



RESEARCH ARTICLE

IMPACT OF CHEMICAL INPUTS ON THE POST-HARVEST STORABILITY OF ONION BULBS

Virginie Marie Dakéné^{1,3}, Abdoulaye Sérémé², Kabakdé Kabore^{3,4*}, Frédéric Anderson Konkobo³, Balamoussa Santara³, Hagrétou SAWADOGO-LINGANI⁴ and Mamoudou Hama Dicko³

¹Laboratory of Biochemistry, Biotechnology, Food Technology and Nutrition, University Joseph Ki-Zerbo, Ouagadougou, Burkina Faso 03 BP 7021 Burkina Faso; ²Department of Natural Substances/ Institute for Research in Applied Sciences and Technology/National Center for Scientific and Technological Research, 03 BP 7047 Ouagadougou 03 ; Burkina Faso; ³Food Science, Technology and Nutrition Laboratory (LabSTAN), Food Technology Department (DTA), Research Institute for Applied and Technological Sciences (IRSAT), Western Regional Direction (DRO/Bobo-Dioulasso) /National Center for Scientific and Technological Research, 03 BP 2393, Bobo-Dioulasso 03, Burkina Faso Tel : (226) 20 97 62 40; ⁴Department of Food Technology/ Institute for Research in Applied Sciences and Technology/National Center for Scientific and Technological Research, 03 BP 7047 Ouagadougou 03; Burkina Faso

ARTICLE INFO

Article History:

Received 17th May, 2026

Received in revised form

20th June, 2026

Accepted 27th July, 2026

Published online 31st August, 2026

Keywords:

Onion, Antioxidant Activities, polyphenol, farming practices, storage,

*Corresponding author:

KABORE Kabakdé

ABSTRACT

The objective of this study is to contribute to a better understanding of the effects of organic and conventional cultivation on the content of phenolic compounds and antioxidant activity during storage of onions. Two solvents were used to optimize the extraction of these compounds. The results showed that acetone is the best solvent for phenolic compounds, whereas methanol is the best solvent for evaluating antioxidant activity. Organic onions also have the highest content of polyphenols (0.35 ± 0.001 mg GAE/g fresh matter (FM)), total flavonoids (0.63 ± 0.001 mg EQ/g FM), and the highest antioxidant activity (0.1077 mg EAA/g FM). In terms of flavonoid and polyphenol content and antioxidant activity, the organic bulbs were better preserved during storage compared to the conventionally grown bulbs and should be preferred for consumption. The best time to consume the organic onions is five or six months after they have been harvested, in order to obtain the highest levels of antioxidants.

Copyright©2026, Virginie Marie Dakéné et al. 2026. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Virginie Marie Dakéné, Abdoulaye Sérémé, Kabakdé Kabore, Frédéric Anderson Konkobo et al. 2026. "Impact of chemical inputs on the post-harvest storability of onion bulbs". *International Journal of Current Research*, 18, (08), 38145-38152.

INTRODUCTION

Onions produced in the world amounted to 85 million tons. The major producers are China, India and the USA (Dinissia *et al.*, 2021). The onion is one of the most traded vegetables in the world, grown in 140 countries and with a relatively long shelf life (Mahmood *et al.*, 2021). It is an important crop for a balanced diet (Mahmood *et al.*, 2021). In fact, onions are rich in nutrients and are a major contributor to the fight against hunger and malnutrition worldwide (Ren & Zhou, 2021). It is also a good source of bioactive compounds like polyphenols and antioxidants (Yu *et al.*, 2021).

These compounds give it several biological properties, such as hypolipidaemic and antidiabetic properties (Airaodion *et al.*, 2020). Onions have anti-inflammatory and anti-obesity activity in addition to their potential antioxidant activity (Yu *et al.*, 2021). They are involved in the regulation of the microbiota in the intestine (Fernández-Jalao *et al.*, 2021). Unfortunately, several biotic and abiotic factors often affect these biological properties of onions. These environmental factors affect phytonutrient composition, especially total phenolics and flavonoids (Bibi, Shah, Khan, Al-hashimi, *et al.*, 2022). In addition to environmental conditions, cultivars and cultivation techniques affect bioactive compound content (Kazimierczak *et al.*, 2021 ; Bouhenni *et al.*, 2021). Indeed, several studies have shown that plants adapt to their environment by synthesizing

specific compounds (Kaboré *et al.*, 2022). Conventional crops use nutrients more readily and synthesize more macromolecules and fewer antioxidant compounds. As a consequence, this method of cultivation has a negative impact on biodiversity by impoverishing the soil and reducing the activities of microorganisms (Montgomery & Biklé, 2021). In addition, chemical residues, which are very toxic for humans and animals, must be removed from conventional crops (Bawa, 2023). Consumers are becoming increasingly resistant to the many risks posed by pesticides and other chemical inputs. They're demanding more and more organic products (Liang *et al.*, 2021). Therefore, in order to protect the environment, biodiversity and health of consumers, organic crops seem to be the best way (Boschiero *et al.*, 2023). Organic agriculture is significant in reducing the cost of chemical pesticides and fertilizers, while protecting consumers from the risks associated with them (Benbrook *et al.*, 2021). In these crops, plants need to adapt to their environment including stress condition and they need to use nutrients to provide a part of microorganism activity. They must be synthesize the bioactive compounds for their protection including antioxidant compounds like phenolics (Bibi, Shah, Khan, Al-Hashimi, *et al.*, 2022). The extraction solvent must be considered along with the cultivation method. Studies have shown that the levels of bioactive compounds vary depending on the techniques and solvents used to extract (Keighobadi *et al.*, 2021 ; Dairi *et al.*, 2021 ; González-de-peredo *et al.*, 2021). Therefore, it is interesting to evaluate the influence of organic and conventional growing on bioactive compounds depending on the extraction solvent used. The aim of this study was to evaluate the influence of the type of cultivation of onions during a long storage period on the content of polyphenols and flavonoids with the use of two extraction solvents.

