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Proximate and antinutrient compositions of indigenous okra (*Abelmoschus esculentus* L.)

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Abstract
The promotion and consumption of indigenous vegetables could help to mitigate food insecurity and alleviate malnutrition in developing countries. Okra is a powerhouse of valuable nutrients, nearly half of which is soluble fibre in the form of gums and pectins which help to lower serum cholesterol, reducing the risk of heart diseases. The presence of phytate in the human diet has a negative effect on mineral uptake. Nutrient and antinutrient compositions of ten genotypes (GAO 5, AOL 12-55, AOL 10-22, AOL 13-73, AOL 13-75, AOL 13-88, AOL 13-90, Parbhanikranti, pusasawani and wild type) of okra fruits were investigated. The result of the study revealed that the proximate composition (g/100 g) in fresh weight basis was significantly ($P < 0.05$) varied and ranged: Dry matter (10.60 -27.10), crude fiber (1.76 –4.69), crude ash (2.44–6.18), total carbohydrates (3.06–6.27), total soluble sugars (1.14 – 2.55) and true protein (1.77–3.31). The essential amino acids concentrations (mg/g) were also significantly ($P < 0.05$) varied and ranged: lysine (10.4-19.1), tryptophan (4.13-12.73) and methionine (0.57-0.85). The results of anti-nutrients analysis showed that Phytate (0.06-0.17%), saponin (0.33-0.63%), and oxalate (0.32-0.51%) contents of all the genotypes were significantly varied. The results of the study revealed that okra fruit contain appreciable amount of vital nutrients like protein, fiber and low in antinutrient contents. Therefore, increase in the production and consumption of these nutrient-rich indigenous okra fruits will help to supplement the diets and alleviate the problems associated with malnutrition in the country.

Keywords: *Abelmoschus esculentus*, amino acids, anti-nutritional compounds, protein, sugar

Introduction
Okra a commercial vegetable crop belongs to family *Malvaceae*. It originates from Ethiopia and is widely spread all over tropical, subtropical and warm temperate regions of the world. It is grown commercially in India, Turkey, Iran, Western Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, Burma, Japan, Malaysia, Brazil, Ghana, Ethiopia, Cyprus and the Southern United States. India ranks first in the world with production more than 6350.3 million tonnes and productivity 12.0 million tonnes/ ha (70% of the total world production) of okra produced from over 530.8 hectare area in 2013-14.It plays an important role in the human diet and is a good source of primary and secondary metabolites such as protein, carbohydrates, vitamins, enzymes, and various minerals which are often lacking in the diet of developing country. Its medicinal value has also been reported in curing ulcers and relief from haemorrhoids. Okra has found medical application as a plasma replacement or blood volume expander and also useful in genito-urinary disorders, spermatorrhoea and chronic dysentery. The fruits of okra have reawakened beneficial interest in bringing this crop into commercial production. [1]. Okra has been called "a perfect villager's vegetable" because of its robust nature, dietary fiber, and distinct seed protein balance of both lysine and tryptophan amino acids. Okra is also abundant with several carbohydrates, minerals and vitamins, which plays a vital role in human diet and health. Okra is also rich in phenolic compounds with important biological properties like quartering and flavonol derivatives, catechin oligomers and hydroxycinnamic derivatives and higher antioxidants activity. Okra has several potential health beneficial effects on some of the important human diseases like cardiovascular disease, type 2 diabetes, digestive diseases and some cancers. Overall, Okra is an important vegetable crop with a diverse array of nutritional quality and potential health benefits [2]. In recent times, the use of herbal products has increased tremendously in the western world as well as developed countries. India is one of the most medico-culturally diverse countries in the world where the medicinal plant sector is part of a time-honoured tradition that is respected even

Today. *Abelmoschus esculentus* (Okra) is an important medicinal plant of tropical and subtropical India. Its medicinal usage has been reported in the traditional systems of medicine such as Ayurveda, Siddha and Unani [3].

Therefore, the present research work was undertaken with the key objective to appraise and compare the detailed biochemical characteristics of ten okra genotypes of okra cultivated under local environment.

