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Chemical Composition & Nutritional Assessment of Seeds of Underutilized Wild Legume Rhynchosia Lour

Vilas T. Patil[1], Madhuri V. Suryawanshi[1], Varsha D. Jadhav (Rathod)[2]
[1]Department of Botany, Shivaji University, Kolhapur -416004, Maharashtra, India
[2]Professor, Department of Botany, Shivaji University, Kolhapur -416004, Maharashtra, India

ABSTRACT

The aim of the present research is to study the chemical composition and nutritional potential of immature and mature seeds of four species of Rhynchosia like R.cana, R.hirta, R.minima, R.rufescence. The preliminary phytochemical analysis was done by using four solvents systems, such as methanol, acetone, aqueous and chloroform. A high amount of phytochemicals like alkaloids, phenols, tannin, caumarin, and glycosides was found in the methanolic extract than the others. In proximate analysis high content of ash (4.5%), crude fat (6%) and protein (8.31%) were observed in immature seeds of R.cana, while dry matter (88%) was observed in mature seeds of R. hirta. A high amount of crude fibre content (17%) was observed in mature seeds of R.minima and moisture (40%) was noted in immature seeds of R.hirta .In mineral analysis High amount of nitrogen (1.33±0.014%), phosphorus (0.24±0.008%) and potassium (1.27±0.005%) were observed in immature seeds, whereas manganese(1220±0.005 mg/100g) in mature seeds of R.cana. A High amount of zinc (730±0.008 mg/100g) and calcium (1.8%) were observed in mature seeds of R.rufescence. In mature seeds of R.minima high magnesium content (9.11%) & copper (1113±0.001mg/100g) were observed, while iron content (6180±0.01mg/100g) in immature seeds of R.minima. From the above study, it is conclude that all four species of Rhynchosia are nutritionally rich, whereas R.cana having high nutritional content as compared to other three species which reviled that wild legume Rhynchosia is a rich source of phytochemicals and nutrition and provides possibilities for advancement as a stand-by for cultivated species as a vegetable.

Key words- Preliminary phytochemical & nutritional, Rhynchosia, immature &mature, wild vegetables

I. INTRODUCTION

The role of seed legumes in animal and man diets is well known in developing countries (Oke *et al.*, 1995); Awareness of the chemical composition of foods is the basic food recommendations for a healthy nutritious diet. At the macro level, a table of food composition is used to plan food demand and supply, and at the micro level to establish prescribed diet as well as to determine and correct the nutritional values of a given diet (Southgate, 1974).Given both population explosion and urbanization, there is a serious problem of inadequate availability

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and consumption of protein foods in India. There is a growing need to make efforts to identify better and cheaper protein sources. Despite the urgent need to meet the nutritional needs of ever-increasing populations, largely unexplored remained the available cheap protein options (Murhty *et al.*, 2003). With the rise in new food sources, wild plant seeds, like tribal pulses, are attracting more attention because they are well suited to adverse environmental conditions, are highly resistant to disease and pests, and have strong nutritional qualities (Maikhuri, *et al.*, 1991).Legumes seeds are essential nutrient sources and can serve as dietary protein sources of high quality to fulfill nutritional requirements (Perumal *et al.*, 2001; Escudero *et al.*, 2006). Legume seeds have twice as much protein on average as cereals, and the protein's nutritional value is typically high (Vijayakumari *et al.* 1997). In this sense, the underused legumes, which have enormous potential for commercial exploitation but remain overlooked, offer a strong variety (Bhag Mal, 1992). Accounts have been given of important pulses under exploited that await exploration for food, fodder, electricity, and industrial purposes (Siddhuraju *et al.*, 2000; Kalidass and Mohan, 2011).

II. MATERIAL AND METHODS

2.1 Collection of Plant Material & Preparation of Extract

The plant materials of all four *Rhynchosia* species were collected from various locations, such as *R.minima*, collected from the village of Kondi in Solapur District, Maharashtra. *R.hirta*, *R.cana*, *R.rufescence* were collected from Karnataka's Nandi hills. Plant material identification was carried out using the flora of the district of Kolhapur and JCB herbarium digital flora of Karnataka. In order to avoid contamination, the immature and mature plant seeds were collected and air dried in laboratory condition and made fine powder using a mechanical grinder. For further nutritional & phytochemical analysis, this fine powder was used.

2.2 Preliminary Phytochemical screening

Weighed dry plant powder (W1) was placed in a cheese cloth and extracted using several solvents in a Soxhlet extractor, including methanol, ethanol, chloroform, petroleum ether, and distilled water. To screen all of these extracts for chemical composition, various qualitative chemical assays were done. Trease and Evans (1985), Brindha *et al.* (1981), Kokate et al. (1995), and Khandewal (2005) were used to conduct qualitative phytochemical analysis. The following assays were carried out on extracts to detect the presence of specific phytoconstituents.

2.2.1 Phenols (Ferric Chloride test)

The ferric chloride test was used to assess the presence of phenols. Two grams of extract were placed in a test tube, along with a few drops of 5% ferric chloride solution. The presence of phenols was indicated by a dark green color (Mace, 1963).

