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Short Communication

Effect of leaf-packaging on the microbiological assessment of some food items

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Microorganisms associated with leaves of *Thaumatococcus daniellii* ("ewe eran"), *Musa paradisiaca* (banana) and *Tectona grandis* (teak) and the food wrapped in the leaves were investigated. The bacterial isolates from both the leaves and food include *Bacillus cereus, B. subtilis, Micrococcus* sp., *Staphylococcus aureus, S. epidermidis, Corynebacterium* sp. and *Lactobacillus acidophilus.* The fungal isolates were *Aspergillus flavus, A. niger, Rhizopus stolonifer, Penicillium expansium* and *Mucor mucedo*. *M. paradisiaca* leaf has the least load of bacterial isolates with an average count of 5.00 x 10^4 cfu/g; followed by *Thaumatococcus grandis,* 8.00 x 10^4 cfu/g and *Tectona daniellii,* 1.44 x 10^5 cfu/g. The pH of all the food samples wrapped in the different leaves decreased from the original values. The moisture contents ranged from 69.57 to 79.00%. Crude fibre, ash and crude protein increase slightly on the first two days of storage and decrease on the third and fourth days.

Key words: *Thaumatococcus daniellii, Musa paradisiacal, Tectona grandis,* microbiological qualities.

INTRODUCTION

Packaging materials have been known to be possible source of microbial contamination of food (Frazier and Westhoff, 1988). Since food eaten has a direct influence on health, it is therefore important that manufacturer and food handlers keep food safe from pathogenic microorganisms (Owhe-Uregbe et al., 1993). Cellophane is the largest volume of single film used in flexible packaging industry. It is a low cost film with moderate tensile strength and clarity, and is a good moisture barrier. Local packaging alternatives include *Thaumatococcus daniellii*, which has a large coudate leaf borne on petiole of 2 to 4 cm long. The plant occurs wide in the African rain forest. Leaves of *Tectona grandis* are also large with a long clean bole often buttressed at the base and sometimes fluted. While *Musa paradisiaca* is large, cheap, readily available and provides good packaging for products that are quickly consumed. They are common in the lowland tropics of Africa, Central Latin America, Southeast Asia and West Indies.

Although, the leaves of these plants are used as wrapping materials, little is recorded on the microbiological qualities of the food items wrapped in them. This study was, therefore, designed to assess the microorganisms associated with local leaves and the food items wrapped in them. The food items assessed with the leaves include yams (*Dioscorea* spp.), maize (*Zea mays*), and beans (*Vigna unguiculata*).

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MATERIALS AND METHODS

Fresh leaves of *Thaumatococcus daniellii* were obtained from Oba market, Akure. *Tectona grandis* leaves were obtained from the teak trees along Obanla-Obakekere road of the Federal University of Technology, Akure. *M. paradisiacal l*eaves were plucked from the Federal University of Technology Research Farm, Akure. Cellophane wrapper was used as control.

Grains of maize, beans and tubers of white yam were prepared into maize pap, steamed beans pudding and pounded yam, respectively. Immediately after preparation, they were wrapped separately with different leaves as packaging materials and then stored for four days in an open cupboard at 30°C. Microbial loads of the leaves were determined before being used to wrap the prepared foods. Moulds on the leaves and foods were characterized and identified according to Barnett and Hunter (1972).

Biochemical tests such as Gram stain, spore stain, catalase test, motility, acid fast stain, oxidation-fermentation (OF) test, acid from glucose sugar fermentation, starch hydrolysis, citrate utilization,

Table 1. Bacterial count of leaves and food samples on the first day.

Bacteria	Bacterial load (cfu/g)			
	On leaves alone	Pounded yam wrapped with leaves	Maize pap wrapped with leaves	Bean pudding wrapped with leaves
Thaumatococcus daniellii	1.44×10^5	5.40×10^5	2.20×10^4	2.50×10^5
Musa paradisiaca	5.00×10^4	4.60×10^4	1.10×10^4	2.20×10^5
Tectona grandis	8.00×10^4	5.10×10^4	1.80×10^4	2.40×10^5
Cellophane (control)	-	-	-	-

Table 2. Fungal load in leaves and food samples on the first day.

Fungus	Fungal load (number/g)			
	On leaves alone	Pounded yam wrapped with leaves	Maize pap wrapped with leaves	Bean pudding wrapped with leaves
Thaumatococcus daniellii	70	90	70	20
Musa paradisiaca	60	80	50	20
Tectona grandis	40	40	40	20
Cellophane (control)	-	-	-	-

indole production test, growth on Mac Conkey Agar, growth in air, nitrate reduction, urease production and growth in sodium chloride (NaCl) were carried out on the bacterial isolates using conventional techniques.

