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Influence of different growing media on the growth, yield, proximate composition, and mineral content of *Solanecio biafrae* (Bologi)

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ABSTRACT

Growing vegetables in soilless media has gained popularity in developed countries, but remains relatively rare in developing nations such as Nigeria. The study was conducted at the Teaching and Research Farm of Ekiti State University using a Completely Randomized Design (CRD), aimed at evaluating the growth, yield, proximate composition, and mineral content of *Solanecio biafrae*,in various growing media (Soilless media and Topsoil). The tested soilless media comprised a mixture of rice husk (RH) and cocopeat, rice husk biochar (RHB), and rice husk alone. Vegetative growth parameters measured included plant height, number of leaves and stem girth, with plant weight serving as the yield metric. Additionally, leaf samples were analyzed in the laboratory for their proximate and mineral contents. The findings demonstrated that the mixture of cocopeat and rice husk significantly improved the growth and yield of bologi. The proximate and mineral compositions varied across different media. Bologi grown with rice husk biochar exhibited the highest moisture content (82.28%), ash content (1.51%), and fat content (2.18%). Plants grown in rice husk alone showed the highest fiber content and the lowest fat content. Regarding mineral content, the highest levels of phosphorus (P), sodium (Na), magnesium (Mg), and potassium (K) were observed in rice husk media. At the same time, soil recorded the highest levels of zinc (Zn), calcium (Ca), and iron (Fe), closely followed by rice husk media. Therefore, it can be concluded that soilless media, should be further explored as a viable medium for plant growth in ensuring sustainability in agriculture.

Keywords: Soilless media, Soil, Bologi, Proximate, Minerals

INTRODUCTION

Solanecio biafrae (Bologi), commonly known as Bologi, is a native leafy vegetable belonging to the family Asteraceae. It is widely cultivated and utilized across diverse African regions, particularly in countries such as Nigeria, Ghana, Benin, Sierra Leone, Cameroon, and Gabon (Famurewa, 2009). In Nigeria, it is predominantly found in the southern part of the country (Baiyeri *et al*., 2023). Known as "worowo" in Yoruba and "ota eke" in Igbo, this underutilized indigenous green leafy vegetable thrives in tropical climates and holds significant nutritional and medicinal value. Bologi is rich in essential nutrients, including proteins, iron, and potassium, making it an excellent addition to the diet for promoting overall health. The high protein content supports muscle development and repair, while iron is crucial for preventing anaemia and maintaining healthy blood levels. Potassium plays a vital role in regulating blood pressure and supporting cardiovascular health (Bello *et al.,* 2018). In addition to its nutritional benefits, the leaves of *S. biafrae* are used in traditional medicine for various ailments. They are known for their galactagogue properties, aiding in lactation for nursing mothers. Bologi is also utilized in the management of diabetes and high blood pressure, showcasing its potential role in chronic disease management. Furthermore, the plant has demonstrated antibacterial activity against pathogens such as *Staphylococcus aureus* and *Escherichia coli*, indicating its usefulness in treating infections (Bello *et al*., 2018). In summarry *S. biafrae* serves as a vital an important dietary component and medicinal resource in West African communities. Its rich nutritional profile and diverse health benefits underscore the need for further research and cultivation to promote its use and availability, thereby contributing to improved health outcomes in the region. Understanding the factors that influence the growth, yield, and nutritional composition of *S. biafrae* is crucial for optimizing its cultivation and maximizing its benefits. Among these factors, the choice of growing media plays a pivotal role. Growing media not only provide the necessary support for plant growth but also significantly affect water retention, nutrient availability, and root development. A growing medium can be defined as a substance through which roots grow and extract water and nutrients (Jacobs *et al*., 2009). It can be natural or artificial, with the latter often referred to as soilless media. Soil typically serves as the readily accessible and commonly used medium for plant growth,providing essential elements such as anchorage, nutrients, air, and water, facilitating plant growth (Sepehri *et al*., 2018; Gavri *et al*., 2023). However, soils can also present significant limitations for plant development, including the presence of disease-causing organisms, nematodes, unsuitable soil reactions, undesirable compaction, poor drainage, and degradation due to erosion (Ellis *et al.,* 1974). These challenges have led to the adoption of artificial soilless media such as rice husk, coir pith (also known as cocopeat) and biochar. Soilless farming offers several advantages,including higher yield, reduced water usage, and minimized environmental pollution compared to traditional farming methods. Therefore, this research aimed at evaluating the impact of different growing media on the growth, yield, proximate composition, and mineral content *of S. biafrae*.

