



## Effects of Agrochemical Residues on Phytochemicals and Antioxidant Capacity in selected Crops

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### ABSTRACT

**Abstract:** The extensive use of agrochemicals such as fertilizers, pesticides, and herbicides in modern agriculture has significantly enhanced crop productivity, but their potential impact on nutritional quality and human health remains a concern. To address this, the present study investigated the effect of these agrochemicals on the phytochemical composition and antioxidant properties of selected crop plants—brinjal, cabbage, carrot, and banana—commonly cultivated in the Haveri district. Proximate analysis revealed variations in moisture, protein, fat, carbohydrate, and fibre content among the selected plants. While qualitative phytochemical screening confirmed the presence of bioactive compounds such as phenols, flavonoids, alkaloids, tannins, saponins, and terpenoids, quantitative estimation indicated only moderate levels of these constituents. Furthermore, antioxidant activities assessed through multiple assays (DPPH, ABTS, FRAP, hydrogen peroxide scavenging, and phosphomolybdate methods) demonstrated appreciable free radical scavenging potential, largely attributed to phenolic and flavonoid content. However, comparative observations suggest that the phytochemical richness and antioxidant capacity may be reduced due to the application of agrochemicals. Consequently, this study highlights the need for careful management of fertilizers and pesticides to maintain the nutritional quality of crops and emphasizes the importance of adopting sustainable agricultural practices to safeguard environmental and human health.

## 1. Introduction

The agriculture sector has been largely dependent on the use of agrochemicals such as herbicides, pesticides, and fertilizers to increase produce and protect crops. However, these agrochemicals may have unintended effects on both the environment and human health. This is important in view of the need to find safer and more sustainable agricultural practices.

Herbicides in contemporary farming are primarily used to eradicate weeds and enhance crop yields. Despite this benefit every herbicide used has a serious impact on fruit and vegetable plants in terms of growth, quality, and safety.

An herbicide is a chemical agent for controlling or killing unwanted vegetation or weeds competing with crops for resources. The use of herbicides is vital to maintain high crop yields and to enhance sustainable agricultural practices.

Fertilizers perform critical roles in stimulating the growth and productivity of fruits and vegetables via provision of essential nutrients. Fertilizers are needed in modern agricultural applications for providing essential nutrients that promote the growth and development of crops. They contribute to crop yields increase, enhancement of quality, and maintenance of soil fertility. Nevertheless, fertilizers can also have adverse effects on the health of crops, soil habitats, and the environment.

In herbicides we find Non-selective herbicides and Selective herbicides, two distinct groups of herbicides. Non-selective herbicides kill all types of plants they hit, such as glyphosate. They are frequently utilized in different farming systems, including grafting and vegetables. Glyphosate is particularly popular because of its efficacy and wide spectrum of action (Duke & Powles, 2008). Selective herbicides kill particular varieties of weeds while causing relatively little harm to vegetation. For instance, 2,4-D is employed for the control of broadleaf weeds without damaging the grasses. Selectivity comes in the shape of numerous metabolic pathways or growing mechanisms which affect weeds and plants differently (Furuta et al., 2007).

Herbicides, pesticides and fertilizers constitute an enormous problem for the residues on fruits and vegetables substantial. The authorities allow setting maximum residue limits (MRLs) to allow the agrochemicals present in residue levels opinions under safe limits. Omitted level residues would affect consumer safety and marketability (EFSA, 2016). High residue levels still affect the safety and marketability of produce.

Herbicides, pesticides and fertilizers can influence the nutritional composition of fruits and vegetables. Some studies suggest that glyphosate could alter the levels of certain nutrients and antioxidants in plants although effects vary and sometimes are controversial (Duke et al., 2012). Balanced fertilization usually results in better nutrient levels in produce.

However, over-reliance on nitrogen may cause some reduction of certain mineral concentrations, such as calcium in fruits and vegetables (Havlin et al., 2014). However, the degree of these effects is often very variable and largely controlled by the specific pesticide in question and the practices of application (Nicolopoulou-Stamati et al., 2016).

These Herbicides, pesticides, and fertilizers play vital role in modern agriculture in fruit and vegetable production as they provide nutrition controls diseases and weeds. Their use has to be managed cautiously to minimize the effect on to crop high quality, residue tiers, human fitness, and the surroundings. The adoption of incorporated and sustainable practices can help balance the blessings of herbicides with the demand for environmental and fitness safety. Our study is mainly focus on the nutritional quality of the plant products, toxicity and finding of non commercialized food plants for their nutritional composition from Haveri district.

