

A preliminary study of the antibacterial properties of ‘Dawadawa’ (*Parkia biglobosa*) and ‘Prekese’ (*Tetrapleura tetraptera*) on microbial load of beef

Atikpo, E.S., Adzitey, F.* & Sallah, E.K.

University for Development Studies, Department of Animal Science, P.O. Box TL 1882, Tamale, Ghana

*Corresponding author: adzitey@yahoo.co.uk

Abstract

Parkia biglobosa (‘Dawadawa’) and *Tetrapleura tetraptera* (‘Prekese’) are important traditional plant spices noted for their use in Ghana especially in soups for their many health benefits. This research was conducted to determine the antibacterial effects of *Parkia biglobosa* and *Tetrapleura tetraptera* on microbial load of beef. *Parkia biglobosa* and *Tetrapleura tetraptera* extracts were used at two levels of inclusion, that is, 1 ml: 10 g and 1 ml: 15 g (for distilled water: spice, respectively). Treatment levels were 0 g (T0 or T3), 5g (T1 or T4) and 15 g (T2 or T5) for *Parkia biglobosa* and *Tetrapleura tetraptera*, respectively and storage were done for 0, 4, 8 and 12 days. The results revealed that *Parkia biglobosa* had no significant effect ($P>0.05$) at the beginning (day 0) and end (day 12) of storage period but not ($P<0.05$) on day 4 and 8. *Parkia biglobosa* was not found to have antibacterial and preservative effect on the beef samples. There were significant differences ($P<0.05$) in beef samples treated with *Tetrapleura tetraptera* (‘Prekese’). *Tetrapleura tetraptera* beef treatment sample (T5) generally had low bacteria counts compared to the control (T3) and T4. *Tetrapleura tetraptera* (‘Prekese’) at 15 g inclusion level was found to have some antibacterial and preservative effect on the beef samples.

Keywords: Meat, microbial load, preservative, shelf-life, traditional spices

Resume

Parkia biglobosa (‘Dawadawa’) et *Tetrapleura tetraptera* (‘Prekese’) sont d’importantes épices végétales traditionnelles connues pour leur utilisation au Ghana, en particulier dans les soupes, pour leurs nombreux avantages pour la santé. Cette recherche a été menée pour déterminer les effets antibactériens de *Parkia biglobosa* et *Tetrapleura tetraptera* sur la charge microbienne du bœuf. Les extraits de *Parkia biglobosa* et de *Tetrapleura tetraptera* ont été utilisés à deux niveaux d’inclusion, à savoir, 1 ml : 10 g et 1 ml : 15 g (pour l’eau distillée : épice, respectivement). Les niveaux de traitement étaient de 0 g (T0 ou T3), 5 g (T1 ou T4) et 15 g (T2 ou T5) pour *Parkia biglobosa* et *Tetrapleura tetraptera*, respectivement, et le stockage a été effectué pendant 0, 4, 8 et 12 jours. Les résultats ont révélé que *Parkia biglobosa* n’avait pas d’effet significatif ($P>0,05$) au début (jour 0) et à la fin (jour 12) de la période de stockage mais avait un effet significatif ($P<0,05$) aux jours 4 et 8. *Parkia biglobosa* n’a pas eu d’effet antibactérien et conservateur sur les échantillons de bœuf. Il y avait des différences significatives ($P<0,05$) dans les échantillons de bœuf traités avec *Tetrapleura tetraptera* (‘Prekese’). L’échantillon de bœuf traité avec *Tetrapleura tetraptera* (T5) présentait généralement un faible taux de bactéries par rapport aux échantillons témoins (T3) et T4. On a constaté que *Tetrapleura tetraptera* (‘Prekese’) à un niveau d’inclusion de 15 g avait un certain effet antibactérien et conservateur sur les échantillons de bœuf.

Mots-clés : Viande, charge microbienne, conservateur, durée de conservation, épices traditionnelles.

