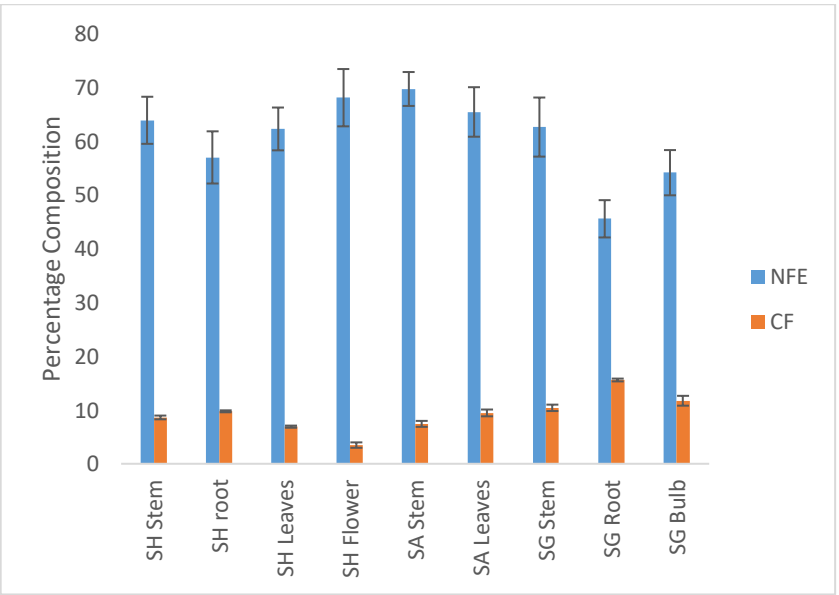

Figure 4: Crude Fibre and Nitrogen Free Extract contents (g/100g) of various parts of *Striga* species

From figure 4 above, the highest value of NFE is 69.2 g/100g and the lowest is 45.6 g/100g in *S. asiatica* stem and *S. generoides* root respectively. In contrast, crude fibre has its highest value in *S. generoides* root and lowest in *S. harmontheca* flowers [22].

Nitrogen-free extract (NFE) is a non-structural carbohydrate found in plants, such as starches and sugars that is easily digestible and energy-rich.

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The ratio of crude fiber to nitrogen-free extract is a crucial factor to assess the nutritional value and digestibility of plant-based feeds and foods. Typically, a higher crude fiber content suggests that the plant material is more mature and harder to digest, whereas a higher NFE content indicates an abundance of easily accessible carbohydrates [17].

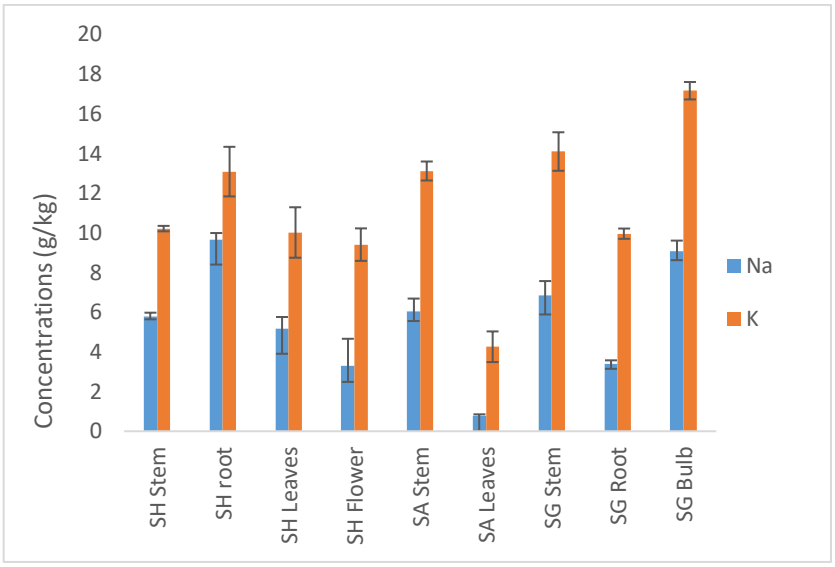

Figure 5: Amount of Sodium and Potassium (mg/kg) in various parts of *Striga* species

Figure 5 revealed the amount of potassium and sodium in the samples. The highest concentration of potassium was found in 1715 mg/kg in the bulb of *S. gesneroides* and 426 g/kg in *S. asiatica* leaves.