## 2. Methodology

The plant material such as Brinjal, Cabbage, Carrot and Banana were collected from the market and brought to the laboratory. They were washed thoroughly and used for the process either fresh or dry.

### 1.1 Proximate composition

The proximate compositions of plants were carried out by following AOAC (2005).

### 1.2 Qualitative phytochemical analysis

The Acetone, Methanol and aqueous extracts were used to perform the phytochemical screening using standard methods (J.B. Harbone, 1973) from the selected plants.

### 1.3 Quantitative estimation of phytochemicals

Determination of total phenols by Folin and Ciocalteu (1927), Determination of total flavonoids by Wu et al. (2006), Total alkaloids was performed as per the Harborne (1973). Total saponins content was measured according to Obadoni and Ochuko (2001). The total tannin content of the plant material was calculated by Folin denis method modified by Schanderi, 1970.

### 1.4 Antioxidant Assay

Antioxidant assay such as DPPH Radical Scavenging Activity, Phosphomolybdate assay (Total antioxidant capacity), Hydrogen peroxide scavenging activity, ABTS radical scavenging assay, and ferric reducing antioxidant power (FRAP) assay was performed according to the procedure Brand-Williams et al. 1995, Prieto et al. 1999, Ruch et al. 198) and Re et al., 1999.

## 3. Result

### 3.1. The proximate composition

The proximate composition of Brinjal, Cabbage, Carrot and Banana given in table 1. The percentage of fat content is  $0.3\pm 0.12$ ,  $0.2\pm 0.24$ ,  $0.2\pm 0.11$  and  $0.32\pm 0.16$  respectively. In these plants about  $1.5\pm 0.02$ ,  $1.4\pm 0.14$ ,  $1.1\pm 0.32$  and  $0.94\pm 0.41$  percentage of protein is present. The crude fibre content in these plants is  $3.2\pm 0.25$ ,  $3.5\pm 0.51$ ,  $2.4\pm 0.63$  and  $2.1\pm 0.12$  in Brinjal, Cabbage, Carrot and Banana the presence on carbohydrate is  $4.8\pm 0.36$ ,  $7.2\pm 0.20$ ,  $9.8\pm 0.20$  and  $15.2\pm 0.68$  respectively.

Table 1.  
Proximate composition of the crop plants

	Moisture	Crude Fat	Ash	Crude protein	Crude Carbohydrate	Crude fibre
<b>Brinjal</b>	89.68±4.23	0.3±0.12	0.62±0.21	1.5±0.02	4.8±0.36	3.2±0.25
<b>Cabbage</b>	86.5±3.47	0.2±0.24	1.2±0.02	1.4±0.14	7.2±0.47	3.5±0.51
<b>Carrot</b>	85.7±4.12	0.2±0.11	0.8±0.10	1.1±0.32	9.8±0.20	2.4±0.63
<b>Banana</b>	80.74±3.98	0.32±0.16	0.7±0.10	0.94±0.41	15.2±0.68	2.1±0.12

### 3.2. Qualitative and quantitative phytochemical analysis

In present study we found that the presence of phenols, flavonoids, alkaloids, tannins and saponins, terpenoids in selected medicinal plants (Table 2).

Table 2.  
Qualitative phytochemical analysis of crop plants

	Brinjal	Cabbage	Carrot	Banana
Alkaloids	+	+	+	+
Flavonoids	+	+	+	+
Terpenoids	+	+	+	+
Phenols	+	+	+	+
Saponins	+	+	-	-
Tannins	-	+	-	+

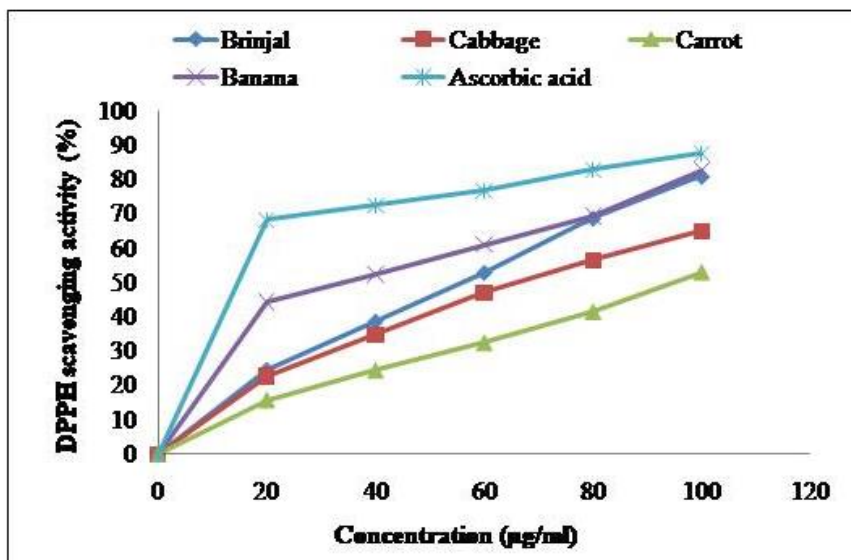
The quantitative estimation of some of the phytochemical is given in table 3. The selected plants are having moderate amount of amount of phytochemicals when compared with the other plants which are grown naturally. The presence of phytochemicals are enough to carry out physiological and biological activities.