Materials and Methods

The present experiment was carried out at Biochemistry department, B.A. College of Agriculture, Anand Agricultural University, Anand. The marketable okra pods consisted of ten genotypes *viz.*, GAO 5, AOL 12-55, AOL 10-22, AOL 13-73, AOL 13-75, AOL 13-88, AOL 13-90, parbhanikranti, pusasawani and wild type were obtained from the Main Vegetable Research Station, Anand Agricultural University, Anand. The recommended methods of the various parameters were adopted to determine. For biochemically characterization dry matter content, total ash, fibre content [4], The true protein [5], free amino acid [6], lysine, tryptophan [7], methionine [8], reducing sugars [9], total carbohydrates, total soluble sugars [10], phytic acid content [11], oxalic acid [12] and saponin [13] were determined from marketable fruits were collected at third picking.

Results and Discussion

Moisture: As fresh okra pods vary considerably in water content, moisture contents were calculated on a dry weight basis, which allows a greater consistency of data. Moisture content of any food is an index of its water activity and is used as a measure of stability and susceptibility to microbial contamination. [14]. this high moisture content also implies that dehydration would increase the relative concentrations of other food nutrient and therefore improve the shelf-life and preservation of the fruits. The analysis revealed a significant variation (72.90 - 89.40%) in fruit moisture content among all genotypes of okra (*Ablemoschus esculentus* L.). Significantly the lowest moisture content was recorded with wild type, while higher moisture content was recorded with parbhanikranti (89.40%) which was at par with AOL 12-55 (87.98%). The variation in moisture content may be due to the climate change and variation among genotypes.

Fibre: Okra contains high fiber, which “helps to stabilize blood sugar by regulating the rate at which sugar is absorbed from the intestinal tract”. Because of fiber along with other nutrition, okra shows useful for minimizing blood sugar levels within the body, assisting along with diabetes [15]. The content of fibre (1.76 to 4.69%) in fruits of the A*belemoschus esculentus* genotypes were significantly varied among all the genotypes. The minimum fibre content was observed for wild type (1.76%) which was at par with pusasawani (2.03%). Significantly higher fibre content was recorded in genotype AOL 13-90 (4.69%).

Ash: The results showed that the sample contains high ash content, which indicates that the okra pods would provide essential valuable and useful minerals needed for body development. [16] The content of ash in the tested traits of *Abelemoschus esculentus* fruits has been presented in Fig3. The ash content was recorded higher in AOL 13-90 (6.18%), which was followed by AOL 12-55 (5.58%), AOL 13-73 (5.42%) and AOL 13-88 (5.37%). The ash content was recorded lower in parbhanikranti (2.44%), which was at par with wild type (2.72%) and pusasawani (3.23%).

Total carbohydrates: Okra is used to to treat digestive issues. The polysaccharides present in immature okra pods possessed considerable anti adhesive properties. Okra’s polysaccharides were particularly effective at inhibiting the adhesion of *Helicobacter pylori*, a bacterium that dwells in the stomach and can cause gastritis and gastric ulcers if left unchecked. Therefore, eating more okra can keep our stomach clean and create an environment that prevents destructive cultures from flourishing [17]. The total carbohydrates content was recorded significantly maximum and minimum in AOL 10-22 (6.27%), wild type (3.06%), respectively. The total carbohydrates were found more or less similar in AOL 12-55 (5.51%), AOL 13-73(5.37%), AOL 13-15 (5.05%) and parbhanikranti (5.51%).

Total soluble sugars and reducing sugars: The total soluble sugars content was recorded maximum and minimum in AOL 12-55(2.55%) and wild type (1.14%) respectively. The data of reducing sugars of various okra fruits are depicted in fig 6. Reducing sugars was varied from (0.19-0.74%) among all okra genotypes.