Introduction

Meat is a nutritious protein-rich food which is enjoyed by many. Despite this, it is highly perishable and has a short shelf-life unless it is treated with preservatives or processed into further products (Olaoye and Ntuen, 2011). Meat can be preserved by chilling, freezing, salting, curing, canning, bottling and smoking (Anonymous, 2018a; FAO, 2018). It can also be processed into products such as sausages, burgers, corned beef, frankfurter, among others (Teye *et al.*, 2015; Amanfo *et al.*, 2015; Adzitey *et al.*, 2016; Ossom *et al.*, 2016; FAO, 2018) to improve its eating quality and to help increase its shelf life. However, meat consumption varies worldwide, depending on cultural, religious, and economic conditions.

Microbial spoilage, autolytic enzymatic spoilage and lipid oxidation are the main causes of meat and meat products spoilage. Spoilage by microbial growth is the most important factor in relation with keeping quality of meat (Lanmbert *et al.*, 1991). Meat spoilage is of great concern to consumers, processors and all others involved in the meat industry. Meat spoilage is inevitable, especially in developing countries where storage systems are often not well developed. One of the ways such countries including Ghana can increase the shelf life of meat is by preservation using plant amendments.

Spices are vegetable products used for flavoring, seasoning and imparting aroma in foods (Shama, 2006). They are used in diets for their nutritional, medicinal and preservative qualities. In West Africa, the plant *Tetrapleura tetraptera* (locally known as 'Prekese') is used as a spice, a medicine and as dietary supplement rich in vitamins (Anonymous, 2016). Okwu (2003) reported on the chemical evaluation, nutritional and flavoring properties of 'Prekese' which contained varying amount of protein, crude lipids, carbohydrate, crude fat and energy. *Parkia biglobosa* is commonly known as 'Dawadawa' in Northern Ghana. It is a source of lipid, protein, carbohydrate, fat and a good source of calcium (Anonymous, 2018b). This study was carried out to determine the antibacterial properties of *Tetrapleura tetraptera* ('Prekese') and *Parkia biglobosa* ('Dawadawa') on microbial load in beef samples.

Materials and methods

Study location. This study was undertaken in the Spanish Laboratory of the University for Development Studies, Tamale. The study area lies within the Guinea Savanna zone, characterized by large area of low grassland interspersed with trees. Tamale is located on longitude 09°24'27" North and latitude 00°51'12" West, and occupies an area of approximately 750 km² (Anonymous, 2018). Tamale is the third most populous settlement in Ghana, with a total population of 537,986 people and a population density of 480.77/km² (Anonymous, 2018). The daily mean temperature (°C) and average relative humidity (%) are 27.9 and 60, respectively (Ghana Statistical Services, 2000; Anonymous, 2018).

Preparation of ‘Prekese’ and ‘Dawadawa’ powders. *Tetrapleura tetraptera* and fermented *Parkia biglobosa* were obtained from Tamale market. They were cut into pieces and dried in an oven at 65°C for 24 hours. They were then ground using sterile mortar and pestle, and sieved through a 1mm test sieve. Subsequently, 10 g and 15 g of every powder was dissolved in 1ml of distilled water to form the extracts.

Microbiological analysis. Beef samples were obtained from the Tamale abattoir and cut into pieces of 25 g each. Each piece was kept in a sterile sealable/zip bag containing *Tetrapleura tetraptera* or *Parkia biglobosa* extracts. They were then stored at 4°C and microbiological analysis carried out on day 0, 4, 8 and 12. Microbiological analysis was carried out according to Adzitey *et al.* (2011). Data obtained was analyzed using Analysis of Variance of Genstat Release Version 12 and separated at 5% significant level.