2.2.2 Anthraquinones (Borntrager's test)

In 1 ml of plant extract, a few drops of 2.5% magnesium acetate solution were added. The presence of anthraquinones was shown by the formation of a pink color.

2.2.3 Tannins

The 50 mg extract was dissolved in distilled water, and then 3ml of a 10% lead acetate solution was added to it. The presence of tannins was indicated by a thick white precipitate (Raaman, 2006).

2.2.4 Saponin

The extract was diluted with distilled water to a level of 20 ml, and the suspension was agitated for 15 minutes in a graduated cylinder. Saponins were detected by the presence of a thick lather (Kokate, 1999).

2.2.5 Alkaloids

i. Mayer's test

A drop of Mayer's reagent was applied to the edge of the test tube after mixing the 1 ml extract with a few drops of 2.5 N HCl. The positive test was indicated by a white or creamy precipitate (Evans, 1997). [Mayer's reagent: Separately dissolve mercuric chloride (1.36 g) and potassium iodide (5 g) in water. These two solutions were combined, and the volume was increased to 100 ml by adding water].

ii. Dragendorff's test

1 ml plant extract and few drops of 2.5N HCLwas mixed with 1 ml Dragendorff's reagent [solution A = Bismuth nitrate (0.17 g) in acetic acid (2 ml) and distilled water (8 ml), solution B= KI (4 g) in acetic acid (10 ml) and distilled water (20 ml)] . Then combine solution A and B and dilute with distilled water to 100 ml.]. The presence of alkaloids was revealed by the formation of a reddish brown precipitate (Evans, 2002).

2.2.6 Reducing sugar (Fehling's test)

On a water bath, one ml of extract was heated with 1 ml Fehling solution A and 1 ml Fehling solution B. The presence of sugar was indicated by a reddish precipitate. (Ramakrishnan *et al*, 1994). [Fehling's solution A: Copper sulphate (34.66 g) was dissolved in distilled water and a volume of 500 ml was obtained by adding distilled water. Fehlings solution B was prepared by dissolving potassium sodium tartarate (173 g) and sodium hydroxide (50 g) in water and diluting to 500 ml].

2.2.7 Glycosides (Keller – Kiliani test)

1 ml glacial acetic acid, a few drops of $FeCl_3$, and a few drops of concentrated H_2SO_4 were added to a 2 ml extract. The presence of cardiac glycosides was revealed by the blue green color.

2.3 Nutritional Analysis

2.3.1 Dry matter and Moisture

The sample's dry matter represents the amount of material left after all moisture has been removed. The material's dry matter and moisture were determined using the AOAC technique (1990). Dishes were washed with detergents and then rinsed with water before being dried in the oven overnight at 60°C. The dishes were then taken out of the oven and placed in a desiccator to cool. Two grams of sample were placed in plates and baked at 60°C overnight. The following formula was used to compute the dry matter and moisture.

$$\text{Dry matter (\%)} = \frac{\text{(Weight of dish + Weight of dried sample)- Weight of dish}}{\text{Weight of sample before drying}} \times 100$$

$$\text{Moisture content (\%)} = \frac{\text{(Weight of fresh sample - Weight of dry sample)}}{\text{Weight of fresh sample}} \times 100$$

2.3.2 Total Ash

The AOAC (1990) method was used to determine the ash content. For one hour, the crucible was held in a muffle furnace at 600°C. To avoid moisture absorption, it was instantly transported from the furnace to a desiccator, cooled to ambient temperature, and weighed. Two grams of dry sample powder were placed in the crucible and heated to 600°C in a muffle furnace for six hours. The crucible was put in a desiccator and allowed to cool to room temperature. To avoid moisture absorption, the crucible was moved as rapidly as feasible. The following formula was used to estimate the ash percentage.

$$\text{Ash (\%)} = \frac{\text{Weight of Ash}}{} \times 100$$

Weight of Sample

2.3.3 Crude fiber

Sadasivam and Manikam developed a method for determining crude fiber content (1992). To eliminate fat content, two grams of dried material were extracted using petroleum ether. The plant powder was dried and taken for further examination. This two-gram dry powder was heated for 30 minutes with 200 ml of 0.255 N H_2SO_4 and bumping chips. It was then filtered through muslin fabric and rinsed with hot water until it was acid-free. The residue was then heated for 30 minutes with 200 ml of 0.313 N NaOH. It was filtered again through muslin cloth and rinsed with 25 ml boiling 1.25% H_2SO_4, three 50 ml portions of water, and 25 ml alcohol. Removed the residue and placed it in an ashing dish that had been pre-weighed (W1 g). Then it was burned over 600°C for 30 minutes. It was reweighed after cooling in the desiccator (W3 g). Using the formula below, the proportion of crude fiber was calculated.

$$\text{Crude fiber content (\%)} = \frac{\text{Loss in weight on ignition } (W2 - W1) - (W3 - W1)}{\text{Weight of sample}} \times 100$$

Where, W1= Preweighted ashing dish,

W2= Ashing dish with dry residue,

W3= Ashing dish with ash.

