# A CHEMICAL STUDY OF AN INDIGENOUS KNOWLEDGE SYSTEM OF MILK PRESERVATION IN ADAMAWA STATE, NIGERIA

Zainab Mohmmed[1], Bitrus Yakubu[2], Anne Samuel Lohlum[2] and Umaru Ali-Dunkrah[2*]

[1]Dept. of Animal Production FCAH&PT, Vom
[2]Dept. of Biochemistry & Appl. Mol. Biol.
National Veterinary Research Institute, Vom.
* Corresponding Author.

## ABSTRACT

The preservative effect of cowpea pods, seeds, husk, and water and ethanol extracts of the seeds and husk were chemically determined. Percentage acidity was used as a measure of efficacy. The percentage acidity of controls in all the tests was higher than those of tests, indicative of preservative effect. The acidity values for the preservation of "kindirmo" with water and ethanol extracts of seeds and husk of cowpea for most of the tests in the given periods of preservation fall within the reported range for fresh yoghurt (0.85-095%). These results demonstrate that the traditional use of cowpea pods to preserve milk has some considerable preservative effect with the extracts exhibiting more preservative effect.

Keywords: Cowpea pods, preservation, acidity, extracts.

## INTRODUCTION

Improved nutritional well being and sustainable food security needs not only better agricultural and farming systems, but also the prevention of food losses (F.A.O., 1999). The preservation of high moisture containing foods especially animal products like milk and eggs is still a major obstacle to food sufficiency and supply in the poor, under developed and developing countries (F.A.O., 1999). This affects peasant farmers' especially animal rearers who lack the facilities and the technology to preserve and process animal products like milk. Low temperature storage, cold storage or refrigeration is necessary to preserve milk for a reasonable period of time (Luck, 1989). Such facilities are however not available to most peasant animal farmers. Heat treatment is the only option which is limited in its application. Pasteurisation is often carried out to minimise possible health hazards arising from pathogenic micro-organisms associated with milk.

The indigenous knowledge system of milk preservation investigated has been used for ages by Fulani milk maids in Adamawa State Nigeria. Dry pods of cowpea seeds are used as the preservative which is added to milk in closed earth pots and kept. Milk can also be boiled and sheared into dishes containing 1-2 rings of cowpea pods and closed. It has been claimed that milk preserved for 1-3 days maintains its original texture, taste and odour. Cowpea is an indigenous crop of Africa where it is eaten as processed dry grain, green pods, and tender green leaves. Cowpea grain has high protein content up to 24 percent. It is a seasonal plant with enormous varieties

and this pod bearing plant is one of the most important legumes grown in the savannah zone of West Africa (Popoola, 1989).

This local method of milk preservation may be very effective in preserving milk and its scientific investigation may provide an easier and cheaper method of preserving milk. This will be of enormous economic benefit to the peasant farmers and the nation in general as the system can be improved and modernised to be more effective. Plants have always been a common source of medicaments in the form of traditional preparations or as pure active principles (Gbile & Adesina, 1987). A study on drug discovery by Medina *et al* (2001) reveals that of the 20 best selling non-protein drugs in 1999, nine were natural products or products derived from them and over 100 natural products or products derived pharmaceuticals are used in medicine. Perhaps same may apply in the area of preservatives; plant products may be safer and biologically friendlier.

It is with this in mind that we decided to investigate this indigenous knowledge system used for ages by the Fulani milk maids in Adamawa State.

We assessed the preservative effect of whole cowpea pods, seeds, husk, water and ethanol extracts on fresh milk and kindirmo (yoghurt).

## MATERIALS AND METHODS

### Sample Collection and Preparation

Fresh milk samples were collected from the livestock Division of the National Veterinary research Institute, Vom. Kindirmo (yoghurt) was prepared by boiling 40ml of fresh milk and allowed to cool to about 50°C. 5ml of cultured sample was introduced into the milk and immediately covered and kept for 18 hours in the laboratory before preservation.

### Extraction

10 grams of seed and husk meals were extracted by maceration in water. After filtration, the extracts were evaporated to dryness with rotary evaporator. These were further dried in a desicator, weighed and labelled as water extracts. 10 grams of seed and husk meals were also extracted with 70 percent ethanol using soxhlet apparatus. The solvent was recovered and the extract evaporated to dryness in a water bath. The extracts were further dried in a desicator, weighed and labelled as ethanol extracts of seed and husk meals respectively.