MATERIAL AND METHODS

Material : The onion bulb of the Galmi violet variety is used as plant material. It is a variety that was developed in 1976 by the Institute of Agronomic and Technological Research of Niger (IRAT). It was registered in the National Catalogue of Species and Varieties of Plants of Niger (CNEV) in 1994. In all regions of Burkina Faso and all of West Africa, it is the most widespread variety. It is also the one most consumed by the population. Organic and conventional onions were used for this study. After collection, the samples were sent to the Biochemistry, Biotechnology, Food Technology and Nutrition Laboratory, University Joseph KI ZERBO. Freshly harvested samples and samples stored for 1 to 8 months were used in the study.

Production sites: This production was carried out from August to November 2018 (i.e. four months). It took place on two different sites located in Doumtenga, in the commune of Nongr-Massom, province of Kadiogo/Burkina Faso. The agro-ecological farm Béo-née is one of the sites. Organic production was carried out on this site. In order to avoid any contamination, the two sites are 1.6 km apart.

Methods

Sample storage: The harvest was fifteen (15) kg of onion bulbs per production type. After harvest, one (01) kg of bulbs from each production type was randomly sampled, bagged, labeled and then placed in the freezer (-18°C) to be used for

antioxidant content determination before storage. The remaining part of each production was placed under domestic conditions, spread out on the floor in the house, under ambient conditions. Then, a sample of 1 kg of each type of production is taken, bagged, labeled and placed in the freezer for analysis at intervals of one (01) month for a period of eight (08) months.

Analysis Methods

Evaluation of total phenolics and flavonoids content:

Extraction was performed with hydromethanolic and hydroacetone solvents in a 20/80 (v/v) ratio for the analysis of phenolic compounds and antioxidant activities. Total polyphenols were determined according to the method described by Singleton & Rossi (1965) using the Folin-Ciocalteu reagent. This assay is based on quantifying the total concentration of hydroxyl groups present in the extract. It is a colorimetric method and the absorbance is read at a wavelength of 760 nm. A standard curve using gallic acid at different concentrations has been established under the same conditions. The aluminum chloride method was used to determine the total flavonoid content of the extracts. The extracts were incubated for 30 min at room temperature in the dark. The absorbance of the solution was measured at 415 nm using a UV-Vis spectrophotometer. The values were expressed as mg QE/100 g FM (Arvouet-Grand *et al.*, 1994).

Evaluation of antioxidant activit: Antioxidant activity was evaluated using 2,2-diphenylpicrylhydrazyl (DPPH) free radical scavenging. DPPH produces stable free radicals that produce a dark purple color. When they react with an antiradical, the solution decolors. A decrease in absorbance is measured at 517 nm. The percentage of DPPH radical inhibition was used to express the radical scavenging activity (% DPPH) of the extracts (Brand-Williams *et al.*, 1995). The antioxidant activity was evaluated using the iron reducing method according to the method described by (Hinneburg *et al.*, 2006). The FRAP (Ferric Reducing Antioxidant Power) method is based on the reduction of ferric ion (Fe^{3+}) to ferrous ion (Fe^{2+}) by reducing compounds (antioxidants), which is accompanied by the appearance of an intense blue color that can be measured at 700 nm.

Statistical analysis: Analysis of variance (ANOVA), turkey test, and principal components analysis were evaluated using R, XLStat, and graphs using Prism.

RESULTS AND DISCUSSION

It was found that onions contained initial concentrations of total polyphenols between 0.24 mg GAE/g and 0.28 ± 0.004 for methanol and 0.30 ± 0.001 mg GAE/g and 0.35 ± 0.001 mg GAE/g for acetone. Regardless of the extraction solvent, however, the organic culture (Figure 1a) presented the best levels. These values are lower than the ones obtained by Dairi *et al.* (2021) which obtained contents of 45 ± 1 to 86 ± 1 mg GAE/100 g. This difference could be due to the variety and the extraction solvents (Poboźniak *et al.*, 2022). Also, these differences can be due to the expression unit, because these authors were expressed their results according to dry matter, but in this study, the results are expressed to fresh matter content. For flavonoids, the contents varied from 0.2 to 0.4 mg EQ/g for methanolic extract and from 0.39 to 0.63 mg EQ/g for acetone extract (Figure 2a). The results showed that the organic crop produced the highest levels. However, from one solvent to

another, the flavonoid contents varied according to the type of culture (Dairi *et al.*, 2021). During storage, the contents of total polyphenols varied from 0.298-0.428mg GAE/g FM for the acetone extract of the organic culture and from 0.30 to 0.438mg GAE/g FM for the acetone extract of the conventional culture (Figure 1b). For the methanolic extract, the total polyphenol content varied from 0.233 to 0.33 mg GAE/g for the organic culture and from 0.19 to 0.335 mg GAE/g for the conventional culture (Figure 1d). As regards flavonoids, the levels in the methanolic extracts of the organic culture varied during storage from 0,099 to 0,479 mgEq/g and in the conventional culture from 0,102 to 1,21 mgEq/g (Figure 2 d).

For the acetone extracts, the contents of flavonoids varied from 0.37 to 0.984 mg EQ/g for the organic culture and from 0.21 to 0.667 mg EQ/g for the conventional culture (Figure 2b). During storage, onions accumulate higher levels of phenolics and flavonoids regardless of the solvent used (Figure 1-2). Phenolic content varies with methanol or acetone extraction after long storage (8 months) (Figure 1 b-d). There is an initial increase in phenolic content and then a steady decrease. Other authors have shown that storage conditions would improve the phytochemicals contained in the onions (Gouda *et al.*, 2023). This accumulation is maximum between the 3rd and 5th month for the organic culture and between the 2nd and 3rd month for the conventional culture.

