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QUANTITATIVE ASSESSMENT OF ANTIOXIDANTS IN FIVE NATIVE TUBERS IN KERALA

Suvarna .S[1], Veena .R.K[2], Silpa .S.P[3]

1. Second year MSc student[1]
2Second year MSc student[2]
3Second year MSc student[3]
[1, 2, 3] PG Department of Environmental Sciences, All Saints' College, Thiruvananthapuram, Kerala

Abstract: **There are vast amount of phytochemicals which can act as antioxidants in the natural means. Plants are one of the rich source of natural antioxidants. Antioxidants are the compounds which can prevent oxidation reaction. Besides this, they can also contribute metabolic activities in plants. In the present study, tubers were examined to determine their antioxidant potential. For this purpose, five native tubers namely *Dioscorea esculenta, Borassus flabellifer, Solanum tuberosum, Ipomoea batatas and Manihot esculenta* were selected. Among the five selected tubers, the highest phenolic content was observed in *Manihot esculenta* (0.183mg/100g) and was found to be least in *Dioscorea esculenta* (0.0598mg/100g). Tannin, flavonoid and alkaloid were found to be high in *Dioscorea esculenta* (1909.9mg/100g, 225mg/100g and 914.24mg/100g respectively). Tannin was found to be minimal in *Solanum tuberosum* (229.99mg/100g). Flavonoid was observed to be least in *Solanum tuberosum* (88.7mg/100g) and alkaloid was least in *Ipomoea batatas* (427.39mg/100g). High concentration of saponin was found in *Borassus flabellifer* (32.7157mg/100g) and was low in *Solanum tuberosum* (4.715mg/100g). Terpenoid was found to be the highest in *Solanum tuberosum* (60.41mg/100g) and lowest in *Manihot esculenta* (45.828mg/100g). The study reveals that the selected tubers contain antioxidants namely, alkaloid, flavonoid, phenol, tannin, saponin and terpenoid. Low tannin is favourable for our health. So, *Solanum tuberosum* (229.99mg/100g) is the good source for tannin. Because of the present relevance of natural antioxidants in modern medical field, this study would be a leading path way of information for selection of the extract for various pharmacological activities.**

Keywords: **Antioxidants, Phenol, Flavonoid, Alkaloid, Tannin.**

1. INTRODUCTION

Plants are treasure of nature. They are rich source of phytochemicals. Phytochemicals can act as antioxidants, secondary metabolites, nutrients, etc. Tuber crops, one of the species in the plant kingdom, can contribute to the production of various phytochemicals. Antioxidants are one among them. They can be used for several actions like plant perennation, to provide energy and nutrients for regrowth during the next growing seasons and as a means of asexual reproduction. antioxidants prevent injury to blood vessel membranes, optimize blood flow to the heart and brain, prevent cancer-causing DNA damage, and lower the risks from cardiovascular and Alzheimer's diseases(Ames *et al.*, 1993). They can prevent or slow the oxidative damage linked to various diseases such as carcinogenesis, atherogenesis and aging (Jo *et al.*, 2006).

2. MATERIALS AND METHODS

In the present study, the following tubers were used.

1. Dioscorea esculenta
2. Borassus flabellifer
3. Solanum tuberosum
4. Ipomoea batatas
5. Manihot esculenta

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1. Estimation of flavonoid

The total flavonoid content (mg/ml) was determined using (Zshishen *et al.*, 1999 & Zou *et al.*, 2004).

2. Estimation of phenol

The total phenolic content of the extracts were determined by (Chun *et al.*, 2003).

3. Estimation of alkaloids

The alkaloid content was estimated using (Trease & Evans, 2002).

4. Estimation of tannins

Total tannin content was determined by using (Trease & Evans, 1992).

5. Estimation of terpenoids

Estimation of terpenoid was determined by Gorai *et al.*, 2014.

6. Estimation of saponins

Estimation of total saponin content was determined by (Hiai et *al.*, 1976).