### Preservation

Fresh milk and kindirmo (yoghurt) were preserved using cowpea pods, seeds, husk, water and ethanol extracts of seed and husk meals. Six capacity sample bottles were washed, dried and labelled a-e and six others prepared in the same way labelled $T_1$-$T_6$. Into bottles labelled a-e pods (2 pieces), seeds (3), husk (1g) and 2ml of sodium benzoate (500ug/ml) were put into a-d respectively, e serving as control. 60ml of fresh milk and kindirmo in each case was measured into each bottle and closed. These were kept on the bench for 18 hours after which acidity was determined as a measure of spoilage. Same was repeated for 36 and 54 hours period of time as well as the water and ethanol extracts. Aqueous solutions of the extracts were prepared

90.025g/ml) and 20ml measured into each bottle labelled $T_1$-$T_4$; $T_5$ and $T_6$ served as controls.

**Determination of Acidity**

Acidity was determined according to the method of Egan *et al.*, (1981). Briefly 2ml of each milk sample was measured into a 250ml conical flask and diluted with 40ml carbon dioxide free distilled water. 2ml of 1% phenolphthalein was added and titrated with 01m NaOH to first persistent pink colour. Acidity was reported as percentage lactic acid by weight.

**Determination of Nutrient Composition**

Fat, water, total solids and ash were determined according to standard AOAC (1990) methods. Protein was assayed using the Formal method. Briefly, 10ml of milk was measured into a 250ml capacity conical flask; 0.5ml of 0.5% phenolphthalein indicator and 0.4ml of neutral saturated for a few minutes and titrated to neutral point with 0.1N NaOH. To the neutral milk was added exactly 2ml of 40% formalin, mixed, allowed to stand for few minutes and titrated with 0.1N NaOH to a faint pink colour. Blank titration of 2ml formalin plus 10ml of water was done. The titre values were used to calculate protein content.

## RESULTS AND DISCUSSION

The results of the analysis of the nutrient composition and percentage acidity of the fresh milk used in this study are presented in table 1. The mean percentage acidity obtained (0.19%) is within the range (0.08-0.30%) reported for fresh milk by most authors (Chamberlin, 1985; Egan *et al.*, 1981; Kordylas, 1990). This is the natural acidity of fresh milk.

**Table 1: Nutrient composition and acidity of fresh milk (%)**

| Water | Protein | Fat | Ash | Total Solids | Acidity |
|---|---|---|---|---|---|
| 87.55±1.10 | 3.74±0.20 | 3.84 ±0.12 | 0.08±0.01 | 12.45±0.04 | 0.19±0.00 |

Values are means of 3 determinations ± S.D.

The acidity of fresh milk preserved using cowpea seeds, pods and husk (a, b and c respectively) for 18, 36 and 54 hours periods of time is shown in table 2. Preservation for 18 hours gave percentage lactic acid values of 0.28-0.29 all of which fall within the range 0.08-0.30% (the normal range of acidity of fresh milk, Ling, 1956). Although there is a significant difference ($P>0.05$) between the determined acidity of fresh milk and those of the tests, it can be expected considering the time required for the active principle(s) from the pods, seeds and husk to dissolve into the milk. This is expected if the active principle acts by inhibiting agents of fermentation or spoilage.

**Table 2: Acidity of fresh milk preserved using cowpea (as % lactic acid)**

| Time | A | B | C | D | E |
|---|---|---|---|---|---|
| 18 | 0.28±0.01 | 0.27±0.02 | 0.29±0.01 | 0.27±0.02 | 0.31±0.00 |
| 36 | 0.42±0.00 | 0.40±0.01 | 0.40±0.00 | 0.47±0.00 | 0.43±0.01 |
| 54 | 0.37±0.01 | 0.38±0.01 | 0.41±0.00 | 0.41±0.00 | 0.48±0.01 |

Values are means of 3determinations ± S.D.

A - Milk + cowpea pods
B - Milk + cowpea seeds
C - Milk + cowpea husk
D - Milk+ sodium benzoate (100ppm)
E - Control (milk alone)

A comparison of A, B & C with D (sodium benzoate preserved) and E (control-milk alone), showed a significant difference (P>0.05) between D and the 3 tests for 36 hours period and no significant difference between E and tests. While a proportionate increase in acidity is observed in the control, slight decrease is observed for the tests especially tests (A&B). The acidity of control for all the 3 periods of time (0.31-0.48%) is higher than all the tests, showing some level of bacterial growth inhibition in the tests. The decrease in acidity observed in A&B could be as a result of inhibition of fermentation or spoilage microbes responsible for increased acidity.