2.3.4 Crude fat

Sadasivam and Manikam's approach was used to determine the crude fat content (1992). In a thimble, two grams of dried material were placed in the soxhlet device. Dry pre-weighed solvent flasks (‘a' g) were attached beneath the apparatus, and the needed volume of petroleum ether was supplied, after which the condenser was connected. The temperature was tuned to produce 2-3 drips of condensation every hour, and the sample was extracted for 16 hours. The thimble was then removed, and the ether was kept in the instrument. On a hot water bath, the excess ether was evaporated from the solvent flask. Then it was allowed to cool before being weighed (‘b' g). The following formula was used to determine crude fat.

$$\text{Crude fat content (\%)} = \frac{(b - a)}{\text{Weight of sample}} \times 100$$

2.3.5 Crude Protein

The total nitrogen content was calculated using Hawk *et al.* (1948) method. A pinch of microsalt (200 g K_2SO_4 + 5 g dehydrated $CuSO_4$), 5 ml H_2SO_4, and double distilled water (1:1) were added slowly to 0.5 g powder of plant samples in Kjeldahl's flask. A few glass beads were added to speed up digestion and prevent the solution from banging around in the flask. The digestion process was continued until a clear solution was obtained. It was brought to room temperature and then double distilled water was added to get the volume up to 100 ml. It was filtered through Whatman No.1 filter paper after being stored at room temperature overnight. The nitrogen content of this filtrate was calculated. 1 ml filtrate, a drop of 8% $KHSO_4$, and 15 ml Nessler's reagent (Reagent A- 7 g KI + 10 g HgI_2 in 40 ml distilled water, Reagent B- 10 g NaOH in 50 ml distilled water) were used in the assay. Reagents A and B were combined in a 4:5 ratio. This was diluted in distilled water up to 50 ml. Distilled water was used to make the blank. On a spectrophotometer, the absorbance was measured at 520 nm. The nitrogen concentration was estimated using an ammonium sulphate standard curve (0.05 mg/ml). The crude protein content was calculated by multiplying the total nitrogen content of the sample by 6.25 (AOAC, 1990).

2.3.6 Carbohydrates analysis: Total Sugar

The sugars were calculated using the technique (Anthrone).100 mg of plant material was injected into a boiling tube and hydrolyzed with 5 ml of 2.5 N HCl for three hours in a boiling water bath. Then, using solid sodium carbonate, it was neutralized until the effervescence continued, yielding a final amount of 100 ml. After that, the extract was centrifuged at 7000 rpm for 10 minutes. After centrifugation, the supernatant was collected for further analysis. 4 ml of anthrone reagent was added to the test tube after 1 ml of supernatant and 2 ml of distilled water were added. The test tubes were then placed in a boiling water bath for eight minutes. The test tube was allowed to cool to room temperature after heating. Finally, as the color changed from green to dark green, then absorbance was measured at 630nm.

2.3.7 Reducing sugar

The method of calculating the reducing sugar was used (Anthrone). 100 mg of plant material was injected into a boiling tube and hydrolyzed for three hours in a boiling water bath with 5 ml of 2.5 N HCl. It was then neutralized with solid sodium carbonate until the effervescence continued, yielding a final volume of 100 ml. After that, the extract was centrifuged for 10 minutes at 7000 rpm. The supernatant was collected after centrifugation for further examination. After mixing 500 µl of supernatant and 3 ml of DNSA reagent (20 ml 2N NaOH + 50 ml sodium potassium tartrate + 20 ml DNSA) into the test tubes. The test tubes were then immersed in a boiling water bath for 15 minutes before being allowed to cool to room temperature. The absorbance was measured using a spectrophotometer at 540nm.

2.3.8 Starch

To extract the sugars, 0.5g of plant material was homogenized in hot 80% ethanol. The extract was then centrifuged for 10 minutes at 7000 rpm to remove the residue. The leftovers were then washed several times with hot 80% ethanol until no color was produced by the washing with anthrone reagent. After washing, it was placed in a water bath to dry. The residue was then mixed with 5 ml distilled water and 6.5 ml 52% perchloric acid. The extract was then maintained at 00 C for 20 minutes. After the incubation period, the supernatant was centrifuged many times with perchloric acid and preserved for further investigation. A test tube was filled with 0.1 ml of supernatant and distilled water to make a final volume of 1 ml. Then, in a test tube, 4ml of anthrone reagent (200mg anthrone in 100ml ice cold 95% Sulphuric acid) was added. The test tubes were then immersed in a water bath for 8 minutes. After the test tubes had been heated to the desired temperature, they were removed from the water bath and allowed to cool at ambient temperature. Finally, using a spectrophotometer, the intensity of the green to dark color was assessed at 630nm.

2.3.9 Mineral Analysis:

i. Preparation of acid digests

In the examination of inorganic components, the acid digestion method of Toth *et al.*, (1948) was used. A total of 0.5g mg of oven dried powder was transferred to a clean 150 ml beaker, to which 10 ml of concentrated HNO_3 was added. It was covered with a watch glass and left for an hour to allow the primary reaction to die down. The mixture was then boiled on a hot plate until all of the material had dissolved entirely. After allowing it to cool to room temperature, 10 ml of 60% perchloric acid was added and carefully mixed. The solution was then boiled on a hot plate until it turned colorless and was reduced to around 2-3ml. It was decided not to allow the solution to dry out while it was heating. It was transferred to a 100ml volumetric flask after cooling, diluted to 100ml with distilled water, and stored overnight. The extract was filtered the next day using Whatman No.44 filter paper. The resulting filtrate was then utilized to analyze various inorganic components.