3. RESULTS AND DISCUSSIONS

ESTIMATION OF PHENOL:

The result of quantitative analysis of phenolic content of five native tubers was presented in the form of figure1. Among the five selected tubers, the highest phenolic content was observed in *Manihot esculenta* (0.183mg/100g). It was followed by *Solanum tuberosum* (0.1449mg/100g), *Borassus flabellifer* (0.0913mg/100g), *Ipomoea batatas* (0.0759mg/100g), and was found to be least in *Dioscorea esculenta* (0.0598mg/100g). The antioxidant activity of phenolic compound is due to the hydroxyl functional group, however, other factors e.g., presence of electron withdrawing or releasing group in the aromatic ring having hydroxyl moiety will increase or decrease the activity (Govindan *et al.*, 2015). In this study total phenolic content was found to be 80.46±1.868 mg GE/g for *F. benghalensis* seed. The amount of phenolic compounds in *Solanum tuberosum* (522.1-593.3 µg/gdw) was highest in methanol extract. Total phenolic concentrations of Solanum *tuberosum* in the five solvents were in the order: methanol > water > ethanol > acetone > hexane. Potato peel contains many phenolic compounds (Samarin *et al.*, 2012).

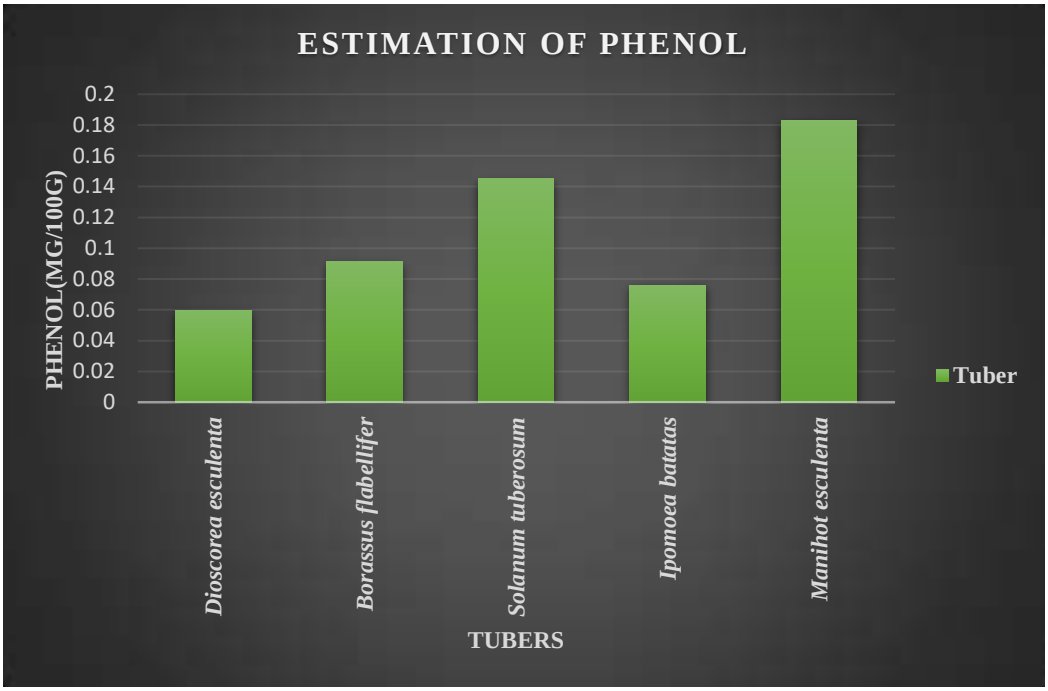

Figure 1: Estimation of Phenol

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ESTIMATION OF TANNIN:

Result of the tannin concentration in the study materials were given in figure 2. Tannin is an important antioxidant in plants. In this study, high concentration of tannin was found in *Dioscorea esculenta* (1909.9mg/100g). This was followed by *Manihot escu*lenta (785.71mg/100g), *Borassus flabellifer* (418.57mg/100g), *Ipomoea batatas* (312.85mg/100g) and was found to be minimal in *Solanum tuberosum* (229.99mg/100g). They cause inhibition to protein absorption and reduce iron availability (Bravo L, 1994). So, the minimum level of tannin in the diet is advisable. So, from the selected tubers *Solanum tuberosum* (229.99mg/100g) can be used as a good source for tannin consumption. Tannins were compounded with organic compounds such as proteins, starches and digestive enzymes thus reduce the dietary importance of foods (Serrano *et al.*, 2009). Another study conducted (Daniel & Krishnakumari 2014) in Eugenia uniflora reveals that tannin contributes various medicinal properties such as antimicrobial, anti-inflammatory and astringent activity. They have been also reported to have anti-viral antibacterial (Akiama *et al.*, 2001 & Funatogawa *et al.*, 2004) and anti-parasitic effects, the level of tannins in the aqueous hot extract of *E. uniflora* was (1.45±0.49). A study in aqueous hot extract of Mushroom contain 6.84 ± 0.12mg/g tannin (Devi & Krishnakumari, 2015). A study by Ugwu *et al.*, 2017 showed the leaf and stem of *Vernonia amygdalina* were rich in tannins with the rootrecording the lowest value. The tannin content of the root of *V. amygdalina* was the least and therefore appears to be appropriate for treating diabetic persons, when compared to the leaf and stem. Thus, the presence of tannin in *Vernonia amygdalina* is useful with antidiabetic properties.

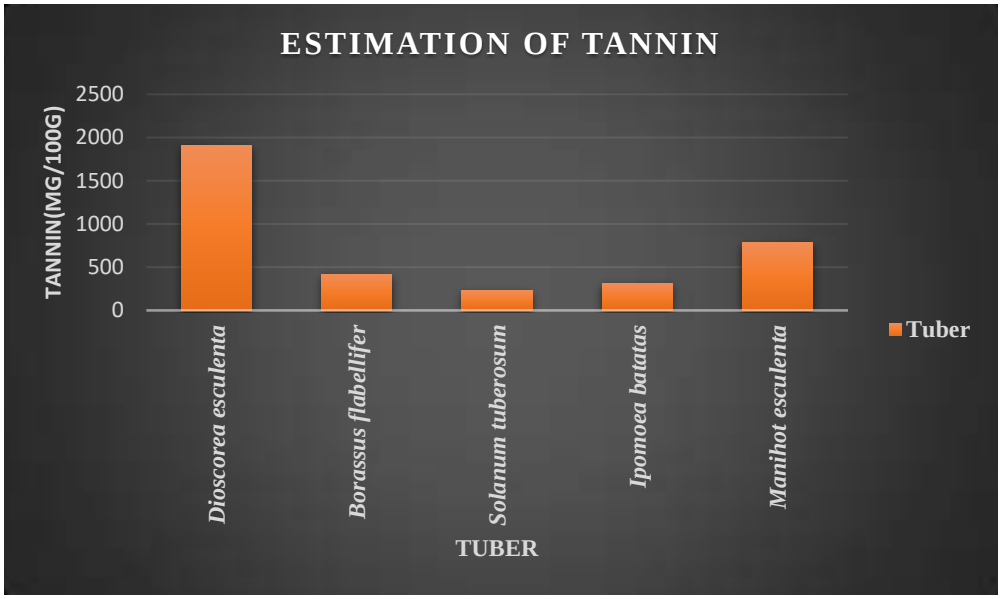

Figure 2: Estimation of Tannin

ESTIMATION OF FLAVONOID:

Results of the flavonoid concentration of the selected tubers were given in figure 3. In this study, it was found that high amount of flavonoid was found in *Dioscorea esculenta* (225mg/100g). It is followed by *Manihot esculenta* (185.2mg/100g), *Borassus flabellifer* (165.3mg/100g), *Ipomoea batatas* (89.1mg/100g) and was found to be very low in *Solanum tuberosum* (88.7mg/100g). A study conducted by Joy *et al.*, 2017 to evaluate the *in vitro* antioxidant and free radical scavenging capacity of ethanolic extract of three different underutilised *Dioscorea* species (*D.alata*, *D.pentaphylla* and *D.oppositifolia*) with a common cultured crop, *Plectranthus rotundifolius*. The maximum flavonoid content was detected in *Dioscorea oppositifolia* (80.06 mg of RUE/g extract) and boiled tubers of *D. alata* have the least (50.51 mg of RUE/g extract). Flavonoids aid as health promoting compound as a result of its anion radicals (Atmani *et al.*, 2009). Total flavonoid concentration were found to be 39.23±1.205 mg QE/g for *F. benghalensis* seed. The compounds like flavonoid, which hold hydroxyl groups, are accountable for the radical scavenging activity in the plants. It was familiar that flavonoids show significant antioxidant action on human health and fitness. Chowdhary *et al.*, 2014 reported that *F. benghalensis* leaf extracts contain total flavonoids of 5.11 µg/mg quercetin equivalents. A Study conducted by Yadav *et al.*, 2011 reveals that the methanolic extract of *Ficus benghalensis* latex has revealed the presence of total flavonoid content 1.84 mg QE/g. The flavonoid concentration of "*Crocus sativa*" in DCM, methanol and water extracts were found to be 1.8 and 9.2 and 11.2mg/g respectively (Mir *et al.*, 2016).

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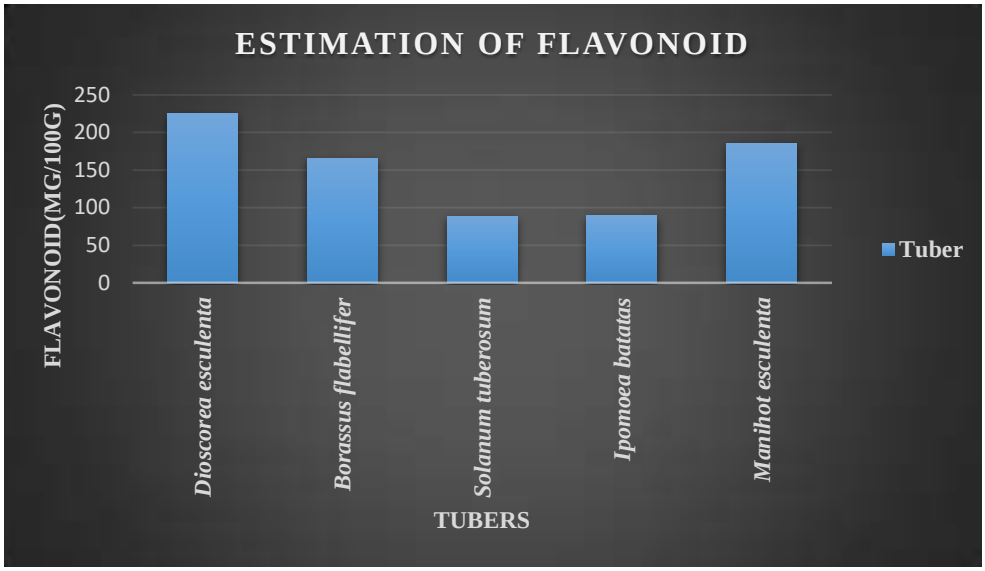

Figure 3: Estimation of Flavonoid

ESTIMATION OF ALKALOID

Results of the alkaloid content of five native tubers were given in figure 5. Alkaloids are good source of antioxidants. It was used for many metabolic activities. In this study high amount of alkaloid was present in *Dioscorea esculenta* (914.24mg/100g). It was followed by *Manihot esculenta* (630.95mg/100g), *Solanum tuberosum* (495.89mg/100g), *Borassus flabellifer* (482.19mg/100g) and was found to be low in *Ipomoea batatas* (427.39mg/100g). A study on Actinidia arguta (Liu et al., 2011) discovered that the content of alkaloids in roots was the highest, with 1.25mg/g. Alkaloid approximately 3/4 of the roots, content difference between leaves and fruits were not significant. Stems, around 2/5 of the roots, were the least alkaloid content. Alternative study in Crocos sativa (Mir *et al.*, 2016) found that alkaloid content of "*Crocus sativa*" flower in methanol and water extracts were found to be (6.4 and 2.4mg/g) respectively. A similar study was conducted by John et al., 2014 in Justicia species. The results disclosed that the leaf extract of *J. beddomi* displayed highest alkaloid content (28.53mg CE) followed by leaf extract of *J. wynaadensis (*26.96 mg CE) and *J. betonica* (26.18 mg CE). The root of *J. wynaadensis* presented least alkaloid content (8.45 mg CE).The higher alkaloid content was revealed in the leaves. The alkaloid concentration was varied with respect to the parts analysed. A study in Mushroom reveals that aqueous hot extract of mushroom contain 2.81 ± 0.61mg/g alkaloid concentration (Devi & Krishnakumari, 2015).