Table 3 shows the percentage acidity of kindirmo (yoghurt) preserved with cowpea pods, seeds and husk (A, B & C) along with control (E) and sodium benzoate preserved (D) for 18, 36 and 54 hours respectively. The acidity values for control - 1.37, 2.65 and 2.80% (for 18, 36 and 54 hours preservation respectively) are higher than the acidity values of the tests. This indicates some level of preservative effect as there is a significant difference (P>0.05) at 5% level of significant difference (P>0.05) at 5% level of significance. Although there is a significant difference (P>0.05) at 5% level of significance between acidity values for the 2 periods (18 &36 hours), the low acidity value differences between periods 36 and 54 hours is indicative of preservative effect. This is more so as the physical tests showed no prominent change in taste, or odour. The tests with seeds however made the milk to loose texture in all the experiments.

**Table 3: Acidity of 'kindirmo' (yoghurt) preserved with cowpea (as % lactic acid)**

| Time (Hours) | A | B | C | D | E |
|---|---|---|---|---|---|
| 18 | 1.02±0.02 | 1.27±0.02 | 1.02±0.01 | 1.09±0.01 | 1.37±0.03 |
| 36 | 2.03.03 | 2.01±0.01 | 2.12±0.02 | 1.95±0.02 | 2.65±0.02 |
| 54 | 2.27±0.02 | 2.25±0.00 | 2.26±0.00 | 2.26±0.01 | 2.80±0.01 |

Values are means of 3determinations ± S.D.

A - Kindirmo + cowpea pods
B - Kindirmo + cowpea seeds
C - Kindirmo + cowpea husk
D - Kindirmo + sodium benzoate (100ppm)

E - Control (kindirmo only)

The results of the preservation of kindirmo with water and ethanol extract of cowpea sees and husk is presented in table 4. The acidity values for all the tests and at all the given periods of preservation except $T_4$ at 54 hours preservation fall within the reported range for fresh yoghurt, 0.85-0.95% (Egan, 1981).

**Table 4: Acidity of kindirmo (yoghurt) preserved with water and ethanol extracts of cowpea seeds and husk (as % lactic acid)**

| Time (Hours) | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ |
|---|---|---|---|---|---|---|
| 18 | 0.65±0.01 | 0.54±0.00 | 0.46±0.01 | 0.72±0.00 | 0.73±0.01 | 0.74±0.01 |
| 36 | 0.82±0.00 | 0.73±0.00 | 0.63±0.01 | 0.86±0.01 | 0.82±0.02 | 0.83±0.02 |
| 54 | 0.99±0.02 | 0.95±0.00 | 0.86±0.00 | 1.05±0.01 | 1.12±0.01 | 1.09±0.02 |

Values are means of 3 determinations ± S.D.

$T_1$ - Kindirmo + water extract of seed meal
$T_2$ - Kindirmo + water extract of husk
$T_3$ - Kindirmo + ethanol extract seed meal
$T_4$ - Kindirmo + ethanol extract of husk
$T_5$ - Control (kindirmo alone)
$T_6$ - Kindirmo + sodium benzoate (1000ppm)

The eighteen hours preservation acidity values (0.46-0.72%) are all below the minimum value of 0.85%. The increase in acidity with time is also low. Water and ethanol extracts preserved kindirmo gave lower acidity values than the cowpea pods, seeds and husk preserved kindirmo.

The chemical analysis of the acidity (as percentage lactic acid) of milk preserved with cowpea pods, seeds, husk, water and ethanol extracts of seeds and husk show that this local preservative exhibits some measure of preservative effect. It seems to slow down fermentation by inhibiting the growth of some species of bacteria which may be responsible for fermentation. The results also suggest that the preservative is soluble in aqueous and polar solvents as the water and ethanol extracts of the seeds and husk exhibited more preservative effect (table 4). Milk preserved with ethanol and water extracts of seeds and husks respectively as observed in this study was shown to be more preserved.

As this work was a preliminary investigation of milk preservation as locally practised by Fulani milk maids, a conclusion cannot be drawn as to the extent of the efficacy of this local preservative. Also environmental factors have to be considered before a conclusion can be drawn. From the above results, the preservation seems to slow down fermentation possibly by inhibiting the growth of some species of the bacteria responsible for fermentation.

In conclusion it is obvious that cowpea pods and seeds seem to be a promising source of an effective preservative especially for use in areas where low temperature storage or refrigeration is not available. Further studies should be carried out to identify the preservation, minimum effective concentration and sage level of the reservation when identified should be determined. Bacterial count studies can be carried out to confirm the antibiotic effect of the preservative and the type of bacteria

affected or inhibited. The discovery of the active principle may be the stepping stone towards the discovery of an effective and more biologically friendly preservative.

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