These results show that the organic crop keeps longer than the conventional crop. This is confirmed by the contents of flavonoids, which show that after 8 months of conservation, the conventional onions lose 69 to 80 % of the flavonoids compared to 59 to 78 % for the organic onions, depending on the solvent used to extract the flavonoids. Previous studies have shown a decrease in flavonoid content of more than 45 % after 4 months of storage (Gemin *et al.*, 2021). This shows that organic bulbs are more stable and better able to withstand storing conditions (Sani & Yong, 2022). Thus, growing organic onions would not only be profitable, but provide an alternative for producing bioactive compounds (Sani & Yong, 2022). Organic farming protects the environment from pesticides while providing healthy food that is not contaminated with residual pesticides (Cordeiro *et al.*, 2022 ; Tudi *et al.*, 2021). No statistical differences were found for the polyphenolic compounds. The flavonoids, on the other hand, showed statistical differences between the different solvents. These results show that the content of polyphenolic compounds is not statistically influenced by the extraction solvent. In contrast, the content of flavonoids varies according to the extraction solvent and the type of cultivation (Morreeuw *et al.*, 2021). The polyphenolic compounds are therefore more stable. This is independent of the extraction solvent used (methanol or acetone) (Nazareth *et al.*, 2021).

They would be responsible for the stability of the organic onion bulbs during the period of preservation (Gouda *et al.*, 2023). The health importance of onions is partly due to their antioxidant capacity. Figure 3 shows that the lowest inhibition levels occurred with the organic onion extracts. In general, the highest inhibition was observed for the conventional onions stored for the first four months. However, the inhibitory power of these onions decreased significantly and steadily after five months of storage. Acetone was the best solvent for extraction of antioxidant compounds, especially for conventional cultivation, while methanol had the strongest affinity for organic cultivation (Figure 3). Onions are known as good

sources of natural antioxidants. In this study, organic onions showed DPPH radical inhibition percentages of 30.39 % to 71.21 % for acetone extract and 55.20 % to 79.60 % for methanol extract. The highest percentage of inhibition with methanol (79.60 %) was observed in organic onions. These values are high than 76 % inhibition found by other authors (González-de-peredo *et al.*, 2021). For the evaluation of antioxidant activity, they also showed that methanol was the best extraction solvent (González-de-peredo *et al.*, 2021). Conventional culture showed maximum inhibition at 2nd month, while organic culture showed maximum inhibition between 3rd and 5th month of storage. These results show that the antioxidant activity as determined by the DPPH method is a function of the content of phenolic compounds and other antioxidant compounds such as vitamin C and carotenoids (Keighobadi *et al.*, 2021).

The values ranged from 0.0097 to 0.1077 mg AAE/g for the organic culture and from 0.00487 to 0.082 mg AAE for the conventional culture when the antioxidant power was evaluated by iron reducing activity (FRAP) (Figure 4). Among the different solvents used, there was no significant difference. As for DPPH, compared to the conventional culture (0.082 mg AAE mg/g), the organic culture showed high values (0.107 mg AAE/g). These values are similar to those obtained by Koteenkova and Kupaeva (2021) on red onion crops. For the organic culture, the highest activity is obtained in the 5th and 6th month of preservation. For the conventional culture, the highest activity is obtained in the 2nd month of preservation.

These results show once again that the organic culture, in addition to being more concentrated in bioactive compounds, allows a good conservation of these compounds (Dash *et al.*, 2021). These differences would be due to the different modes of action of each of the two antioxidant evaluation methods. In fact, the content of flavonoids, especially quercetin and its derivatives, in onion bulbs would be responsible for the inhibition of DPPH (Sagar *et al.*, 2022). while the reducing activity results from reducing compounds, especially certain phenols, selenium and the activity of certain enzymes (Golubkina & Caruso, 2020).

Onions play several biological roles due to their richness in bioactive compounds (Güner *et al.*, 2021). They are natural sources of antioxidants that can scavenge free radicals and protect the body from oxidation (Dorrigiv *et al.*, 2021). They can help prevent cardiovascular disease, cancer, and other chronic diseases (Ren & Zhou, 2021). Onion consumption is associated with a reduction in inflammation and protection against obesity (Zhao *et al.*, 2021).

To get the most out of onions, it's recommended that organic onions be consumed whenever possible, rather than conventional, to avoid getting contaminated with chemical compounds (Sagar *et al.*, 2022). These analyses show that depending on the extraction solvent and the type of culture, total polyphenols and total flavonoids react differently. For total polyphenols, the conventional culture presents the highest contents, also with the methanolic extract for flavonoids. The onions from the organic culture showed the highest content of flavonoids in the acetonic extract. Study of solvents used shows that acetone is the best extractor of total polyphenols and flavonoids.