Protein: Protein plays a central role in biological systems. The main functions of proteins are growth and replacement of lost tissues in the human body. Diet is nutritionally satisfactory, if it contains high caloric value and a sufficient amount of protein [18]. The pods of these accessions of okra meet this requirements and this implies that okra pod can serve as a good source of protein. The content of Protein in the tested traits of okra fruits are represented in fig.7. The protein content was recorded the highest in AOL-13-88 (3.31%) and the lowest in AOL 13-73 (1.77%).

Amino acids: The amino acid contents of various okra fruits are depicted in fig 8. The obtained values were significant. Significantly the highest and the lowest amino acids were recorded in AOL-13-90(20.6mg/g) and GAO-5 (7.7 mg/g), respectively. The amino acid composition of okra protein is comparable to that of soybean and the protein efficiency ratio is higher than that of soybean and the amino acid pattern of the protein renders if an adequate supplement to legume or cereal based diets.

The fruit lysine content varied between 10.39 to 19.10 mg/g among ten okra genotypes. Significantly maximum lysine content was observed in AOL 13-90 (19.10 mg/g), while minimum lysine content was recorded in AOL-10-22(10.39 mg/g) which was at par with AOL 13-73 (10.9 mg/g) and Parbhanikranti (11.10mg/g).The content of tryptophan in the tested traits of okra fruits are represented in fig 10. Significantly the maximum tryptophan content was recorded in AOL-13-88 (12.7 mg/g) and minimum in wild type (4.1 mg/g), respectively. The content of methionine ranged from 0.85 to 0.51mg/g in fruits of the okra genotypes are shown in fig 11. The maximum methionine content was observed for Parbhanikranti (0.85mg/g). The methionine content was recorded more or less similar in AOL 12-55 (0.79 mg/g), AOL 10-22 (0.76 mg/g) and AOL 13-88 (0.78 mg/g).

Antinutritionts: Antinutritional factors are a chemical compounds synthesized in natural food and/or feedstuffs by the normal metabolism of species which exerts effect contrary to optimum nutrition [19] Antinutritional factors are also reduce the maximum utilization of nutrients especially proteins, vitamins, and minerals, thus preventing optimal exploitation of the nutrients present in a food and decreasing the nutritive value [20]. Phytate represents a complex class of naturally occurring phosphorus compound that can significantly influence the functional and nutritional properties of foods. The content of phytic acid in the tested traits of *Abelmoschus esculentus* fruits are shown in fig12. The phyticacid content was recorded maximum in AOL-13-88 (0.17%) which was at par with pusasawani (0.156%). The phytic acid content was recorded the lower in AOL-12-55 (0.06%), which was at par with AOL-10-22 (0.07%) and parbhanikranti (0.08%). Significantly maximum and minimum oxalic acid content (Fig. 13) was recorded in wild type (5.09%) and AOL-12-55(3.22%), respectively. Saponins are a group of secondary metabolites, nonvolatile surfactants that are widely distributed in the plant kingdom. The content of saponin (1.64 to 2.54%) in fruits of okra genotypes were significantly varied among all the genotypes (fig. 14). The maximum saponin content was observed for AOL-13-73 (2.54%).

