alkaloids, cardiac glycosides, saponins and flavonoids were all detected as phytochemical constituents in the *Tridax* extracts in this work. This is in consonance with the findings of Jisha et al. (2016) and Palou et al. (2001) who reported a number of active chemical constituents such as alkaloids, flavonoids, carotenoids, β-sitosterol, fumeric acid, myristic, palmitic, arachidic, linoleic acid and tannin from botanicals and all these phytochemical composition, makes the plant a natural bio pesticide with potential antimicrobial efficacy against a broad spectrum of microorganisms (Nair et al. 2015; Mishra et al., 2018).

Each of these phytochemical constituents as enunciated by others authors, is connected with significant antimicrobial properties. For instance, alkaloids and flavonoids when present exhibit antimicrobial properties. These compounds inhibit the growth of spoilage-causing microorganisms, extending the shelf life of fruits (Das, 2014). These compounds possess antioxidant properties, which play a crucial role in fruit preservation by inhibiting oxidative processes and prevent the degradation of fruits by scavenging free radicals that contribute to spoilage (Nair et al., 2015). This is further buttressed by the reports of Vasudevan et al. (2017) that alkaloids and flavonoids act as natural antimicrobial agents, inhibiting the growth of bacteria and fungi that contribute to fruit spoilage. Also, tannins act as natural preservatives by forming complexes with proteins and enzymes, thereby inhibiting microbial growth and enzymatic browning (Okigbo et al., 2010).

Even the GC - MS analysis of the *Tridax* extract revealed a lot of bioactive compounds and these natural compounds exert their effects through various mechanisms, making them effective against different types of microorganisms. For instance, n-Hexadecanoic acid identified in the extract is reported to have pesticide activities (Rajasekaran and Cary, 2014). Also, 9-octadecenoic acid methyl ester possesses anti-microbial properties while stearic acid were also found to exhibit antibacterial and antifungal activities (Gehan et al., 2009). Remarkably, the presence of bioactive compounds in *Tridax procumbens* may contribute to natural pest resistance, presenting opportunities for sustainable pest management in agriculture. The method typically involves the application of plant extracts onto the fruit surface or as part of coatings, creating a protective barrier against fungal colonization. Besides, their anti-microbial properties inhibit the growth and development of post-harvest pathogens, thereby preserving the quality of the orange fruits.

4 Conclusions

The study demonstrates antifungal efficacy of the aqueous extracts of *Tridax procumbens* against *Lasiodiplodia* sp (IMI: 50324), the brown rot pathogen of amber sweet orange fruits. The findings reveal the effectiveness of the aqueous extract at all tested concentrations against the brown rot pathogen by keeping the infected orange fruits healthy (disease free) for the first 10 days of storage under ambient temperature when compared with the untreated fruits. Further investigations even show that 15 and 100% concentrations of the aqueous extract still maintain the healthy status (wholesomeness) of the orange fruits for 30 days without any sign of rottenness as against the untreated and fungicide treated fruits that had already become unwholesome and diseased. Thus, we adjudge 15 and 100% of the *Tridax* aqueous extracts the most effective among the tested concentrations. They show potential for further development as safe, ecofriendly and effective natural substitutes against fruit pathogens.

Author's Contributions

Oladele O.O. carried out the conceptualization, methodology, investigation, supervision, formal analysis and writing of original manuscript while Oyedokun F.D. and Adebomi D.M. were involved in the methodology, investigation, resources and data analysis. All authors read and approved the final manuscript.

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References

Arekemase M.O., and Oyeyiola G.P., 2007, Fungi associated with spoiled citrus fruits obtained from Ilorin, Centre Point Science (Edition), 4: 138-149.

Burgess T.I., Barber P.A., Mohali S., Pegg G., and Wingfield M.J., 2006, Three new *Lasiodiplodia* spp. from the tropics, recognized based on DNA sequence comparisons and morphology, Mycologia, 98(3): 423-435.
https://doi.org/10.1080/15572536.2006.11832677