Using an Atomic absorption Spectrophotometer, the levels of calcium, magnesium, sodium, iron, manganese, zinc, and copper were determined. If necessary, a suitable dilution of the plant extract was made using double distilled water. Flame photometry was used to assess sodium and potassium using the usual flame photometer method (Model- Elico, ch-22A). Various amounts of sodium and potassium were created for standardization, ranging from 10 to 80 ppm, by diluting a stock solution of NaCl (100 ppm). Using an atomic absorption spectrophotometer, the remaining inorganic elements, such as calcium, potassium, magnesium, iron, manganese, zinc, and copper, were calculated (Perkin-Elmer, 3030 A).

ii. Estimation of Phosphorus

The method reported by Sekine *et al.* was used to measure phosphorus from the same acid digest (1965). In a test tube, two ml acid digest was mixed with two ml 2N HNO_3, one ml Molybdate-Vanadate reagent (Reagent A: 1.25 g ammonium vanadate dissolved in 1N HNO_3), and the volume was increased to 500 ml with 1N HNO_3. Reagent B: 25g ammonium molybdate was dissolved in distilled water and the volume was increased to 500ml. Then, in equal amounts, reagents A and B were combined). With distilled water, the volume was increased to 10 mL and left to react for 20 minutes. A reaction mixture was used to measure the yellow color intensity at 420 nm after 20 minutes. The standard curve was plotted using the color given by standards of known phosphorus concentration in KH_2PO_4 solution (0.110 g KH_2PO_4 per liter = 0.025 mg P. ml-1) using Molybdate Vanadate reagent. The content of Phosphorus in the plant material was expressed in mg/100g on a dry weight basis using a standard curve.

iii. Total nitrogen:

The total nitrogen content was calculated using Method of Hawk *et al* (1948). 5 ml H_2SO_4 and double distilled water (1:1) were carefully added to the 0.5g powder of plant samples in Kjeldahl's flask, together with a pinch of microsalt (200 g K_2SO_4 + 5 g dehydrated $CuSO_4$) and a few glass beads were added to speed up digestion and prevent the solution from banging around in the flask. The digestion process was continued until a clear solution was obtained. It was brought to room temperature and then double distilled water was added to make the capacity 100 ml. It was filtered through Whatman No.1 filter paper after being stored at room temperature overnight. This filtrate was used to calculate nitrogen levels. 1 mL filtrate, a drop of 8% $KHSO_4$, and 15 mL Nessler's reagent (Reagent A-7 g KI + 10 g HgI_2 in 40 mL distilled water, Reagent B-10 g NaOH in 50 mL distilled water) were used in the test. Reagents A and B were combined in a 4:5 ratio. This was diluted in distilled water up to 50 ml. Distilled water was used to make the blank. A double beam spectrophotometer was used to measure the absorbance at 520 nm (Shimadzu UV 190). The nitrogen concentration was estimated using an Ammonium sulphate (0.05 mg/ml) standard curve.

III. RESULT AND DISCUSSION

In present study the preliminary phytochemical analysis was done by using four solvents systems, such as methanol, acetone, aqueous and chloroform. A high amount of phytochemicals like alkaloids, phenols, tannin, caumarin, and glycosides was found in the methanolic extract than the others. In proximate analysis high content of ash (4.5%), crude fat (6%) and protein (8.31%) were observed in immature seeds of *R.cana*, while dry matter (88%) was observed in mature seeds of *R. hirta*. A high amount of crude fibre content (17%) was observed in mature seeds of *R.minima* and moisture (40%) was noted in immature seeds of *R.hirta* .In mineral analysis High amount of nitrogen (1.33±0.014%), phosphorus (0.24±0.008%) and potassium (1.27±0.005%) were observed in immature seeds, whereas manganese(1220±0.005 mg/100g) in mature seeds of *R.cana*. A High

amount of zinc (730±0.008 mg/100g) and calcium (1.8%) were observed in mature seeds of *R.rufescence*. In mature seeds of *R.minima* high magnesium content (9.11%) & copper (1113±0.001mg/100g) were observed, while iron content (6180±0.01mg/100g) in immature seeds of *R.minima*.

The reducing sugar content of immature and mature seeds of all four species of *Rhynchosia* like *Rhynchosia cana, Rhynchosia hirta, Rhynchosia rufescence, Rhynchosia minima* are showed in (Figure 1). In *R. hirta* high amount of reducing sugar is in mature seeds (0.803± 0.78 g/100g) than that of immature seeds (0.528± 0.53 g/100g) while in case *of R. cana, R. rufescence* and *R. minima* immature seeds showing high amount of reducing sugar (0.940± 1.74 g/100g), (1.391± 0.39 g/100g) and (0.966± 0.53 g/100g) respectively, than that of mature seeds which having low amount of reducing sugar (0.855± 1.29 g/100g), (0.810± 0.25 g/100g) and (0.666± 0.39 g/100g) respectively.