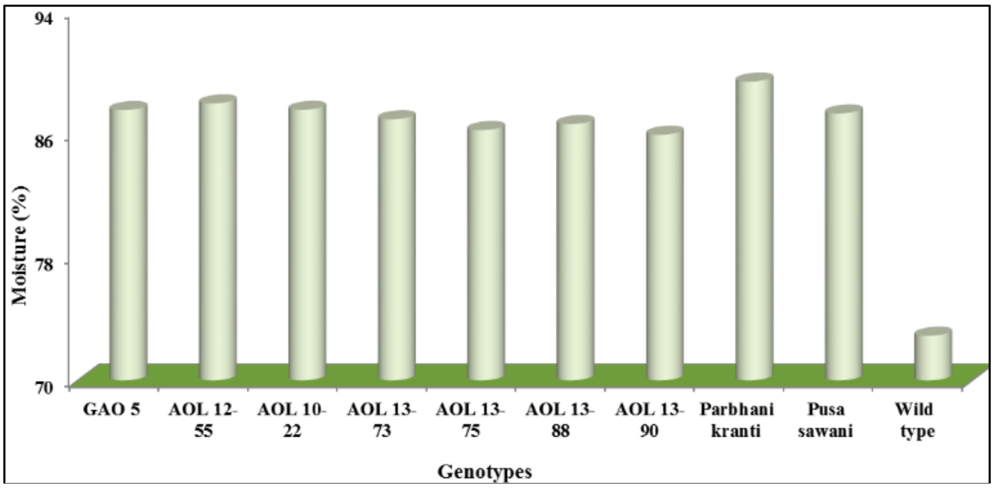

Fig 1: Comparison of Moisture contents in different genotypes of okra fruits

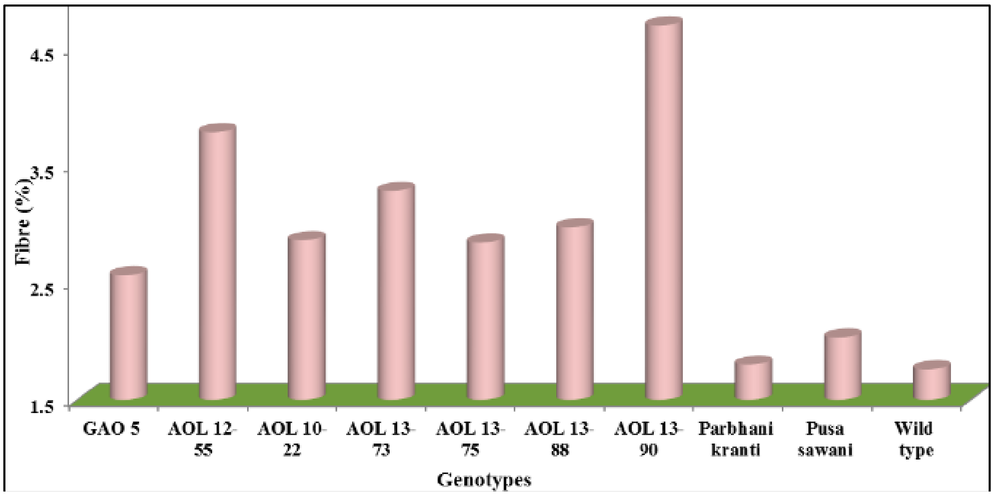

Fig 2: Comparison of fibre contents in different genotypes of okra fruits

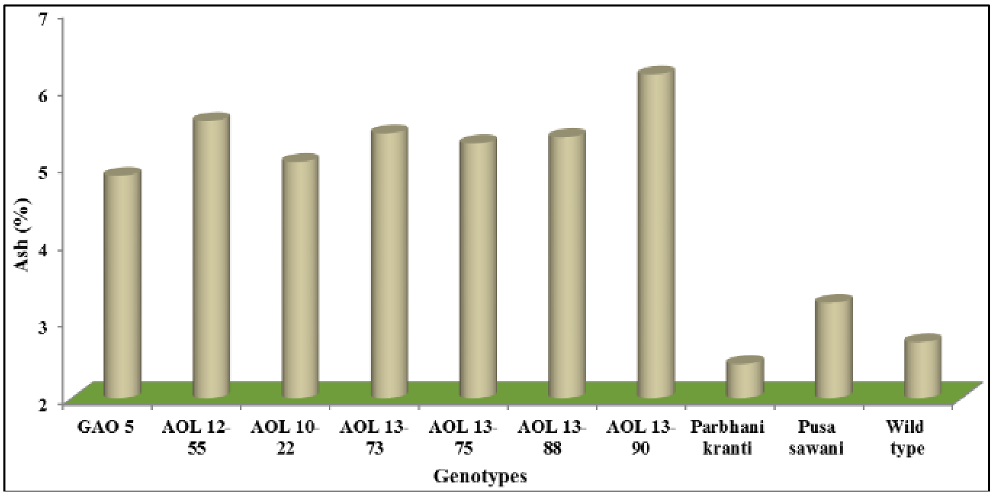

Fig 3: Comparison of ash contents in different genotypes of okra fruits