Table 3.  
Quantitative analysis of crop plants

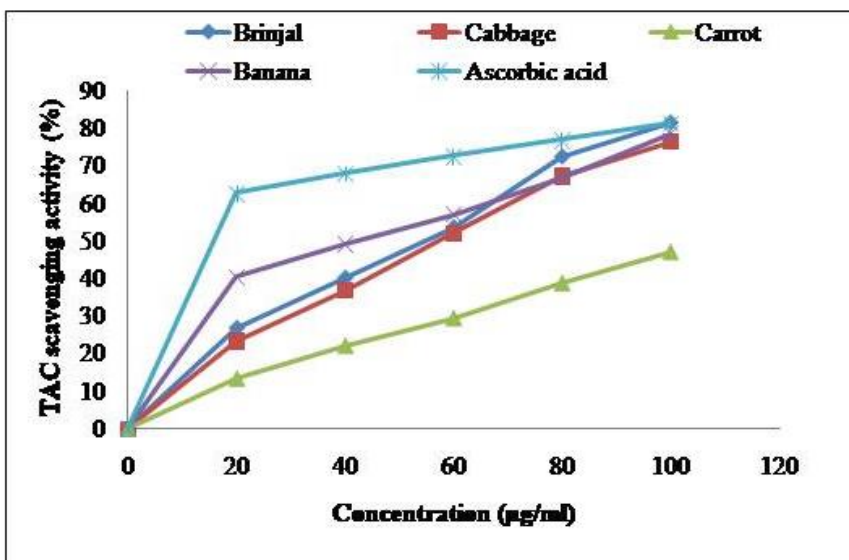
	Brinjal	Cabbage	Carrot	Banana
Phenolics (mg of GAE/g extract)	7.68±0.98	1.42±0.02	8.2±0.62	0.72±0.32
Flavonoids (mg of QE/g extract)	2.9±0.64	1.02±0.096	6.2±0.81	1.02±0.62
Alkaloids (mg/g)	0.2±0.01	0.86±0.01	0.64±0.04	0.94±0.20
Tannins (mg TAE/g extract)	1.67±0.48	0.89±0.31	1.02±0.69	-

### 3.3 Antioxidant activity

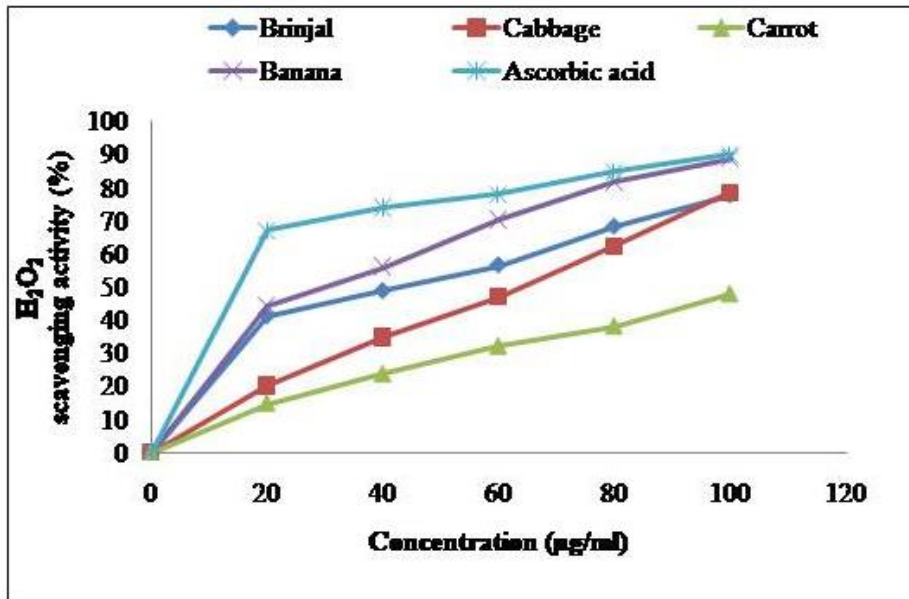
The phytochemicals present in the crop plants are having strong antioxidants and are able to reduce the risk of chronic disease by protecting against free-radical damage, by modifying metabolic activation and detoxification of carcinogens, or even influencing processes that alter the course of tumor cells (Herrera et al., 2009). In present investigation we studied the antioxidant activities of selected crop plants. The antioxidant activity of the selected plants is mentioned in the figure 1 to 5.