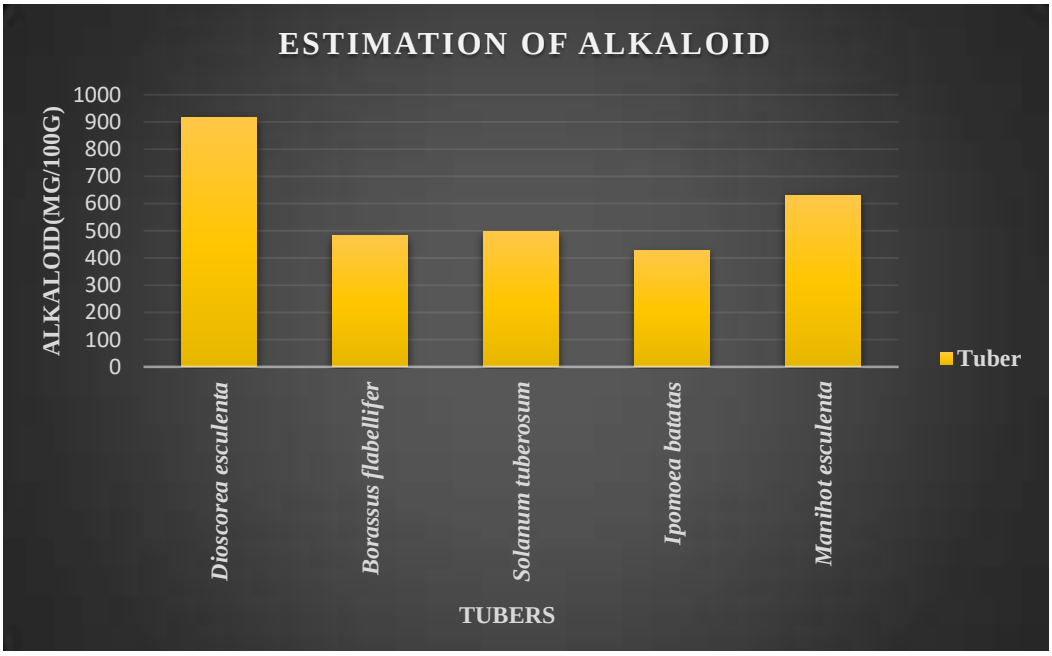

Figure 4: Estimation of Alkaloid

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ESTIMATION OF SAPONIN:

Results of the saponin concentration of the study materials were given in figure 4. Saponin is vital antioxidant in all plants. From the result it was clear that high concentration of saponin was found in *Borassus flabellifer* (32.7157mg/100g). It was followed by *Ipomoea batatas* (21.178mg/100g), *Manihot esculenta* (20.715mg/100g), *Dioscorea esculenta* (15.7052mg/100g), and was examined least in *Solanum tuberosum* (4.715mg/100g). A comparable study was conducted by Mir *et al.*, 2016 in Crocos sativa. The Saponin concentration of "*Crocus sativa*" in methanol and water extracts and was found to be (1.2, 3.4mg/g) respectively. A study carried out on the *Anredera cordifolia* plant (Binahong) (Murni Astuti, 2011) determined that fresh and dried sample of Binahong plant shows positive results for saponin compound. The saponin compound screening test of the plant studied showed that leaves, stems, flowers and tubers indicate presence of saponins. Saponin is an active constituent (Edeoga *et al*, 2005) and they were known to show medicinal activities as well as exhibiting physiological activity (Sofowara, 1993). Saponins have big molecule and very important for human benefits (Konoshima *et al*, 1995). Saponin have high molecule weight, and in low concentration saponins can used for haemolysis of red blood cell and then for activity of antibacterial function (Harborne, 1973). The positive result of saponins are important to recover post-surgery as anti-bacterial, anti-fungus and anti-viral ,and saponins have a potential to make clean and there is protein of recovery and wound recovery post-surgery (Hidayati, 2009).