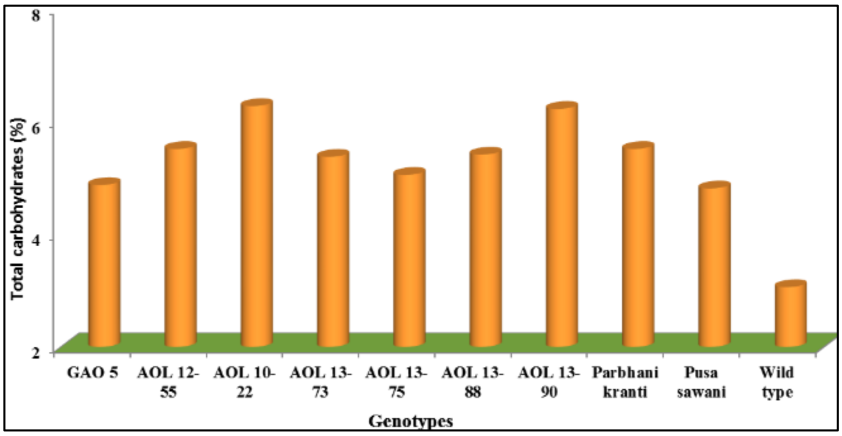

Fig 4: Comparison of total carbohydrate contents in different genotypes of okra fruits

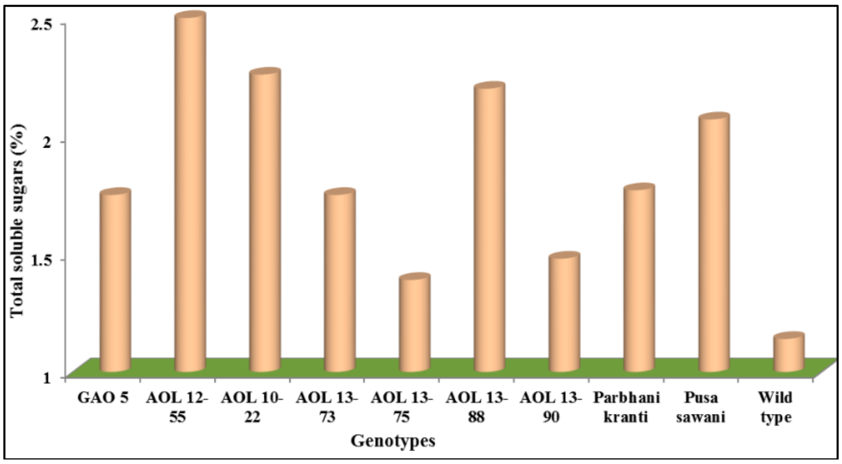

Fig 5: Comparison of total soluble sugar content in different genotypes of okra fruits

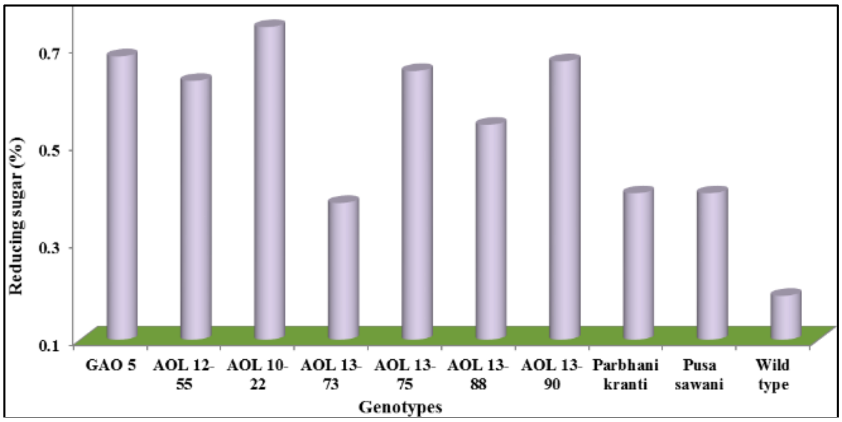

Fig 6: Comparison of reducing sugar content in different genotypes of okra fruits