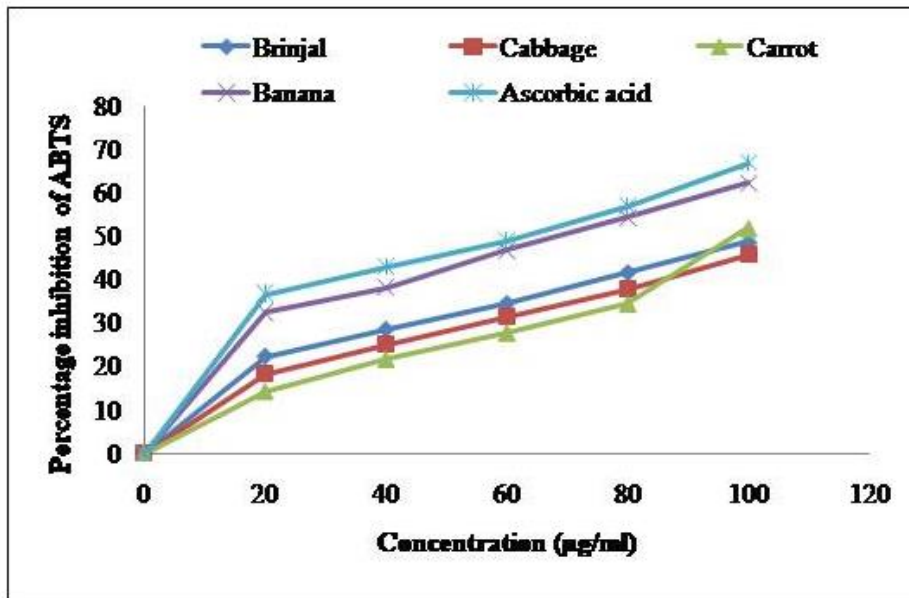
**Figure 1: DPPH Radical Scavenging Activity**



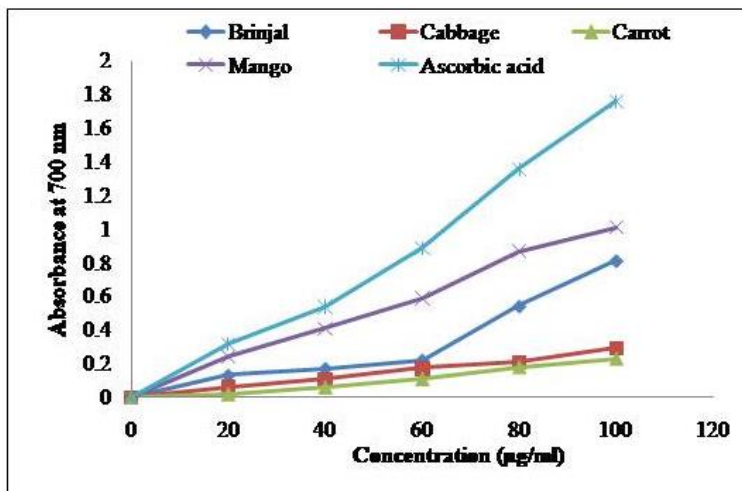
**Figure 2: Phosphomolybdate assay (Total antioxidant capacity)**



**Figure 3: Hydrogen peroxide scavenging activity**



**Figure 4: ABTS radical scavenging assay**



**Figure 5: Determination of ferric reducing antioxidant power (FRAP) assay**

The result shows that Brinjal, Cabbage, Carrot, and Banana have shown antioxidant activity which can be relate to the previous studies (Rokayya et al., 2013; Liang et al., 2019). In present investigation the indication of the presence of higher antioxidant activity in the selected crop pants could be due to the presence of phenols and flavonoids

### Conclusion

The use of chemical fertilizers, herbicides and pesticides has caused the effect on animal and human health resulting in the healthy issues. These agrochemicals deposited in the soil, water, air and entering in the living bodies. The main crops of Haveri district are Brinjal, Banana, Cabbage, Carrot, Tomato, Cotton, Maize etc. in present work various biological and phytochemical activities are carried out majority of the plants have not shown such activities in these plants. It is observed that these plants are rich in phytochemicals their content mighty be declined or quality of the content is reduced.