MATERIAL AND METHODS

Experimental Site:

This research was conducted at the Department of Crop, Horticulture, and Landscape Design, Faculty of Agricultural Sciences, Ekiti State University, situated between 7°31' and 7°49' North of the equator and longitude 5°71' and 5°27' East of the Greenwich Meridian, over a period of 60 days.

Experimental Design:

The experiment utilized a completely randomized design (CRD) with three replications. The experiment was a single–factor study involving different media types,including cocopeat mixed with rice husk,rice husk alone (RH),rice husk biochar(RHB), and topsoil .

Plant Materials:

Bologi stem cuttings were used as the planting stock. These were obtained from Bologi vegetables purchased from the market. After removing the leaves, the cuttings were trimmed to the appropriate sizes, sterilized, and planted into the growing media.

Preparation of Growing Media:

The various media were placed into growing bags. Soil samples were ollected from the field of Ekiti State University Teaching and Research Farm. Rice husks, procured from a rice mill within Ado-Ekiti metropolis, were soaked in water and sterilized with hydrogen peroxide (H_2O_2) before planting. They were allowed to settle for two weeks before planting the bologi stem cuttings. Rice husk biochar was produced through the carbonization method. Cocopeat was also sterilized using hydrogen peroxide. Rice husk contains 0.72% N, 0.71 mgkg^{-1} available P, 18.24 cmolkg^{-1} pottassium and 23.20% organic carbon, cocopeat contains 2.54 % N, 0.89 mgkg^{-1} available P, 32.24 cmolkg-1 pottassium and 32.25 % organic carbon while Rice husk biochar contains 0.82 % N,0.21 mgkg^{-1} available P,8.45 cmolkg^{-1} pottassium and 31.61% organic carbon (Kehinde-Fadare *et al*., 2025).

Data Collection

1. **Plant Height (cm):** Determined using a measuring tape to measure the vine length of the plant to the tip of the main vine.
2. **Number of Leaves:** Determined by direct counting of the leaves on each plant.
3. **Stem Girth (cm):** Measured using a vernier calliper
4. **Plant Weight (g):** Recorded using an electronic weighing balance

.**Data Analysis**

All data were subjected to statistical analysis using SPSS for mean comparison, and Duncan's test was used to differentiate between means at $P < 0.05$.

RESULTS

Effect of different media on the growth parameters and weight of bologi:

The impact of various media on the Bologi plant height is presented in (Table 1), the results revealed that bologi cultivated in a cocopeat mixed with ricehusk (CO+RH) achieved a maximum height of 75.33 cm, surpassing that of the other media, Bologi grown with rice husk alone yielded a height of 61.67 cm,followed by Bologi grown with rice husk biochar (26.67 cm) and Bologi grown with topsoil (25.00 cm), which recorded the lowest height. Bologi grown in CO+RH medium showed a significant increase in height compared to topsoil (Table 1) illustrates the effect of various growing media on the stem girth of Bologi plants. The results showed that Bologi grown with a cocopeat-rice husk mixture produced the highest stem girth (0.59 cm), followed by Bologi grown with rice husk, which gave a stem girth of 0.49 cm. Then, bologi grown with topsoil had a stem girth value of 0.38 cm, while bologi grown with rice husk biochar had the least girth of 0.36 cm. Bologi grown with a cocopeat-rice husk mixture was significantly higher ($p > 0.05$) than Bologi grown with rice husk biochar, with a percentage of 64% concerning stem girth. The impact of various growing media on the number of leaves of Bologi plants is also shown in (Table 1). The results show that Bologi grown with rice husk produced the highest number of leaves, 43.00, followed by Bologi grown with cocopeat-rice husk mixture, 35.33, and then Bologi grown with rice husk biochar, 15.33, and Bologi grown with topsoil, 12.33. The influence of media on biological leaf area is also shown in (Table 1). It is evident here that Bologi grown with a cocopeat-rice husk mixture produced the largest leaf area, measuring 49.04 cm^2, followed closely by Bologi grown in rice husk (42.61 cm^2), Bologi grown with rice husk biochar (30.50 cm^2), and Bologi grown with topsoil, which has a leaf area of approximately 30.38 cm^2. Still, no significant differences ($p > 0.05$) were observed among the media in terms of the impact on the plant weight of Bologi. It was found that Bologi plants cultivated with the cocopeat-rice husk mixture achieved the highest weight of 47.50g, followed by Bologi plants grown with rice husk, at 32.67g. Then, Bologi grown with topsoil yielded a weight of 11.07 g, and Bologi grown with rice husk biochar weighed 11.03 g Bologi grown with the cocopeat-rice husk mixture significantly outperformed Bologi grown with rice husk.

Table 1. Effect of different Media on the growth parameters and weight of bologi

Parameters				
Media	**Plant height (cm)**	**Stem girth (cm)**	**Number of leaves**	**Wgt (g)**
CO+RH	75.33a ± 1.290	0.59a ± 0.00816	35.33b ± 0.0816	47.50a ± 0.108
RH	61.67b ± 1.290	0.49 b ± 0.00816	43.00a ± 0.0816	36.67 b ± 0.108
RHB	26.67 c ± 1.290	0.36c ±0.00816	15.33 c ± 0.0816	11.03 c ± 0.108
TS	25.00c ± 1.290	0.36 c ± 0.00816	12.33 c ± 0.0816	11.17 c ± 0.108
LSD	2.97704	0.01883	1.88292	2.49077
P-Value	p < 0.0001	p < 0.0001	p < 0.0001	p < 0.0001

Means with the same letter(s) on the same column are not significantly different at 5% probability using Duncan's Multiple Range Test. Note: CO:RH= rice husk+cocopeat mix; RH= rice husk RHB= Rice husk biochar TS=Top soil ± Standard error

Effect of growing Media on the proximate composition of bologi:

The effects of proximate qualities on bologi leaf across different media are detailed in (Table 2). The moisture content ranged from 82.28% to 77.66%, with values of 82.28%, 79.91%, 78.52%, and 77.66% for bologi grown in RHB, RH, TS, and CP+RH, respectively The average ash contents were 1.50%, 1.35%, 1.32%, and 1.28% for RB RH, RH+CP and TS respectively.The rice husk biochar yielded the highest ash content, which was 17% higher than that from topsoil. Fat content ranged from 2.18% to 1.16%, with RHB having the highest fat content, while the lowest value of 1.21% was recorded for rice husk. Crude fibre content also varied among the different media, with CO+RH yielding the highest content, which was 38% higher than that from topsoil. Protein content varied across the media, with bologi grown in the RH medium showing the highest value, significantly different from the other media. Carbohydrate content also showed significant variation among the media, with bologi grown in the CO+RH medium having the highest value.

Table 2. The effect of different growing media on proximate qualities (%) of *S. biafrae*

Parameters						
Media	**Moisture%**	**ASH %**	**Fat %**	**Fibre %**	**Protein %**	**CHO %**
CO+RH	77.66d ± 0.00408	1.32c ± 0.00408	1.21c ± 0.00408	3.72c ± 0.00408	5.72c ± 0.0033	10.37a ± 0.0047
RH	79.91b ± 0.00408	1.35b ± 0.00408	1.16d ± 0.00408	4.16a ± 0.00408	6.16a ± 0.0033	7.26c ± 0.0047
RHB	82.28a ± 0.00408	1.50a ± 0.00408	2.18a ± 0.00408	3.87c ± 0.00408	5.77b ± 0.0033	4.39d ± 0.0047
TS	78.52c ± 0.00408	1.28d ± 0.00408	1.31b ± 0.00408	4.13b±0.00408	5.43d±0.0033	9.34b ± 0.0047
LSD	0.00941	0.00941	0.00941	0.00941	0.00769	0.01087
P- Value	p < 0.0001	p < 0.0001	p < 0.0001	p < 0.0001	p < 0.0001	p < 0.0001