Physio-chemical parameters of the food samples such as crude fibre content, moisture content, crude protein, ash content, crude fat and carbohydrate content were also determined according to AOAC (1984). Experiments were in 3 replicates.

RESULTS AND DISCUSSION

Table 1 shows the total bacterial counts of the various samples. The highest bacterial count of 1.44×10^5 cfu/g was found on the leaves of *Thumatococcus daniellii.* There was no growth of bacteria on the cellophane wrapper that was used as control. The same kinds of bacterial isolated from the leaves used in wrapping were also isolated from the food. They are *Bacillus cereus, B. subtilis, Lacotbacillus acidophilus* sp., *Staphylococcus aureus, S. epidermidis, Pseudomonas* sp., *Corynebacterium* sp., *Micrococcus* sp. Frazier and Westhoff (1988) reported that *Pseudomonas*, *Bacillus*, *Alcaligenes* and *Micrococcus* are among some of the bacterial species recovered on the surface of plants. *Bacillus* sp., *Lactobacillus* sp., *Escherichia coli, Staphylococcus* sp. and *Streptococcus* sp. have previously been reported by Owhe-ureghe et al. (1993) to be associated with steamed bean pudding and maize pap.

There was lesser bacterial load in the leaves used in wrapping the food on the first day (Table 1). This could be due to the heat in the food. However, the count increases in the course of storage of the food samples. Highest bacterial count was seen in the food wrapped with *Tectona grandis* leaves, which could be due to the softness of the leaf making it more likely to harbour bacteria, followed by *Thaumatococcus daniellii* and *M. paradisiaca*.

Table 2 shows fungi count per gram in sample. A total of five fungi were isolated from the samples. The population ranged from 20 to 90 per gram with highest value in *Taumatococcus daniellii.* The isolated mould includes *Mucor mucedo, Aspergillus niger, A. flavus, Penicillium expansum, Rhizopus stolonifer.*

There was no growth of fungi on the cellophane wrapper that was used as control. Abba-Kareem and Okegbue (1991) reported that some strains of *Aspergillus flavus* are known to be toxin-producing. Aflatoxin which are mycotoxins produced by such strain are undesirable in foods because they are potential health hazard. Moulds also have undesirable effect on foods as they cause considerable loss in the soluble carbohydrate content.

All the foods processed for study (Table 3) have high moisture content, which facilitated the growth of microorganism in them and may encourage spoilage. At the fourth day there was decrease in microbial content of the food, which could be attributed to the lowering of the pH causing the medium to be more acidic and unfavorable for the growth and multiplication of bacteria and some fungi (Tables 4 and 5).

The protein and fat contents of the steamed bean pudding were 18.29 and 1.72%, respectively. Lasekan et al. (1987) reported protein and fat contents of 18.60 and 0.90%, respectively, for steamed bean pudding. There was reduction in the protein content of food during

Table 3. Proximate composition of food sample on the first day and fourth days.

Parameter	Pounded yam (%)		Maize pap (%)		Steamed bean pudding (%)	
	First day	Fourth day	First day	Fourth day	First day	Fourth day
Moisture content	71.80	71.61	79.00	77.05	69.57	72.26
Ash content	0.92	0.62	0.13	1.88	1.45	0.58
Fat content	0.15	0.10	0.06	0.01	1.72	1.08
Fiber content	0.58	0.80	ND	ND	2.11	1.09
Crude protein content	4.38	2.97	3.07	3.50	18.29	15.21
Carbohydrate content	22.17	23.91	17.69	18.86	6.86	8.48

Table 4. Bacterial count of leaf and food samples cfu/g on the fouth day.

Samples	Bacterial load in pounded yam wrapped with leaves	Bacterial load in maize pap wrapped with leaves	Bacterial load in steam bean pudding wrapped with leaves
Thaumatococcus daniellii	3.60 x 102	1.40×10^2	3.10×10^2
Musa paradisiaca	3.10×10^2	1.30×10^2	2.00×10^2
Tectona grandis	4.10×10^2	1.20×10^2	2.30×10^2
Cellophane (control)	-	-	-

Table 5. Shows fungal load in samples per gram on the fouth day.

Samples	Bacterial load in pounded yam wrapped with leaves	Fungal load in maize pap wrapped with leaves	Fungal load in steam bean pudding wrapped with leaves
Thaumatococcus daniellii	5×10^1	4×10^1	1×10^1
Musa paradisiaca	6×10^1	3×10^1	1×10^1
Tectona grandis	3×10^1	2×10^1	2×10^1
Cellophane (control)	-	-	-

storage (Table 3). There was also a decrease in the fibre content of pounded yam.

In conclusion, the leaves used in wrapping the food items introduced some microorganisms into food. It is therefore recommended that users of this wrapper should wash the leaves with clean water before using and food wrapped in these wrappers should be consumed as soon as possible to reduce multiplication of microorganisms.

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