The total sugar content of immature and mature seeds of all four species of *Rhynchosia* like *Rhynchosia cana, Rhynchosia hirta, Rhynchosia rufescence, Rhynchosia minima* are showed in (Figure 2). In *R. cana* high amount of total sugar is in mature seeds (0.915± 0.39 g/100g) than that of immature seeds (0.865± 0.67 g/100g) while in case of *R. hirta, R. rufescence* and *R. minima* immature seeds having high amount of total sugar content (0.813±0.39g/100g), (1.214±1.17g/100g) and (0.901±1.29g/100g) respectively than that of mature seeds which having low amount of total sugar content (0.710± 0.67 g/100g), (0.827± 0.82 g/100g) and (0.792± 0.39 g/100g) respectively.

The starch content of immature and mature seeds of all four species of *Rhynchosia* like *Rhynchosia cana*, *Rhynchosia hirta, Rhynchosia rufescence, Rhynchosia minima* are showed in (Figure 3). In *R. hirta* high amount of starch content is in mature seeds (1.266± 4.16 g/100g) than that of immature seeds (1.084± 2.51 g/100g) while in case of *R. cana* high amount of starch content is in immature seeds (1.582± 2.08 mg/100g) than that of mature seeds (1.477±3.78 mg/100g). In *R. rufescence* high amount of starch content is in mature seeds (1.577± 1.52 g/100g) than that of immature seeds (1.453± 4.04 g/100g) whereas in *R. minima* high amount of starch content is in immature seeds (1.581± 5 g/100g) than that of mature seeds (1.442± 2.51 g/100g).

Kalidass, C., & Mohan, V. R., (2012) studied the nutritional and antinutritional composition of some species of *Rhynchosia*. They found proximate composition of species *Rhynchosia* are reveals, the content of crude protein was found to be high in *R. rufescens* (19.40%). This is comparable to some common traditional protein source, such as *Centrosema pubescens* (18.97%), *Centrosema pascuorum* (18.15%), *Lablab purpureus* (17.28%) (Nworgu and Ajayi, 2005), and *Dioscorea pentaphylla* var tribal food tubers. Pentaphylla (9.18%), *Dioscorea var oppositifolia* (7.00%), *Dioscorea spicata* (6.38%), and *Dioscorea tomentosa* (8.31%), respectively (Mohan and Kalidass, 2010). The crude lipid content of *Rhynchosia cana* accessions *Siruvani and Petchiparai, R. filipes, R. rufescens* tends to be higher than the common / tribal pulses previously studied such as *Mucuna flegellipes* (Ihedioha and Okoye, 2011), and *Dioscorea pentaphylla var tubers. Dioscorea oppositifolia var. Pentaphylla. Dioscorea spicata, Dioscorea tomentosa and Dioscorea* (Mohan and Kalidass, 2010). The overall dietary fiber content of all of the *Rhynchosia* species studied is found to be more than the other *Luffa cylindrica* tribal pulses (Olaofe *et al.,* 2008); *Canavalia ensiformis* (Doss *et al.*, 2011). The ash content of the investigated species of *Rhynchosia* (2.80-3.50 percent) would be important to the extent that it contains the nutritionally important mineral elements. Kalidass, C., & Mohan, V. R. 2012).It seems that, because of their low fat content, the *Rhynchosia* species have a high carbohydrate range (64.25 – 72.51 per cent). All the *Rhynchosia* species investigated have a high energy range (1563.21 – 1593.37 kJ 100g-1 DM) compared to the commonly grown pulse crops such as cowpea, green gram, horse gram, moth bean and peas (Narasinga Rao *et al.*, 1989), which are within 1318 – 1394 kJ 100g-1 DM. Robinson (1987) indicated that a diet that meets the RDA

(Recommended Dietary Allowances) values of two-thirds should be considered sufficient for an person. Minerals such as calcium, iron, copper, zinc, potassium and magnesium are a good source of food legumes (Salunkhe *et al.*, 1985). According to (Kalidass, C. & Mohan, V. R. 2012) the seeds of all the *Rhynchosia* species studied contained higher levels of sodium , potassium and calcium compared to other legumes, *Phaseolus vulgaris, Phaseolus limensis, Vigna unguiculata, Cicer arietinum, Pisum sativum and Lens culinaris* (Meiners *et al.*, 1976); In this study, all species of *Rhynchosia* reported a higher potassium level relative to the acceptable dietary allowance value (RDA) of infants and children (< 1550 mg) (NRC / NAS 1980). The high potassium content can be beneficially used in the diet of people taking diuretics to control hypertension and suffering from excessive potassium excretion by body fluid (Siddhuraju *et al.*, 2001). The iron content *of Rhynchosia filipes*, manganese content of *Rhynchosia cana* accessions Siruvani and Petchiparai, *Rhynchosia rufescens* and *Rhynchosia suaveolens* were found to be higher than that of the ICMR's recommended dietary allowance for iron and manganese (1992).

Table 1. Preliminary phytochemical analysis of immature & mature seeds of *Rhynchosia* in methanol extract.