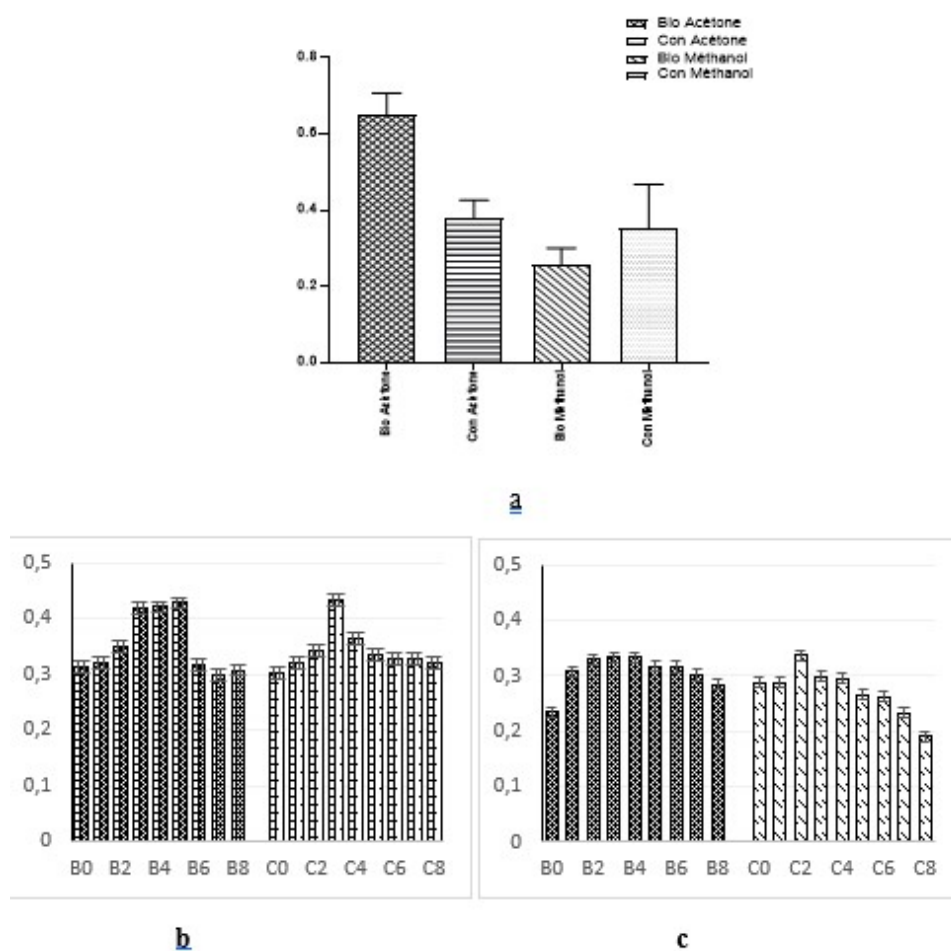


Figure 1. Total phenolic content before storage (a) ; acetone extract (b) and methanol extract after storage (d) (C0,...,C8) : conventionnal crop ; (B0,...,B8) : organic crop

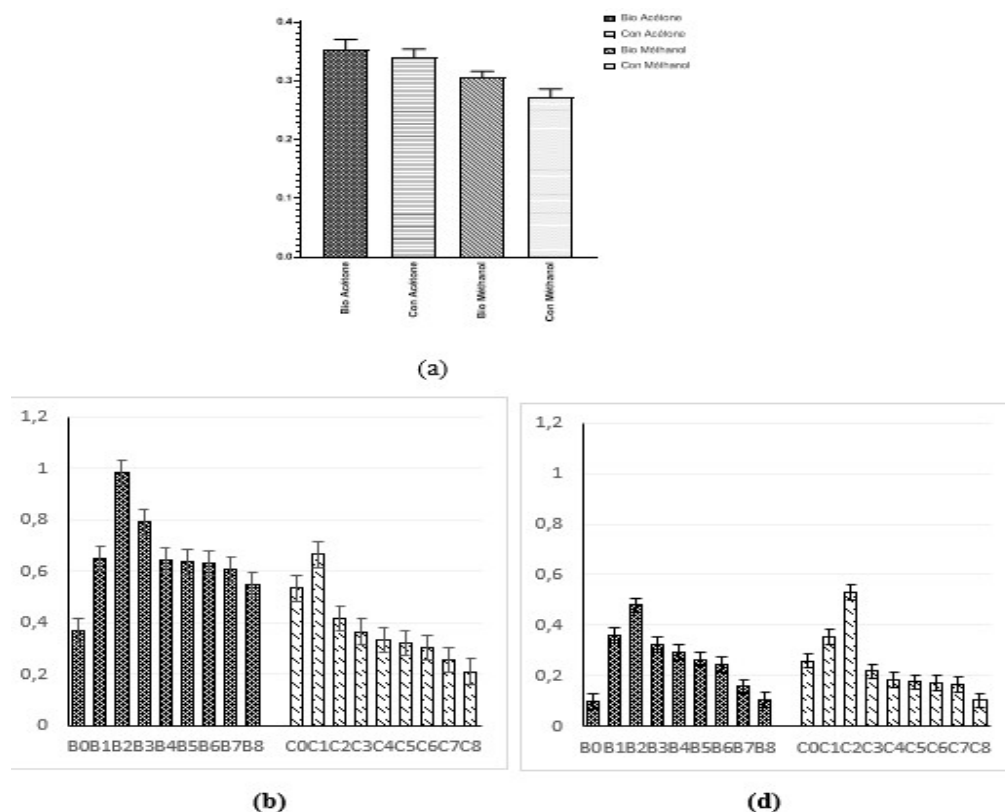


Figure 2. total flavonoides content before storage (a); acetone extract (b) and (d) methanol extract after storage; C0,...,C8) : conventionnal crop; (B0,...,B8) : organic crop