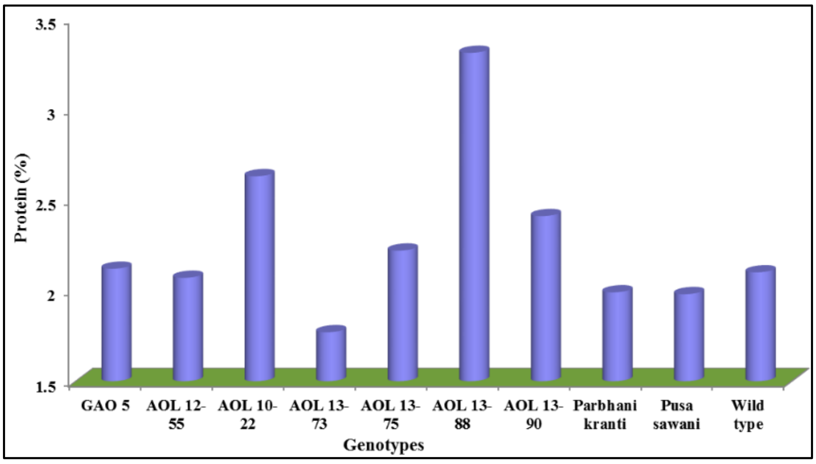

Fig 7: Comparison of protein content in different genotypes of okra fruits

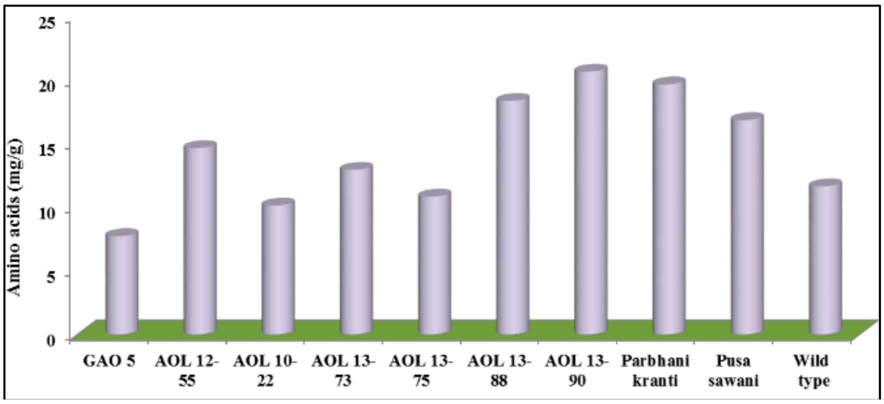

Fig 8: Comparison of total amino acid content in different genotypes of okra fruits