Parameter	RMI	RMM	RCI	RCM	RRI	RRM	RHI	RHM
Alkaloids	+++	+++	+	+++	+++	+++	++	+++
Phenols	+++	+++	+	+	-	+	+++	+++
Tannins	++	++	+++	++	+++	+++	+++	+++
Saponins	+	+	+	+	+	+	-	-
Flavones	+	+	+	-	-	-	++	++
Anthraquinones	-	-	-	-	-	-	-	-
Carbohydrates	-	-	-	-	-	-	-	-
Xanthoprotein	-	-	-	-	-	-	-	-
Caumarine	+++	+++	+++	++	++	++	++	++
Glycoside	++	++	++	++	++	+++	+++	+++

(+ = Low, ++ = Medium, +++ = High, - = Absent, RCI- *Rhynchosia cana* immature, RCM- *Rhynchosia cana* mature, RHI- *Rhynchosia hirta* immature, RHM- *Rhynchosia hirta* mature, RRI- *Rhynchosia rufescence* immature, RRM- *Rhynchosia rufescence* mature, RMI- *Rhynchosia minima* immature, RMM- *Rhynchosia minima* mature).

Table 2. Preliminary phytochemical analysis of immature & mature seeds of *Rhynchosia* in chloroform extract.

Parameters	RMI	RMM	RCI	RCM	RRI	RRM	RHI	RHM
Alkaloids	-	-	-	-	-	-	-	-
Phenols	-	-	-	-	-	-	-	-
Tannins	+	+	+	+	++	++	+	+
Saponins	+++	++	++	++	+	+	+	+
Flavones	-	-	-	-	-	-	-	-
Anthraquinones	-	-	-	-	-	-	-	-
Carbohydrates	+++	+++	+++	+++	+++	+++	+++	+++
Xanthoprotein	-	-	-	-	-	-	-	-
Caumarine	-	-	-	-	-	-	-	-
Glycoside	-	-	-	-	-	-	-	-

(+ = Low, ++ = Medium, +++ = High, - = Absent, RCI- *Rhynchosia cana* immature, RCM- *Rhynchosia cana* mature, RHI- *Rhynchosia hirta* immature, RHM- *Rhynchosia hirta* mature, RRI- *Rhynchosia rufescence* immature, RRM- *Rhynchosia rufescence* mature, RMI- *Rhynchosia minima* immature, RMM- *Rhynchosia minima* mature).

Table 3. Preliminary phytochemical analysis of immature & mature seeds of *Rhynchosia* in acetone extract.

Parameter	RMI	RMM	RCI	RCM	RRI	RRM	RHI	RHM
Alkaloids	-	-	-	-	-	-	-	-
Phenols	-	-	-	-	-	-	-	-
Tannins	-	-	-	-	-	-	-	-
Saponins	-	-	-	-	-	-	-	-
Flavones	+	+	+	+	++	++	-	-
Anthraquinones	-	-	-	-	-	-	-	-
Carbohydrates	-	-	-	-	-	-	-	-
Xanthoprotein	-	-	-	-	-	-	-	-
Caumarine	++	++	++	++	++	+++	-	-
Glycoside	++	++	++	++	++	++	++	++

(+ = Low, ++ = Medium, +++ = High, - = Absent, RCI- *Rhynchosia cana* immature, RCM- *Rhynchosia cana* mature, RHI- *Rhynchosia hirta* immature, RHM- *Rhynchosia hirta* mature, RRI- *Rhynchosia rufescence* immature, RRM- *Rhynchosia rufescence* mature, RMI- *Rhynchosia minima* immature, RMM- *Rhynchosia minima* mature).

Table 4. Preliminary phytochemical analysis of immature & mature seeds of *Rhynchosia* in aqueous extract.

Parameter	RMI	RMM	RCI	RCM	RRI	RRM	RHI	RHM
Alkaloids	+	+	+	+	+	+	+	+++
Phenols	-	-	-	-	-	-	-	-
Tannins	+	+	+	+	+	+	+	+
Saponins	++	++	+++	+++	++	+	++	+++
Flavones	+	++	++	++	+	+	+	++
Anthraquinones	-	-	-	-	-	-	-	-
Carbohydrates	-	-	-	-	-	-	-	-
Xanthoprotein	-	-	-	-	-	-	-	-
Caumarine	-	-	-	-	-	-	-	-
Glycoside	-	-	-	-	-	-	-	-

(+ = Low, ++ = Medium, +++ = High, - = Absent, RCI- *Rhynchosia cana* immature, RCM- *Rhynchosia cana* mature, RHI- *Rhynchosia hirta* immature, RHM- *Rhynchosia hirta* mature, RRI- *Rhynchosia rufescence* immature, RRM- *Rhynchosia rufescence* mature, RMI- *Rhynchosia minima* immature, RMM- *Rhynchosia minima* mature).

Table 5. Proximate analysis of immature & mature seeds of *Rhynchosia*.