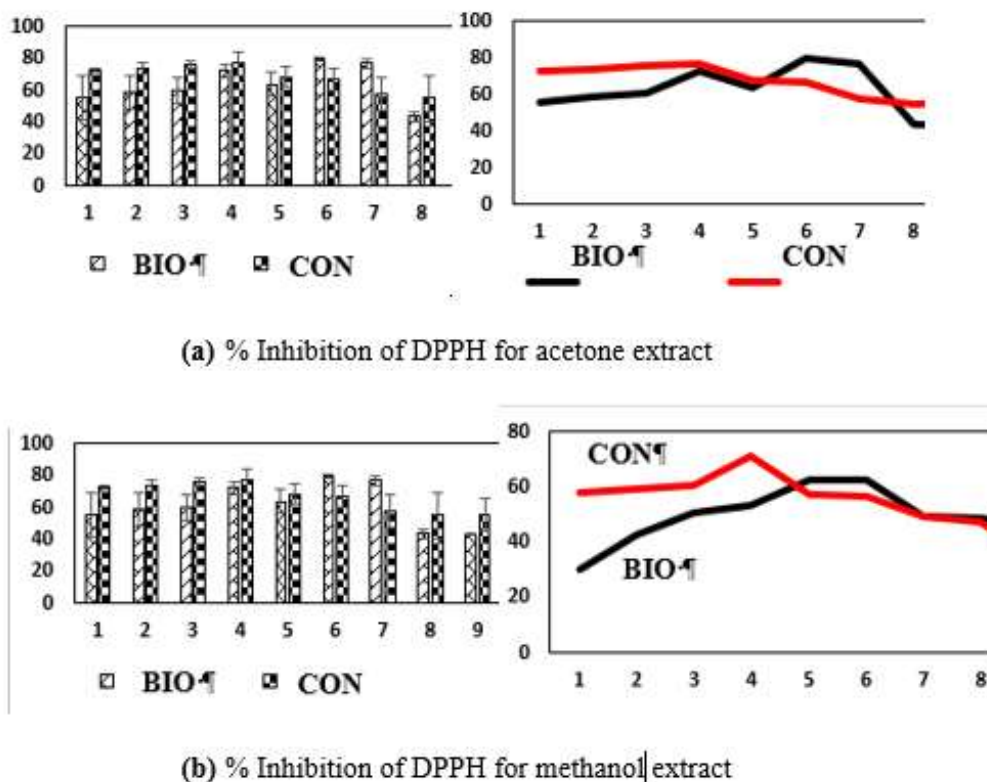


Figure 3. DPPH inhibition of organic and conventional culture in relation to the extraction solvent
 Con : conventional crop ; Bio : organic crop

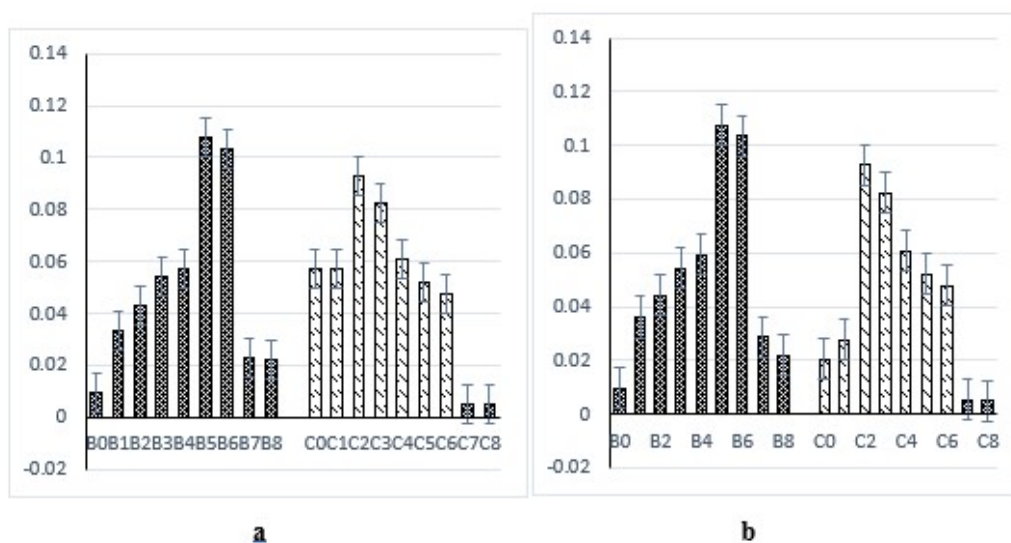


Figure 4 : FRAP antioxidant content (a) ; acetone extract and methonol extract (b) ;
 (C0,.....,C8): conventionnal crop ; (B0,....,B8) : organic crop

This shows that the affinity between the phenolic compounds of the onion and acetone is higher than that of methanol (Mikucka *et al.*, 2022). These results differ from those obtained by other authors who have shown that acetone is the best for extracting phenolic compounds and evaluating antioxidant activities (Wang *et al.*, 2021). This difference could be due to the difference in the type of plant that was used. On the other hand, for the evaluation of the best antioxidant activity, methanol is the best extractor than acetone (Figure 3-4). The analysis of the biplot (Figure 5a) shows that the parameters are more clustered in the acetone extraction and more dispersed in the methanol extraction (Cui *et al.*, 2021). The Principal Component Analysis between the studied parameters and the

extraction solvents (Figure 5a) shows two groups divided according to the solvents used. The parameters are more clustered in acetone, although these two groups have points in common. Acetone is also more correlated with total phenolics and flavonoids. The methanolic extracts, on the other hand, represent a more dispersed group and have a better correlation with the antioxidant activities. Most of the compounds extracted with acetone were also found in methanol. This shows that methanol extracts different phytochemical compounds whereas acetone extracts mainly phenolic compounds. Figure 5b, showing the Principal Component Analysis of the compounds investigated in relation with the

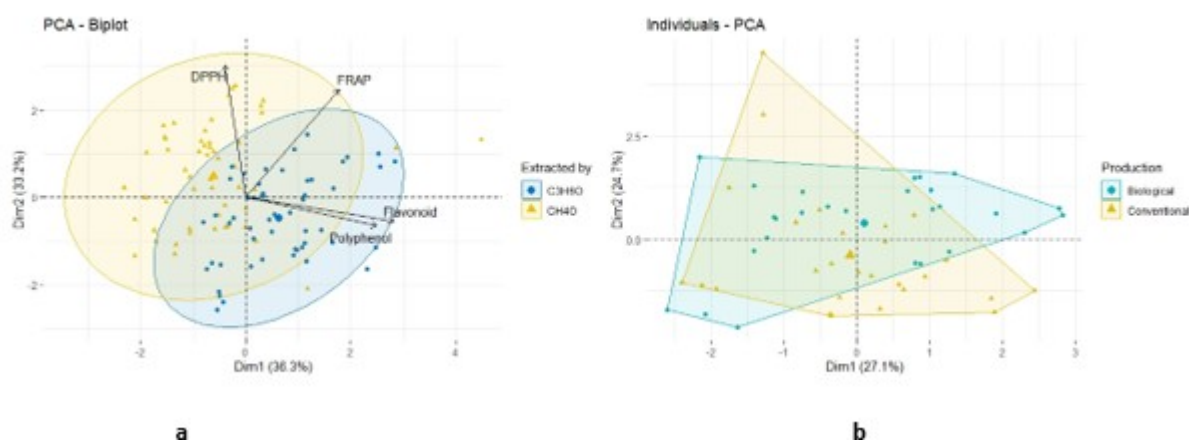


Figure 5. The principal component analysis between the parameters and the extraction solvents (a) and between parameters and crop types (b)