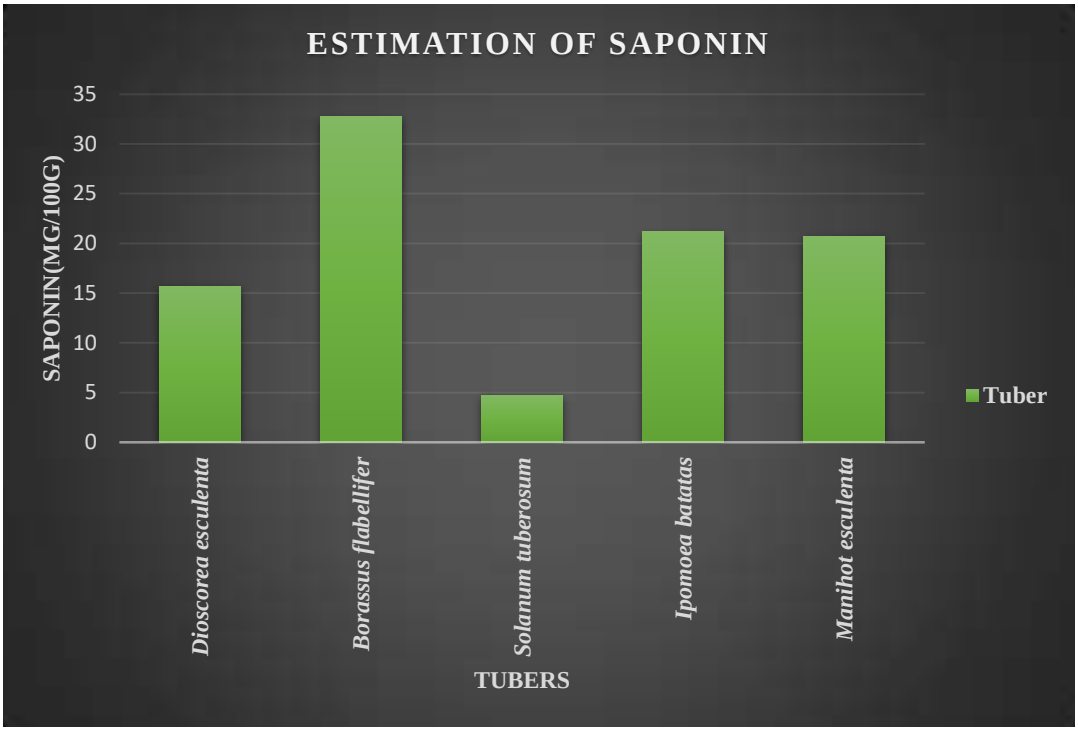

Figure 5: Estimation of Saponin

ESTIMATION OF TERPENOID:

Results of the alkaloid estimation of selected tubers were given in figure 6. From the result, it was clear that high amount of terpenoid was found in *Solanum tuberosum* (60.41mg/100g). It was followed by *Dioscorea esculenta* (57.41mg/100g), *Ipomoea batatas* (51.744mg/100g), *Borassus flabellifer* (46.911mg/100g) and it was observed to be least in *Manihot esculenta* (45.828mg/100g). Terpenoids are normal secondary metabolite found in plant species which is providing flavour and fragrance. It avoids the development of chronic joint swelling (Agnihotri, 2010). Terpenoids characterize a diverse class of molecules that are related to therapeutic properties including anti-cancer, anti-parasitic, anti-microbial, anti-allergic, anti-spasmodic, anti-hyperglycemic, anti-inflammatory and immunomodulatory properties (Barre *et al*., 1997, Habtemariam *et al*., 1993, Scortichini *et al*., 1991). Quantification of terpenoids in the aqueous stem extract of *S.oblonga* is *96.2* milligram quercetin equivalent per gram (Malar and Chellaram, 2015).