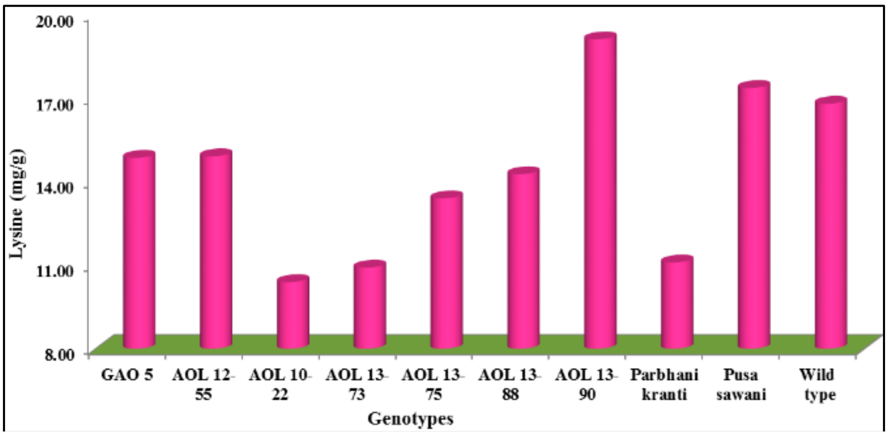

Fig 9: Comparison of lysine content in different genotypes of okra fruits

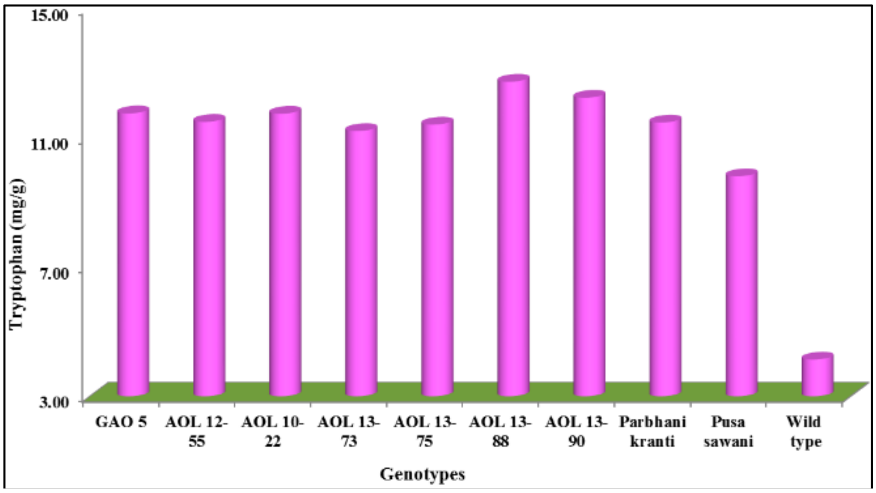

Fig 10: Comparison of tryptophan content in different genotypes of okra fruits

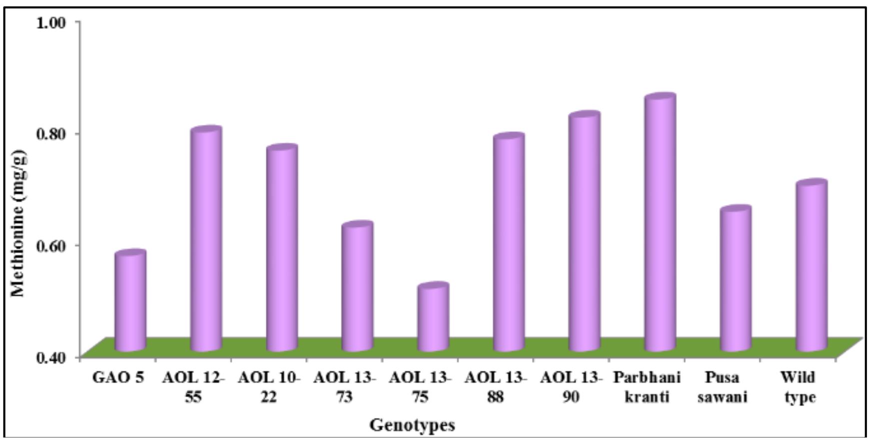

Fig 11: Comparison of methionine content in different genotypes of okra fruits

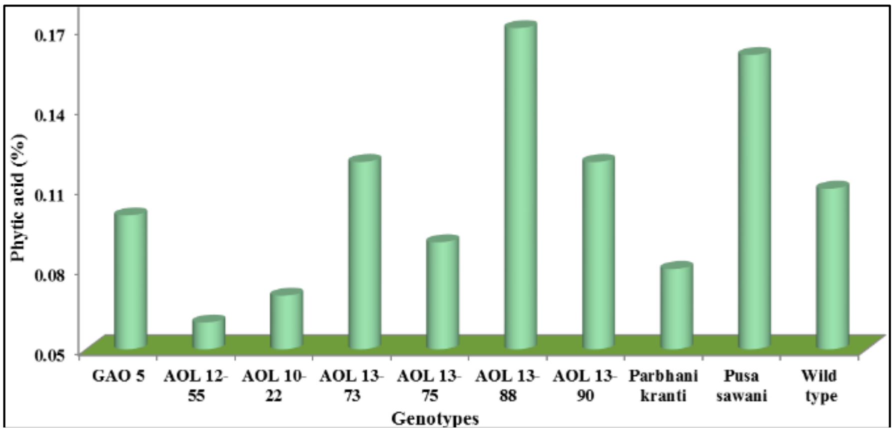

Fig 12: Comparison of phytic acid content in different genotypes of okra fruits

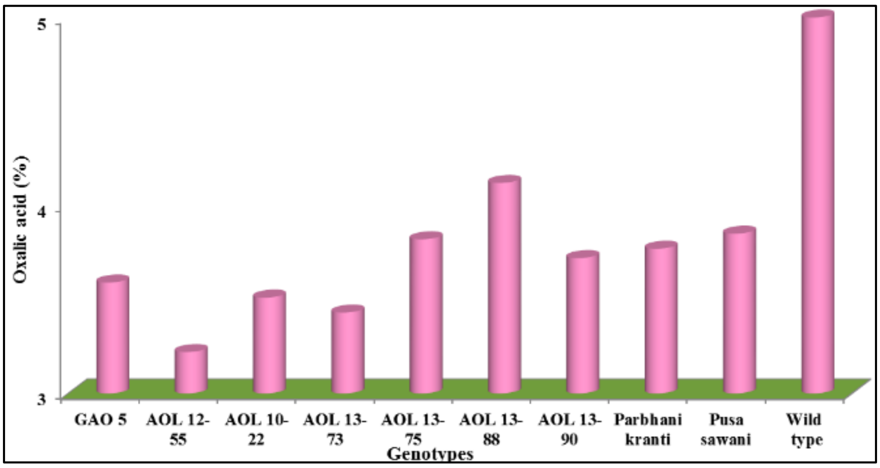

Fig 13: Comparison of Oxalic acid content in different genotypes of okra fruits

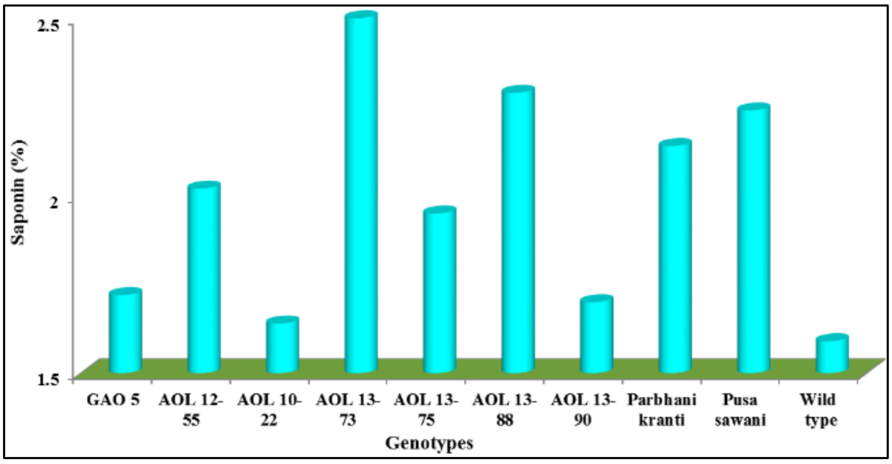

Fig 14: Comparison of saponin content in different genotypes of okra fruits

Conclusion

The nutritional analysis result showed that okra fruits contain valuable protein and required carbohydrates in the fruits. Therefore, consumption of okra fruit will provide the necessary energy to the body and important antioxidants that could boast immune body system and prevent diseases. In the present experiment genotype AOL 13-90 recorded higher amount of fibre, ash, total amino acid and lysine content. Genotypes AOL 10-22 possess higher content of total carbohydates and reducing sugars. Wild type contain lower amount of tryptophan, fibre, total carnohydrates, total soluble sugars and reducing sugars and saponin. Thus these genotypes may be further use as breeding purpose for its highly nutraceutical value.

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