types of crops, shows that the compounds extracted by the different solvents vary between crops. Two groups have been identified, one consisting of compounds extracted from organic crops and one from conventional crops. In contrast to organic farming, where the compounds were more or less grouped together, conventional farming was found to contain a wide range of compounds. The Principal Component Analysis showed that the organic crop had a better distribution than the conventional crop (Figure 5b). This indicates that with increasing storage time the phenolic content decreases and consequently the antioxidant activity decreases significantly. The conventional crop has lost significant antioxidant quality after more than three months of storage. Therefore, it is preferable to have it for consumption before three months of storage (Puig-Montserrat *et al.*, 2021). On the other hand, the organic culture can be consumed and even have a beneficial effect on the conservation of up to six months. For later consumption, it is therefore preferable to use organically grown onions. Since they are free of chemical contamination, they are even more advantageous (Zandi & Basu, 2021).

CONCLUSION

Onions have many biological properties due to their bioactive compounds. However, their concentration varies depending on the growing technique and extraction solvent used. Compared to conventional farming, organic farming has many advantages. It allows good preservation for future use, in addition to being free of chemical contaminants. Consuming organic onions is recommended for their health benefits. Acetone was found to be the best extractor of phenolic compounds. Methanol gave the best results for evaluating antioxidant activity. In case of strong antioxidant activities, it would be advisable to evaluate their biological activities both in vitro as well as in vivo.

Conflicts of Interest: The authors declare that there is no conflict of interest.

Author Contributions:

Conceptualization, V.M.D. and K.K.; formal analysis, F. A. K. and B.S.; investigation, V.M.D. and K. K; methodology, V.M.D. and A.S.; supervision, A.S; H. S. and M.H.D.; writing—original draft, V.M.D. and K.K.; writing—review and editing, P.R.B., C.D., M K. A. C. and A.S.

Supplementary Materials: there are no additional materials for this manuscript

Funding: This study received no funding other than contributions from the authors.

Data Availability Statement: Study data are available from the corresponding author for researchers upon request.

Geolocation information : Ouagadougou's geographic coordinates are: latitude: 12.371428, longitude: -1.5196601. The geographic coordinates in the UTM coordinate system are: east (easting): 660940.811098, north (northing): 1368071.448628, zone: 30, northern hemisphere. Ouagadougou's altitude above sea level is 299 m. Ouagadougou's GPS coordinates are: latitude: 12.3657, longitude: -1.53393.

ACKNOWLEDGEMENT

The African Biotechnology Network (RABIOTECH, ISP/IPICS project N° 172 600 000) is appreciated for supporting publication fees and academic mobilities.

REFERENCES

- Airaodion, I. A., U Akaninyene, I., O Ngwogu, K., A Ekenjoku, J., & C Ngwogu, A. (2020). Hypolipidaemic and Antidiabetic Potency of *Allium cepa* (Onions) Bulb in Alloxan-Induced Diabetic Rats. *Acta Scientifci Nutritional Health*, 4(3), 01--08. <https://doi.org/10.31080/asnh.2020.04.0648>
- Arvouet-Grand, A., Vennat, B., Pourrat, A., & Legret, P. (1994). Standardisation d'un extrait de propolis et identification des principaux constituants. *Journal de Pharmacie de Belgique*, 49(6), 462–468.
- Bawa, U. (2023). Heavy metals concentration in food crops irrigated with pesticides and their associated human health risks in Paki, Kaduna State, Nigeria. *Cogent Food and Agriculture*, 9(1). <https://doi.org/10.1080/23311932.2023.2191889>
- Benbrook, C., Kegley, S., & Baker, B. (2021). Organic farming lessens reliance on pesticides and promotes public health by lowering dietary risks. *Agronomy*, 11(7), 1–36. <https://doi.org/10.3390/agronomy11071266>
- Bibi, N., Shah, M. H., Khan, N., Al-hashimi, A., & Elshikh, M. S. (2022). Variations in Total Phenolic , Total Flavonoid Contents , and Free Radicals' Scavenging