Means with the same letter(s) on the same column are not significantly different at 5% probability using Duncan's Multiple Range Test. Note: CO:RH= rice husk+cocopeat mix; RH= rice husk; RHB= ricehusk biochar. TS=Top soil , ± Standard error

The effect of different growing media on Mineral content mg/100g of *S.biafrae*

As shown in (Table 3), the use of different media for planting bologi significantly influenced the mineral content of the leaves, with notable variations in Na, Ca, K, Zn, Mg, Fe, and P across the media. Rice husk (RH) recorded the highest sodium content at 60.25 mg/100g, while the combination of cocopeat and rice husk (CO + RH) had the lowest at 41.50 mg/100g. The RH medium also had the highest levels of potassium (K), magnesium (Mg), and phosphorus (P), whereas topsoil (TP) recorded the lowest values for these three minerals. For iron (Fe), values ranged from 5.58 to 2.79 mg/100g, with TP providing the highest Fe content and the CO + RH combination yielding the lowest. TP also had the highest calcium (Ca) content, followed closely by rice husk biochar (RHB), while the lowest Ca level was found in the CO + RH medium. Additionally, topsoil produced the highest zinc (Zn) content.

Table 3. The effect of different growing media on mineral content mg/100g of *S. biafrae*

	Parameters						
Media	**Na**	**Ca**	**K**	**Zn**	**Mg**	**Fe**	**P**
CO+RH	41.50c ± 2.186	102 75d ± 0.189	295.53b ± 0.181	2.57d ± 0.102	28.24c ± 0.005	2.79d ± 0.002	132.53b ± 0.004
RH	62.55a ± 2.186	120.55c ± 0.189	305.45a±0.181	2.85b ± 0.102	30.97a ± 0.005	3.26b ± 0.002	135.53a ± 0.004
RHB	50.55b ± 2.186	147.60b ± 0.189	285.85c±0.181	2.52c±0.102	28.56b ± 0.005	2.20c ± 0.002	126.36c ± 0.004
TP	50.60b ± 2.186	163.70a ± 0.189	237.20d ± 0.181	3.61a ± 0.102	26.93d ± 0.005	5.58a ± 0.002	125.19d ± 0.004
LSD	5.04123	0.43652	0.41926	0.23561	0.01215	0.00544	0.00941
P-Value	p < 0.0001	p < 0.0001	p < 0.0001	p < 0.0001	p < 0.0001	p < 0.0001	p < 0.0001

Means with the same letter(s) on the same column are not significantly different at 5% probability using Duncan's Multiple Range Test. Note: CO:RH= rice husk+cocopeat mix; RH= rice husk; RHB= ricehusk husk biochar. TS=Top soil ± Standard error

DISCUSSION

The mix of cocopeat and rice husk (CO+RH) proved to be the most effective growing medium, promoting strong plant growth and development, as indicated by the highest plant height and weight observed in this medium, which aligns closely with the findings of (Djaingsastro *et al.,* 2021). The moisture content observed in this study was slightly higher than the range reported by (Nupo *et al.,* 2013). The highest moisture content was found in Bologi grown with rice husk biochar. However, the moisture content of Bologi across all media, ranging from 77.66% to 82.28%, aligns with that reported for *Ocimum gratissimum* (78%) and is close to that of *Telfairia occidentalis* (86.15%) and *Vernonia amygdalina* (84.10%) as reported by (Udousoro and Ekanem, 2013). The moisture levels of the fresh vegetables align with the USDA standards, which indicate that fresh fruits and vegetables typically have a moisture content ranging from 72.4% to 95.2% (USDA, 2009). High moisture content aids in maintaining the protoplasmic contents of cells (Gbadamosi, 2011) and supports the activity of water-soluble enzymes and co-enzymes necessary for the metabolic processes in these leafy vegetables (Ihenacho and Ubebani, 2009). The fat content observed in this research across different media was comparable to the levels reported in *Amaranthus cruentus*, *Amaranthus dubius*, and *Basella alba* by (Akinwunmi and Omotayo, 2016). Dietary fat is a significant factor in the palatability of food (Antia, 2006).