Potassium, a crucial macronutrient, regulates plant physiological processes, improving drought tolerance, disease resistance, and fruit and vegetable quality, while deficiency can cause stunted growth and lodging [18].

Sodium, though a non-essential nutrient, can be beneficial in some plants, such as halophytes, by regulating osmotic balance and chlorophyll production, but excessive intake can cause toxicity. The concentration of sodium in the samples falls between 964 mg/kg and 78 mg/kg in *S. hermontheca* roots and *S. asiatica* leaves respectively.

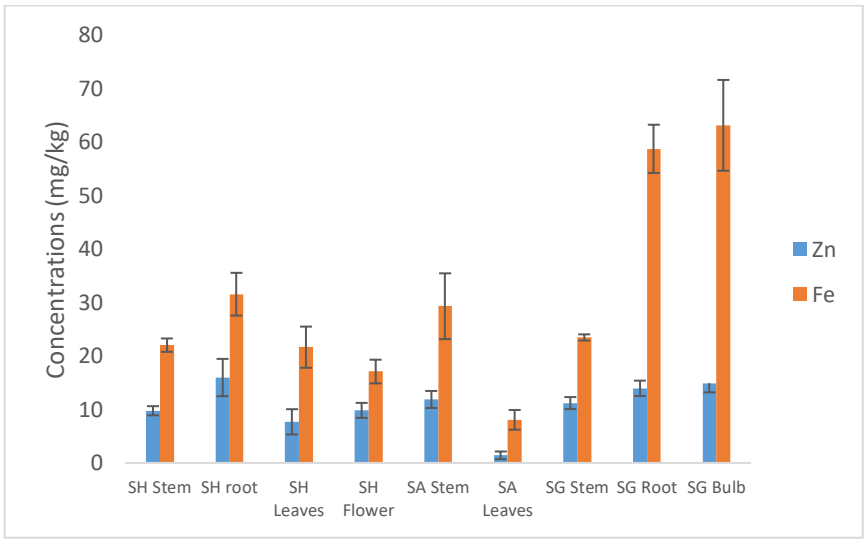

Figure 6: Amount of Zinc and Iron in various parts of *Striga* species

Figure 6 displayed the zinc and iron content of all the three species of *Striga* used for the experiment. Zinc concentration is within 16.0 mg/kg and 1.0 mg/kg in *S. hermontheca* root and *S. asiaticas*, while iron falls within 63.0 mg/kg to 8.0 mg/kg in *S.gesneroides* bulb and *S. asiatica* leaves respectively.

Zinc is a crucial micronutrient for plants, regulating growth, protein creation, and carbohydrate processing. Insufficient levels can lead to decreased crop production and yellowing leaves [19]. The levels of zinc concentration in all parts of the plants are within the optimum requirement of 25-100 ppm [20]

Iron is essential for chlorophyll production and photosynthesis in plants, aiding enzymes and electron movement. Lack of iron causes interveinal chlorosis, yellowing leaves and green veins in alkaline soils [21].

CONCLUSION

Striga grass, despite being considered a parasitic plant, offers significant nutritional benefits. This study explores the nutritional values of *Striga* grass revealing a remarkable amount of minerals such as zinc, potassium, sodium and iron. It also indicated that the grass is rich in protein, fibre and carbohydrates. *S gesneroides* roots and bulb have high nutrient composition than the other two species, and therefore making it a potential supplement fodder that can give animals the vital nutrients they require.

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