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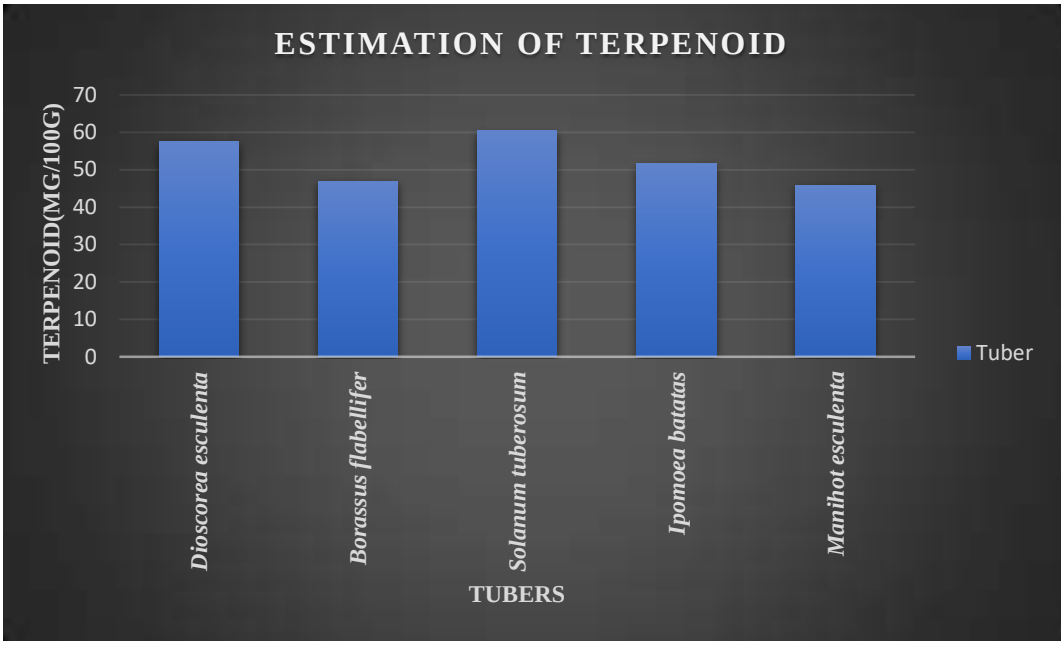

Figure 6: Estimation of Terpenoid

4. SUMMARY AND CONCLUSION

In this study titled, "Quantitative assessment of antioxidant in five native tubers in Kerala", antioxidants namely, phenol, tannin, flavonoid, alkaloid and terpenoid were quantitatively calculated in five selected tubers such as *Dioscorea esculenta, Borassus flabellifer, Solanum tuberosum, Ipomoea batatas and Manihot esculenta.* Among the five selected tubers, the highest phenolic content was observed in *Manihot esculenta* (0.183mg/100g) and was found to be least in *Dioscorea esculenta* (0.0598mg/100g). Tannin, flavonoid and alkaloid were found to be high in *Dioscorea esculenta (*1909.9mg/100g, 225mg/100g and 914.24mg/100g respectively). Tannin was found to be minimal in *Solanum tuberosum* (229.99mg/100g). Flavonoid was observed to be least in *Solanum tuberosum* (88.7mg/100g) and alkaloid was least in *Ipomoea batatas* (427.39mg/100g). High concentration of saponin was found in *Borassus flabellifer* (32.7157mg/100g) and was low in *Solanum tuberosum* (4.715mg/100g). Terpenoid was found to be the highest in *Solanum tuberosum* (60.41mg/100g) and lowest in *Manihot esculenta* (45.828mg/100g). The study reveals that the selected tubers contain antioxidants namely, alkaloid, flavonoid, phenol, tannin, saponin and terpenoid. Low tannin is favourable for our health. So, *Solanum tuberosum* (229.99mg/100g) is the good source for tannin. Because of the present relevance of natural antioxidants in modern medical field, this study would be a leading path way of information for selection of the extract for pharmacological action and isolation of constituents responsible for the activity.

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