Sr. No	Plant Name	Dry Matter (%)	Moisture (%)	Ash (%)	Crude Fat (%)	Crude Fiber (%)	Protein (%)
1	RHI	60	40	3.5	2	9	6.81
2	RHM	88	12	02	4	12	5.37
3	RCI	73	27	4.5	6	4	8.31
4	RCM	72	14.5	03	2.5	8	6.75
5	RRI	65	17	04	3.5	8.5	5.43
6	RRM	74	30.5	03	4.5	3	6.25
7	RMI	43	57	02	3.5	5	5.06
8	RMM	82	6.5	03	2.5	17	5.25

(RCI- *Rhynchosia cana* immature, RCM- *Rhynchosia cana* mature, RHI- *Rhynchosia hirta* immature, RHM- *Rhynchosia hirta* mature, RRI- *Rhynchosia rufescence* immature, RRM- *Rhynchosia rufescence* mature, RMI- *Rhynchosia minima* immature, RMM- *Rhynchosia minima* mature).

Table 6. Mineral analysis of immature & mature seeds of *Rhynchosia.*

Sr. No	Plant Name	(Z) mg/100 g	(Fe) mg/100g	(Mn) mg/100g	(Cu) mg/100gm	(PO4) %	(Ca) %	Nitrogen %	Phosphorus %	(Mg) %
1	RHI	527±0.05	3250±0.02	160±0.03	1110±0.04	1.18±0.03	0.544±0.001	1.08±0.003	0.2±0.05	0.10 ± 0.03
2	RHM	610±0.05	3930±0.0145	110±0.005	1200±0.08	1.03±0.003	0.706±0.001	0.86±0.005	0.19±0.005	0.14±0.05
3	RCI	670±0.003	4290±0.01	140±0.005	980±0.003	1.27±0.005	0.496±0.005	1.33±0.014	0.24±0.008	0.11±0.03
4	RCM	640±0.05	2550±0.02	1220±0.005	1103±0.002	1.12±0.005	0.579±0.003	1.18±0.014	0.23±0.0012	0.11±0.03
5	RRI	620±0.08	4580±0.02	220±0.08	890±0.027	1.24±0.05	1.248±	0.97±0.015	0.24±0.0015	0.11±0.06
6	RRM	730±0.08	6170±0.01	220±0.012	1390± 0.17	1.23±0.03	1.837±0.015	1.3±0.08	0.21±0.008	0.093±0.08
7	RMI	600±0.023	6180± 0.01	137±0.005	860±0.001	1.02±0.03	0.08±0.017	0.81±0.02	0.22±0.01	0.12±0.003
8	RMM	680±0.08	3920±0.01	190±0.005	1113±0.001	1.02±0.008	0.374±0.005	0.87±0.01	0.23±0.1	9.11±0.006

(RCI- *Rhynchosia cana* immature, RCM- *Rhynchosia cana* mature, RHI- *Rhynchosia hirta* immature, RHM- *Rhynchosia hirta* mature, RRI- *Rhynchosia rufescence* immature, RRM- *Rhynchosia rufescence* mature, RMI- *Rhynchosia minima* immature, RMM- *Rhynchosia minima* mature).

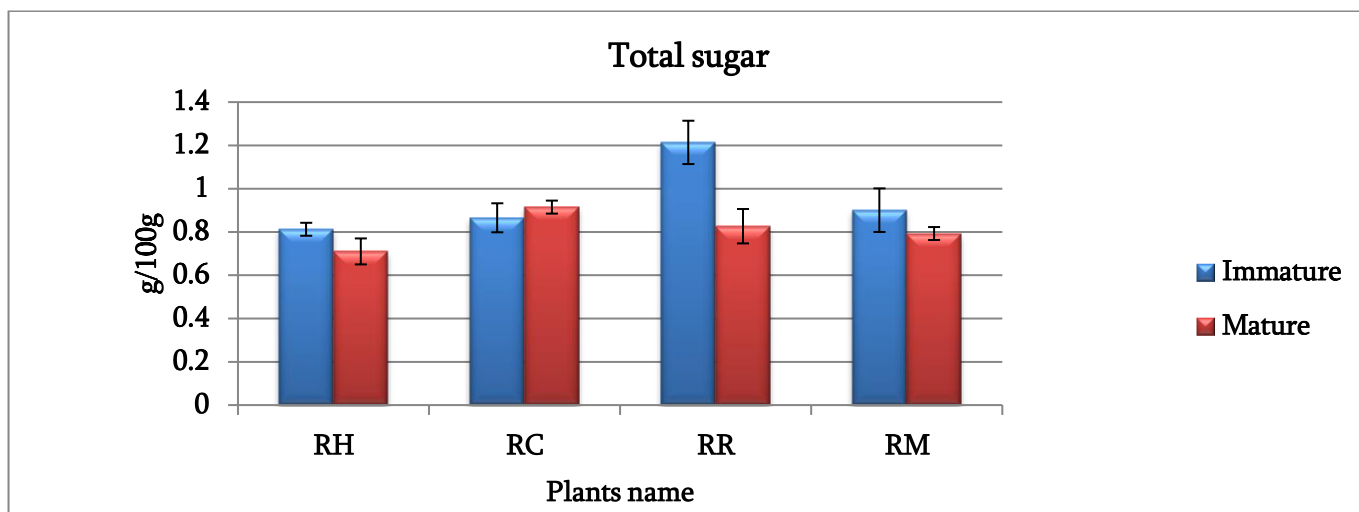

Fig.1. Total sugar content of immature and mature seeds of four species of *Rhynchosia.*