- Potential of Onion Varieties Planted. *Plants*, 21(950), 21. https://doi.org/Plants_2022_11_950. <https://doi.org/10.3390/plants11070950>
- Bibi, N., Shah, M. H., Khan, N., Al-Hashimi, A., Elshikh, M. S., Iqbal, A., Ahmad, S., & Abbasi, A. M. (2022). Variations in Total Phenolic, Total Flavonoid Contents, and Free Radicals' Scavenging Potential of Onion Varieties Planted under Diverse Environmental Conditions. *Plants*, 11(7). <https://doi.org/10.3390/plants11070950>
- Boschiero, M., De Laurentiis, V., Caldeira, C., & Sala, S. (2023). Comparison of organic and conventional cropping systems: A systematic review of life cycle assessment studies. *Environmental Impact Assessment Review*, 102(January), 107187. <https://doi.org/10.1016/j.eiar.2023.107187>
- Bouhenni, H., Doukani, K., Hanganu, D., Olah, N.-K., Şekeroğlu, N., & Gezici, S. (2021). Analysis of bioactive compounds and antioxidant activities of cultivated garlic (*Allium sativum* L.) and red onion (*Allium cepa* L.) in Algeria. *International Journal of Agriculture, Environment and Food Sciences*, 4(December), 550–560. <https://doi.org/10.31015/jaefs.2021.4.15>
- Brand-Williams, W., Cuvelier, M. E., & Berset, C. (1995). From functional food to medicinal product: Systematic approach in analysis of polyphenolics from propolis and wine. *Lebensm.-Wiss. u.-Technol.*, 28(1), 25–30. <https://doi.org/10.1186/1475-2891-8-33>
- Cordeiro, E. C. N., Mógor, Á. F., Amatucci, J. D. O., Mógor, G., de Lara, G. B., & Marques, H. M. C. (2022). Microalga Biofertilizer Triggers Metabolic Changes Improving Onion Growth and Yield. *Horticulturae*, 8(3), 12. <https://doi.org/10.3390/horticulturae8030223>
- Cui, Q., Wang, Y., Zhou, W., He, S., Yang, M., Xue, Q., Wang, Y., Zhao, T., Cao, J., Khan, A., & Cheng, G. (2021). Phenolic composition, antioxidant and cytoprotective effects of aqueous-methanol extract from *Anneslea fragrans* leaves as affected by drying methods. *International Journal of Food Science and Technology*, 56(9), 4807–4819. <https://doi.org/10.1111/ijfs.15084>
- Dairi, S., Dahmoune, F., Belbahi, A., Remini, H., Kadri, N., Aoun, O., Bouaoudia, N., & Madani, K. (2021). Optimization of microwave extraction method of phenolic compounds from red onion using response surface methodology and inhibition of lipoprotein low-density oxidation. *Journal of Applied Research on Medicinal and Aromatic Plants*, 22(February), 100301. <https://doi.org/10.1016/j.jarmap.2021.100301>
- Dash, P., Das, S., Mannan, M., & Jahan, M. (2021). Comparative Evaluation of Onion Germplasm (*Allium Cepa* L.) Of Bangladesh for Physical And Antioxidant Properties. *SAARC Journal of Agriculture*, 19(1), 113–123. <https://doi.org/10.3329/sja.v19i1.54783>
- Dinissia, J., Tcheunteu, L. T., Maimouna, A., Hawaou, Alium, H., Nwaga, D., & Megueni, C. (2021). Diagnostique de production de l'oignon dans la partie Septentrionale du Cameroun. *International Journal of Biological and Chemical Sciences*, 15(3), 923–935. <https://doi.org/10.4314/ijbcs.v15i3.7>
- Dorrigiv, M., Zareiyan, A., & Hosseinzadeh, H. (2021). Onion (*Allium cepa*) and its main constituents as antidotes or protective agents against natural or chemical toxicities: A comprehensive review. *Iranian Journal of Pharmaceutical Research*, 20(1), 3–26. <https://doi.org/10.22037/ijpr.2020.112773.13940>
- Fernández-Jalao, I., Balderas, C., Calvo, M. V., Fontecha, J., Sánchez-Moreno, C., & De Ancos, B. (2021). Impact of high-pressure processed onion on colonic metabolism using a dynamic gastrointestinal digestion simulator. *Metabolites*, 11(5), 27. <https://doi.org/10.3390/metabo11050262>
- Gemin, L. G., Lara, G. B. de, Mógor, Á. F., Mógor, G., & Queiroz, C. de. (2021). Organic onion biofortification using microalgae and humic acid. *Research, Society and Development*, 10(13), e320101321432. <https://doi.org/10.33448/rsd-v10i13.21432>
- Golubkina, N., & Caruso, G. (2020). Chapter 5 - Onion. In A. K. B. T.-N. C. and A. P. of F. and V. Jaiswal (Ed.), *Nutritional Composition and Antioxidant Properties of Fruits and Vegetables* (pp. 73–87). Academic Press. <https://doi.org/10.1016/B978-0-12-812780-3.00005-2>
- González-de-peredo, A. V., Vázquez-espinosa, M., Espada-bellido, E., Carrera, C., Ferreira-gonzález, M., Barbero, G. F., & Palma, M. (2021). Flavonol composition and antioxidant activity of onions (*Allium cepa* L.) based on the development of new analytical ultrasound-assisted extraction methods. *Antioxidants*, 10(2), 1–22. <https://doi.org/10.3390/antiox10020273>
- Gouda, M., Nassarawa, S. S., Gupta, S. D., Sanusi, N. I., & Nasiru, M. M. (2023). Evaluation of carbon dioxide elevation on phenolic compounds and antioxidant activity of red onion (*Allium cepa* L.) during postharvest storage. *Plant Physiology and Biochemistry*, 200, 107752. <https://doi.org/10.1016/j.plaphy.2023.107752>
- Güner, S., Boz, Z., Yağız, Y., Topalcengiz, Z., Welt, B. A., Sarnoski, P., Simonne, A., Kristinsson, H. G., & Marshall, M. R. (2021). Investigation of phenolic compounds and antioxidant activity in red and yellow onions and a synergistic utilization of skin extract in modified atmosphere packaging of salmon (*Salmo salar*). *Packaging Technology and Science*, 34(6), 371–382. <https://doi.org/10.1002/pts.2568>
- Hinneburg, I., Damien, D. H. J., & Hiltunen, R. (2006). Antioxidant activities of extracts from selected culinary herbs and spices. *Food Chemistry*, 97(1), 122–129. <https://doi.org/10.1016/j.foodchem.2005.03.028>
- Kaboré, K., Konaté, K., Bazié, D., Dakuyo, R., Sanou, A., Sama, H., Santara, B., & Dicko, M. H. (2022). Effects of growing zones on nutritional and bioactive compounds of by-products of two tomato cultivars. *Journal of Agriculture and Food Research*, 100414. <https://doi.org/10.1016/J.JAFR.2022.100414>
- Kazimierczak, R., Średnicka-Tober, D., Barański, M., Hallmann, E., Góralska-Walczak, R., Kopczyńska, K., Rembalska, E., Górski, J., Leifert, C., Rempel, L., & Kaniszewski, S. (2021). The effect of different fertilization regimes on yield, selected nutrients, and bioactive compounds profiles of onion. *Agronomy*, 11(5), 13. <https://doi.org/10.3390/agronomy11050883>
- Keighobadi, K., Golabadi, M., Khozaei, M., & Rezai, A. (2021). Phytochemical Screening of the Aqueous Extracts of Iranian Onion (*Allium cepa* L.) Landraces. *Journal of Food Biosciences and Technology*, 11(2), 99–106. <https://doi.org/10.1001.1.22287086.2021.11.2.9.3>
- Kotenkova, E. A., & Kupaeva, N. V. (2021). Onion husk (*Allium cepa*) as a promising source of natural antioxidants. *IOP Conference Series: Earth and Environmental Science*, 640(5), 5–10. <https://doi.org/10.1088/1755-1315/640/5/052002>
- Liang, C. P., Sack, C., McGrath, S., Cao, Y., Thompson, C. J., & Robin, L. P. (2021). US Food and Drug Administration