Results and discussion

Table 1 shows the effect of *Parkia biglobosa* (‘Dawadawa’) on bacterial load of beef samples. From Table 1, significant differences ($P>0.05$) were not observed in day 0 and 12. However, significant differences ($P<0.05$) were observed in day 4 and 8. The initial bacterial load for the control (T0) on day 1 was 4.525 log cfu/g, this increased to 5.780 log cfu/g by day 12. Similarly, T1 had an initial load of 4.834 log cfu/g on day 1, and increased to 5.780 log cfu/g on day 12. Even though T1 numerically had higher bacterial load than T0 at the beginning of the experiment, they all ended with the same bacterial load. The T2, that is, extracts with the highest inclusion level tended to have better effects on the bacterial load of the meat samples. This study suggests that beef samples sold in the Tamale metropolis were already contaminated by bacteria, and fermented *Parkia biglobosa* had a significant or a non-significant influence on the bacterial load. Adzitey *et al.* (2011) reported that beef samples sold in the Tamale metropolis were contaminated with bacteria with load ranging from 5.57 to 6.22 log cfu/cm². They also found *Escherichia coli*, *Streptococcus* spp., *Salmonella* spp. and *Staphylococcus* spp. in the beef samples. Ademola *et al.* (2013) confirmed the presence of microbial load in processed *Parkia biglobosa* seeds.

The results of the effect of *Tetrapleura tetraptera* (‘Prekese’) on bacterial load of beef samples is presented in Table 2. There were significant differences ($P<0.05$) in the bacterial load on all the days examined except day 1. Similarly, to the study involving *Parkia biglobosa* (‘Dawadawa’), the beef samples (T3) examined were already contaminated with bacteria. Beef samples treated with 15 g *Tetrapleura tetraptera* (‘Prekese’) (T5) resulted in a significant reduction ($P<0.05$) in the bacteria load at the beginning of the experiment. The T5 continued to exhibit a significant reduction ($P<0.05$) in bacteria load on day 4 and 8. Beef samples treated with 5g *Tetrapleura tetraptera* (‘Prekese’) (T4) also exhibited a significant reduction ($P<0.05$) in bacteria load on day 4 compared to the beef samples without *Tetrapleura tetraptera* (‘Prekese’) (T3). Nonetheless, the positive effect of *Tetrapleura tetraptera* (‘Prekese’) was not seen in day 12. Ekwenye and Okorie (2010) reported that the presence of phytochemicals in stem bark and fruit extracts of *Tetrapleura tetraptera* plant possesses antimicrobial properties. Aladesanmi (2006) also stated that *Tetrapleura tetraptera* (‘Prekese’) has antimicrobial activity.

Table 1. Effects of *Parkia biglobosa* ('Dawadawa') extract on bacterial load of beef

'Dawadawa' level	0 g (log cfu/g)	5g (log cfu/g)	15g (log cfu/g)	LSD	P value
Days	T0	T1	T2		
Day 0	4.525	4.834	4.312	4.525	0.760
Day 4	4.457 ^b	5.424 ^a	4.442 ^b	0.017	<.001
Day 8	5.463 ^b	6.406 ^a	5.792 ^b	0.537	0.014
Day 12	5.780	5.780	5.300	0.919	0.393

^{a,b}, values on the same row with different superscripts differ at P<0.05

Table 2. Effects of *Tetrapleura tetraptera* ('Prekese') extract on bacterial load of beef

'Prekese' level	0g (log cfu/g)	5g (log cfu/g)	15g (log cfu/g)	LSD	P value
Days	T3	T4	T5		
Day 0	5.464 ^a	5.385 ^{ab}	5.287 ^b	0.137	0.052
Day 4	5.410 ^a	5.378 ^b	5.282 ^c	0.090	0.031
Day 8	5.437 ^a	5.426 ^a	5.262 ^c	0.087	0.004
Day 12	5.389	5.421	5.276	0.173	0.179

^{a,b}, values on the same row with different superscripts differ at P<0.05

Conclusion and recommendation

There were no differences in beef samples treated with *Parkia biglobosa* ('Dawadawa') at the beginning (Day 0) and end (Day 12) of the experiment. *Parkia biglobosa* did not show any clear antibacterial activity. There were differences in beef samples treated with *Tetrapleura tetraptera* ('Prekese') extracts on days 0, 4 and 8. Beef samples treated with 15g *Tetrapleura tetraptera* extract had positive effect on bacteria load on the beef samples. There is the need for further studies to determine the use effects of *Parkia biglobosa* and *Tetrapleura tetraptera* extracts using different extraction methods against specific pathogens. Studies to determine potential chemicals responsible for antimicrobial activities are also needed.