Additionally vegetable fats and oils have been reported to lower blood lipids, contributing to a reduced risk of diseases associated with coronary artery damage.The crude fiber content was found to be higher than the value reported by (Nupo *et al.,* 2013). The highest fiber content was observed in Bologi grown in a mixture of cocopeat and rice husk, exceeding that reported for *Talinum triangulare* (4.23%) and *Amaranthus hybridus* (4.40%) by (Udousoro and Ekanem, 2013). Fiber in leafy vegetables plays several roles in the body, including cleansing the digestive tract, removing potential carcinogens, and maintaining blood sugar levels (Emebu and Anyika, 2011). The crude fat analysis also indicates that leafy vegetables are low in lipids, reinforcing their importance as part of a healthy diet. The carbohydrate content in Bologi grown with cocopeat and rice husk was higher and similar to that grown with topsoil, but these values were higher than those reported for some leafy vegetables consumed in Nigeria, such as *Vernonia amygdalina* (8.65%) and *Ocimum gratissimum* (1.22%), but lower than *Hibiscus sabdariffa* (15.79%) as reported by (Asaolu, 2012) Carbohydrates are a significant class of naturally occurring organic compounds that are essential for life and also serve as key raw materials for many industries (Ebun-Oluwa and Alade, 2007). The ash content in this study was highest in Bologi grown in a rice husk biochar medium, with a value of 2.18%. However, this value was lower than those reported for bush mallow, garden egg leaf, spinach, and bush okra by (Ukom and Obi, 2018). All the fresh samples had ash content that falls within the USDA standard range of 0.2% to 1.9%, as reported by (USDA, 2009). The ash content reflects the mineral content of leafy vegetabls .The calcium levels observed in our research (102.75-163.70) were higher than the range of 38-70 reported by (Udosen, 1996) in his analysis of the proximate and mineral composition of some Nigerian vegetables. However, they were lower than the levels reported by (Famurewa, 2011) for *S. biafrae*. Calcium is known to support the growth and maintenance of bones, teeth, and muscles (Okaka *et al.,* 2006). The topsoil yielded the highest zinc content, and the range of zinc across all the media used in this study falls within the range reported by (Udosen, 1996). Zinc plays a crucial role in the normal functioning of the immune system and is also involved in protein metabolism (Ibrahim *et al.,* 2001).The sodium content in our research was similar to the levels found by (Asaolu *et al.,* 2012) in bitter leaf (Famurewa, 2011) in *S. biafrae*. Iron (Fe) is an essential trace element for haemoglobin formation and the oxidation of fats, carbohydrates, and proteins (Adeleye and Otokiki, 1999). The iron content in this research, using different media, showed a higher iron content than that reported by (Famurewa, 2011), with topsoil showing the highest zinc value. The magnesium content was higher in *S. biafrae* grown in rice husk compared to other media. However, this value was still lower than the levels found in *Hibiscus sabdariffa* as reported by (Ilodibia *et al.,* 2019) but higher than those reported for *Talinum triangulare* (Okon and James, 2014).

CONCLUSION

The combination of cocopeat and rice husk had a more pronounced effect on the growth and yield of the vegetables. Despite the differences in the vegetables' proximate qualities across the different media, the values are within the range reported by other researchers. This study also found that the fibre content of rice husk influenced the growth of the vegetables grown in it. In conclusion, it is recommended that the use of soilless media for vegetable cultivation be explored

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