- regulatory pesticide residue monitoring of human foods: 2009-2017. *Food Additives and Contaminants - Part A Chemistry, Analysis, Control, Exposure and Risk Assessment*, 38(9), 1520–1538. <https://doi.org/10.1080/19440049.2021.1934574>
- Mahmood, N., Muazzam, M. A., Ahmad, M., Hussain, S., & Javed, W. (2021). Phytochemistry of *Allium cepa* L. (Onion): An Overview of Its Nutritional and Pharmacological Importance. *Scientific Inquiry and Review (SIR)*, 5(3), 41–59. <https://doi.org/https://doi.org/10.32350/sir/53.04>
- Mikucka, W., Zielinska, M., Bulkowska, K., & Witonska, I. (2022). Processing of Distillery Stillage to Recover Phenolic Compounds with Ultrasound-Assisted and Microwave-Assisted Extractions. *International Journal of Environmental Research and Public Health*, 19(5), 1–21. <https://doi.org/10.3390/ijerph19052709>
- Montgomery, D. R., & Biklé, A. (2021). Soil Health and Nutrient Density: Beyond Organic vs. Conventional Farming. *Frontiers in Sustainable Food Systems*, 5(November), 1–14. <https://doi.org/10.3389/fsufs.2021.699147>
- Morreeuw, Z. P., Castillo-Quiroz, D., Ríos-González, L. J., Martínez-Rincón, R., Estrada, N., Melchor-Martínez, E. M., Iqbal, H. M. N., Parra-Saldívar, R., & Reyes, A. G. (2021). High throughput profiling of flavonoid abundance in agave lechuguilla residue-valorizing under explored mexican plant. *Plants*, 10(695), 19. <https://doi.org/10.3390/plants10040695>
- Nazareth, M. S., Shreelakshmi, S. V., Rao, P. J., & Shetty, N. P. (2021). Micro and nanoemulsions of *Carissa spinarum* fruit polyphenols, enhances anthocyanin stability and anti-quorum sensing activity: Comparison of degradation kinetics. *Food Chemistry*, 359(April), 129876. <https://doi.org/10.1016/j.foodchem.2021.129876>
- Pobożniak, M., Olczyk, M., Wójtowicz, T., Kamińska, I., Hanus-Fajerska, E., Kostecka-Gugała, A., & Kruczek, M. (2022). Anatomical and Biochemical Traits Associated with Field Resistance of Onion Cultivars to Onion Thrips and the Effect of Mechanical Injury on the Level of Biochemical Compounds in Onion Leaves. *Agronomy*, 12(1), 26. <https://doi.org/10.3390/agronomy12010147>
- Puig-Montserrat, X., Mas, M., Flaquer, C., Tuneu-Corral, C., & López-Baucells, A. (2021). Benefits of organic olive farming for the conservation of gleaning bats. *Agriculture, Ecosystems and Environment*, 313(August 2020), 1–9. <https://doi.org/10.1016/j.agee.2021.107361>
- Ren, F., & Zhou, S. (2021). Phenolic components and health beneficial properties of onions. *Agriculture (Switzerland)*, 11(9), 17. <https://doi.org/10.3390/agriculture11090872>
- Sagar, N. A., Pareek, S., Benkeblia, N., & Xiao, J. (2022). Onion (*Allium cepa* L.) bioactives: Chemistry, pharmacotherapeutic functions, and industrial applications. *Food Frontiers*, 3(3), 380–412. <https://doi.org/10.1002/fft2.135>
- Sani, M. N. H., & Yong, J. W. H. (2022). Harnessing Synergistic Biostimulatory Processes: A Plausible Approach for Enhanced Crop Growth and Resilience in Organic Farming. *Biology*, 11(41), 27. <https://doi.org/https://doi.org/10.3390/biology11010041>
- Singleton, V. L., & Rossi, J. A. J. (1965). Colorimetry to total phenolics with phosphomolybdic acid reagents. *American Journal of Enology and Viniculture*, 16(48), 144–158. <http://garfield.library.upenn.edu/classics1985/A1985AUG6900001>
- Tudi, M., Ruan, H. D., Wang, L., Lyu, J., Sadler, R., Connell, D., & Chu, C. (2021). Agriculture Development, Pesticide Application and Its Impact on the Environment. *International Journal of Environmental Research and Public Health*, 18(1112), 1–23.
- Wang, Z., Tang, C., Dai, F., Xiao, G., & Luo, G. (2021). HPLC determination of phenolic compounds in different solvent extracts of mulberry leaves and antioxidant capacity of extracts. *International Journal of Food Properties*, 24(1), 544–552. <https://doi.org/10.1080/10942912.2021.1904980>
- Yu, S., Li, H., Cui, T., Cui, M., Piao, C., Wang, S., Ju, M., Liu, X., Zhou, G., Xu, H., & Li, G. (2021). Onion (*Allium cepa* L.) peel extract effects on 3T3-L1 adipocytes and high-fat diet-induced obese mice. *Food Bioscience*, 41(March), 101019. <https://doi.org/10.1016/j.fbio.2021.101019>
- Zandi, P., & Basu, S. K. (2021). *Organic Farming for Sustainable Agriculture*. 1(1), 71–87. http://dx.doi.org/10.1007/978-3-319-26803-3_3
- Zhao, X. X., Lin, F. J., Li, H., Li, H. Bin, Wu, D. T., Geng, F., Ma, W., Wang, Y., Miao, B. H., & Gan, R. Y. (2021). Recent Advances in Bioactive Compounds, Health Functions, and Safety Concerns of Onion (*Allium cepa* L.). *Frontiers in Nutrition*, 8(July). <https://doi.org/10.3389/fnut.2021.669805>