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### References

1. AOAC (2005) Official method of Analysis. 18th Edition, Association of Officiating Analytical Chemists, Washington DC, Method 935.14 and 992.24.
2. Brand-W, Cuvelier W., and Berset, C.L.W.T. (1995) Use of a Free Radical Method to Evaluate Antioxidant Activity. LWT-Food Science and Technology, 28, 25-30.
3. Duke S O and Powles S B (2008). Glyphosate: a once-in-a-century herbicide. Pest Manag Sci. 64(4):319-25. doi: 10.1002/ps.1518.
4. EFSA 2016. European Food Safety Authority Scientific Cooperation Annual Report 2016.
5. Folin, O. and Ciocalteu, V. (1927) On Tyrosine and Tryptophane Determinations in Proteins. Journal of Biological Chemistry, 73, 627-650.
6. Furuta K M, Xiang L, Cui S and Yoshida S (2021). Molecular dissection of haustorium development in Orobanchaceae parasitic plants. Plant Physiology: 186: 1424–1434.
7. Harborne, J.B. (1973) Phytochemical Methods. Chapman and Hall Ltd., London, 49-188.

8. Havlin, J.L., S.L. Tisdale, J.C. Beaton and W.L. Nelson. 2005. *Soil Fertility and Fertilizers: An Introduction to Nutrient Management*. 7ed, Pearson Prentice Hall. Upper Saddle River, New Jersey. 515 p.
9. Herrera M, Dominguez G, Jose M. G, Peña C, Jimenez C, Silva J, Garcia V, Gomez I, Diaz R, Martin P, and Bonilla F 2009. Differences in Repair of DNA Cross-links between Lymphocytes and Epithelial Tumor Cells from Colon Cancer Patients Measured In vitro with the Comet Assay. *Clin Cancer Res*;15(17), 5466-5472.
10. Liang Y, Li Y, Zhang L and Liu X 2019. Phytochemicals and antioxidant activity in four varieties of head cabbages commonly consumed in China. *Food Production, Processing and Nutrition*. 1:3 1-9.
11. Nicolopoulou-Stamati P, Maipas S, Kotampasi C, Stamatis P, Hens L (2016). Chemical Pesticides and Human Health: The Urgent Need for a New Concept in Agriculture. *Front Public Health*. 4: 148. doi: 10.3389/fpubh.2016.00148
12. Obadoni, B.O. and Ochuko, P.O. (2001) Phytochemical Studies and Comparative Efficacy of the Crude Extracts of Some Homeostatic Plants in Edo and Delta States of Nigeria. *Global Journal of Pure and Applied Science*, 8, 203-208.
13. Prieto, P., Pineda, M. and Aguilar, M. (1999) Spectrophotometric Quantitation of Antioxidant Capacity through the Formation of a Phosphomolybdenum Complex: Specific Application to the Determination of Vitamin E. *Analytical Biochemistry*, 269, 337-341.
14. Re R, Pellegrini N, Proteggente A, Pannala A, Yang M, Rice-Evans C (1999). "Antioxidant Activity Applying an Improved ABTS Radical Cation Decolorization Assay," *Free Radical Biology and Medicine*, Vol. 26, No. 9-10, pp. 1231-1237.
15. Rokayya S, Li C J, Zhao Y, Li Y, Sun C H 2013. Cabbage (*Brassica oleracea* L. var. capitata) Phytochemicals with Antioxidant and Anti-inflammatory Potential. *Asian Pacific Journal of Cancer Prevention*. 14 (11), 6657-6662.
16. Ruch, R.J., Cheng, S.J., and Klaunig, J.E. (1989) Prevention of cytotoxicity and inhibition of intracellular communication by antioxidant catechins isolated from Chinese green tea. *Carcinogenesis*, 10, pp. 1003-1008.
17. Schanderi SH (1970) *Methods in food analysis*. Academic, New York, p 709.
18. Wu L C , Hsu H.W. , Chen Y.C. , Chiu C.C. , Lin Y.I. , Ho J.A. (2006). Antioxidant and antiproliferative activities of red pitaya. *Food Chem.*, 95, pp. 319-327.