References

- Ademola, I.T., Baiyewu, R.A., Adekunle, E.A., Awe, A.B., Adewumi, O. J., Ayodele, O.O. and Oluwatoke, F.J. 2013. Microbial load of processed *Parkia biglobosa* seeds: towards enhanced shelf life. *African Journal of Agricultural Research* 8:102-105.
- Adzitey, F., Birteeb, P. and Holdbrook, K.B. 2016. Quality characteristics of whole guinea fowl egg as binder in beef and chevon burgers. *Journal of World's Poultry Research* 6: 66-72.
- Adzitey, F., Teye, G.A., Kutah, W.N. and Adday, S. 2011. Microbial quality of beef sold on selected markets in the Tamale Metropolis in the Northern Region of Ghana. *Livestock Research for Rural Development* 23 (1): 1-7.
- Aladesanmi, A.J. 2007. *Tetrapleura tetraptera*: molluscicidal activity and chemical constituents. *African Journal of Traditional, Complementary and Alternative Medicines* 4:23-36.
- Amanfo, D.O., Adzitey, F. and Teye, G.A. 2015. The effect of 'Prekese' (*Tetrapleura tetraptera*)

- pod extract processed at different time intervals on the sensory qualities of pork sausage. *Ghana Journal of Science, Technology and Development* 2 (1): 54-58.
- Anonymous, 2018a. Methods for preserving meat. Available at: <http://blog.emergencyoutdoors.com/methods-for-preserving-meat/>. Last accessed on 25-04-2018.
- Anonymous, 2018b. Dawada. Available at: http://www.specialtyproduce.com/produce/Dawadawa_12606.php. Last accessed on 25-04-2018.
- Anonymous, 2016. Prekese (*Tetrapleura tetraptera*) – The health benefits) Available at: <http://www.nutritionandall.com/prekese/>. Last accessed on 25-04-2018.
- Anonymous, 2014. Tamale metropolis. Available at: https://en.wikipedia.org/wiki/Tamale_Ghana; 2014. Last accessed on 25-04-2018.
- Ekwenye, U.N. and Okorie, C.F. 2010. Antibacterial activity of *Tetrapleura tetraptera* Taub. pod extracts. *International Journal of Pharma and Bio Sciences* 1:734-741.
- Food and Agriculture Organisation (FAO), 2018. Methods of processing and preservation of meat. Available at: <http://www.fao.org/docrep/t0562e/T0562E03.htm>. Last accessed on 25-04-2018.
- Ghana Statistical Service, 2000. 2000 Population and housing census. Available at: <http://statsghana.gov.gh/nada/index.php/catalog/3>. Last accessed on 06/06/2018.
- Lambert, A.D., Smith, J.P. and Dodds, K.L. 1991. Shelf life extension and microbiological safety of fresh meat – a review. *Food Microbiology* 8:267-297.
- Okwu, D.E. 2003. The potentials of *Ocimum gratissimum*, *Penrgularia extensa* and *Tetrapleura tetraptera* as a spice and flavouring agents. *Nigeria Agriculture Journal* 35:143-148.
- Olaoye, Q.A. and Ntuen, I.G. 2011. Spoilage and preservation of meat: a general appraisal and potential of lactic acid bacteria as biological preservatives. *International Research Journal of Biotechnology* 2: 33-46.
- Ossom, R.N., Adzitey, F. and Teye, G.A. 2016. The effect of higher levels of egg albumen as binder in beef burger. *Journal of Food Research and Technology* 4 (1): 16-21.
- Sharma, A. 2006. Irradiation to decontaminate herbs and spices. *Handbook of Herbs and Spices* 3 60-73.
- Teye, G.A., Adzitey, F., Bawah, J. and Takyi, F. 2015. Dawadawa (*Parkia biglobosa*) pulp as an extender in beef sausage. *UDS International Journal of Development* 1: 30-35.