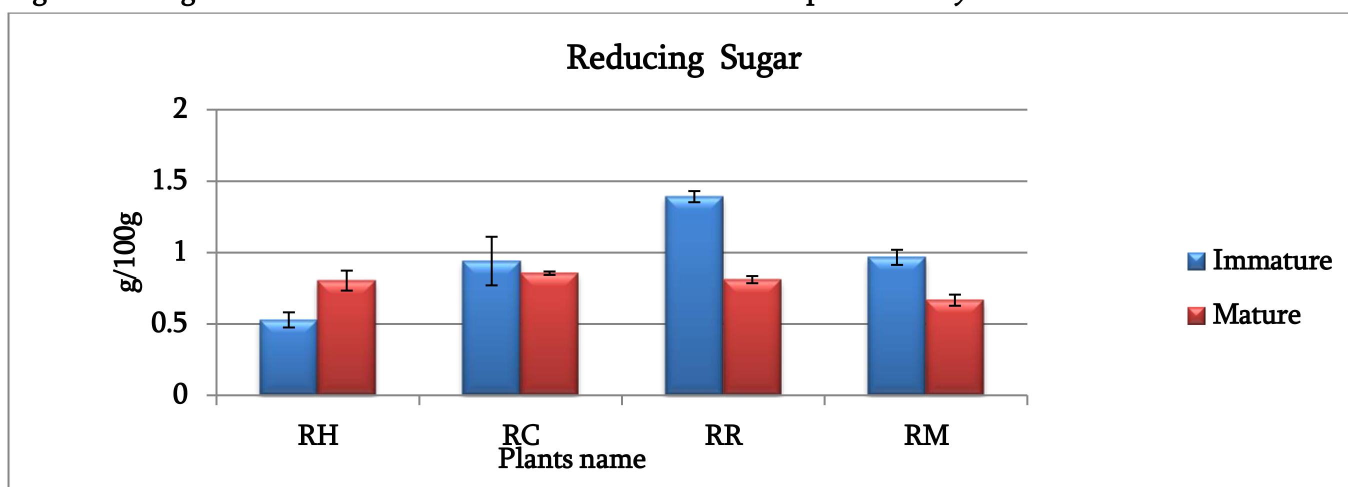

Fig.2. Reducing sugar content of immature and mature seeds of four species of *Rhynchosia.*

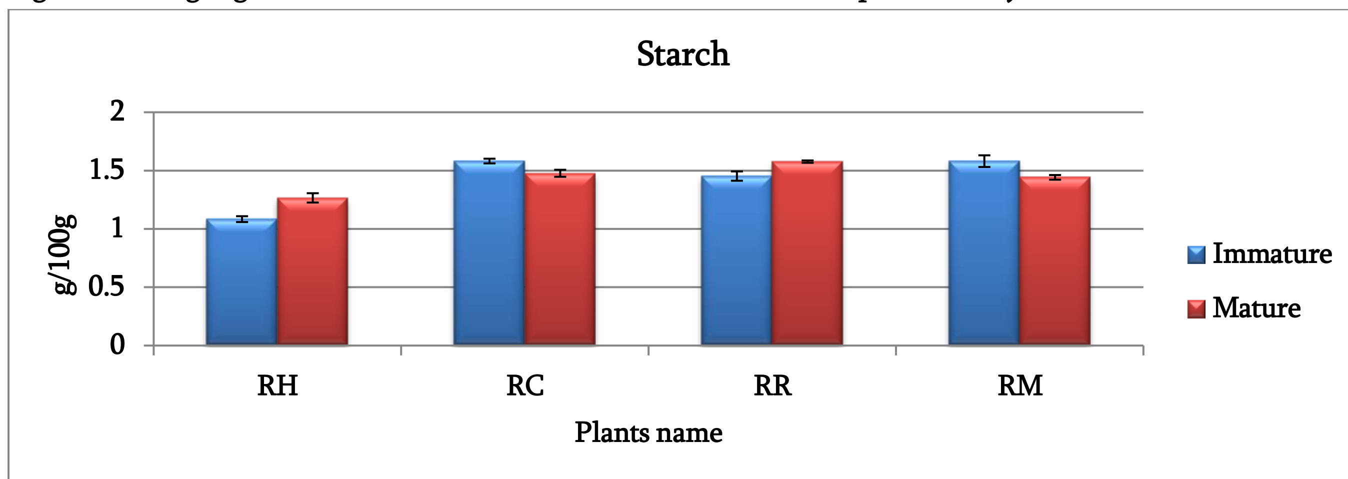

Fig.3. Starch content of immature and mature seeds of four species of *Rhynchosia.*

IV. CONCLUSION

From the above study, it is conclude that all four species of *Rhynchosia* are nutritionally rich, whereas *R.cana* having high nutritional content as compared to other three species which reviled that wild legume *Rhynchosia* is a rich source of phytochemicals and nutrition and provides possibilities for advancement as a stand-by for

cultivated species as a vegetable. *Rhynchosia* is an economically important genus that is distributed all over the world. The *Rhynchosia's* preliminary phytochemical screening revealed alkaloids, flavonoids, tannins, saponine, terpenoids, and glycosides.

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