



Starch Modification Potential of *Kanwa*, an Alkaline Salt

ABSTRACT

Objective: Investigate the potential of kanwa (an alkaline salt) to modify cassava starch.

Methodology and results: The modification studies were carried out at room temperature 25-30°C for 5h. Cassava starches were modified using kanwa at 0.1, 0.5 and 1.0%. Kanwa improved the swelling power, paste clarity, viscosity on cooling from 95 to 50°C, peak viscosity, freeze-thaw stability and reduced gelatinization time over the unmodified starch.

Conclusion and application of findings: Kanwa can be used as a starch-modifying agent at low concentrations. The starches that are modified using kanwa can be used in foods that require thickening and stability e.g. pie filling.

Key words: kanwa, cassava starch, modification, viscosity, paste clarity, freeze-thaw stability, gelatinization.

INTRODUCTION

Many native starches are unsuitable for industrial applications due to poor characteristics exhibited under some processing conditions such as extreme temperature, high shear pressure and varying pH (Wang *et al.*, 1993). In order to enhance their industrial applications, such starches are modified by physical, enzymic, biological and chemical methods. Modified starches have generally better paste clarity, gel stability, increased resistance to retrogradation, increased solubility and improved freeze-thaw stability, which improves their application as stabilizers, fillers, binders and adhesives.

Chemical modification of cassava and other plant starches with improved qualities and applications have been reported by several workers (Knight, 1974; Paterson *et al.*, 1994; Nurulislam & Azemi, 1997; Ahmed *et al.*, 2005; Alummoottil *et al.*, 2005). Due to current consumer and worker safety requirements, the use of some new synthetic

chemicals has been prohibited, including use of high concentrations of the existing agents. This has led to the need for research into naturally occurring starch-modifying agents.

Some natural products, e.g. alum used in water processing for home or industrial needs; and ginger used as a seasoning agent and as preservative have been reported to improve the functional properties of cassava and rice starches, respectively (Lee *et al.*, 1995; Daramola & Osanyinlusi, 2006). 'Kanwa' is a naturally occurring alkaline rock salt used as a tenderizer, flavouring agent, food preservative and as a prophylactic (Uzogara *et al.*, 1988). Kanwa has also been reported to improve protein digestibility of cowpea (Uzogara *et al.*, 1988, Omueti *et al.*, 1992). 'Kanwa' is 'trona' or sodium sesquicarbonate with trace amounts of Calcium, Magnesium, Iron, Zinc, Sulphur, Chlorine, Silicon, Phosphorus, Potassium and Aluminium (Makanjuola & Beetlestone, 1975).

The salt occurs in abundance in Nigeria where it is known by various names, e.g. *akanwu*, *kanwan*, *kaun*, *kawe* and *potash*. This natural product is relatively inexpensive and less hazardous, thus requiring less safety precautions to use. This study

investigated the potential of this salt to modify cassava starch when applied at concentrations. The pasting properties of the modified starches were also determined.

MATERIALS AND METHODS

Starch extraction and modification: Starch was extracted from tuberous roots of the improved cassava variety 82/00058 aged 12 months at harvest. The roots were obtained from the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. The cassava roots were grated, mixed with water and the slurry was sieved. The filtrate was allowed to settle for 24h before decantation of the supernatant. The starch was drained, dried and milled into powder. 'Kanwa' was purchased from a retail market in Ibadan and used without further treatment. All other chemicals used were of analytical grade.

The slurry method described by Agboola *et al.*, (1991) was used to prepare modified cassava starches. Native starch (150g) was suspended in a solution of 200ml distilled water and 10ml 1M NaOH. The alkaline suspension was kept for 30min at room temperature with occasional stirring before the addition of 'kanwa' at 0.1, 0.5 or 1.0% of the dry weight of native starch. The mixture was kept for a further 5h at room temperature followed by washing thoroughly with distilled water while filtering through a Whatman No. 4 filter paper under vacuum suction, and then dried at 50°C for 24h in a hot air oven. The modified starches were cooled to room temperature and milled into powder. Unmodified (native) starch was used as a control.

Physico-chemical and pasting properties of starch: The yield of the modified starches was determined on a dry matter basis. Solubility at 60°C was determined as described by Smith (1967) and starch-swelling power by

the method of Leach *et al.*, (1959). The procedure was slightly modified for small samples of 0.1g to use 10ml distilled water. Ash and moisture content of the native and modified starches were determined according to AOAC (1980).

The pH of the samples was determined by the method of Smith (1967) using an Omega HHPX digital pH meter while paste clarity was determined by the spectrophotometric method of Graig *et al.*, (1989). A 1% (w/v) starch suspension in distilled water was heated in a boiling water bath while stirring for 30min. The paste was cooled to room temperature and the percent light transmittance measured at 620nm using a Unicam UV spectrophotometer sense 2 CE 202. A Brabender viscoamylograph with a sensitivity cartridge of 700cgf, bowl speed of 75rpm and bowl size of 400ml was used to determine the pasting properties. Starch slurry of 7.5% (w/v) was heated from a temperature of 30°C at a rate of 2.5°C min⁻¹ to a maximum of 95°C. The paste was held at 95°C for 15min and cooled to 50°C. Pasting temperature, peak viscosity, viscosity at 95 and at 50°C, setback viscosity and gelatinization time were obtained from the graph plotted by the machine. Freeze-thaw stability was determined as described by Knight (1974). A 10% (w/v) slurry was heated to 95°C, cooled to 50°C and held for 15min before it was allowed to freeze overnight and thawed at room temperature over 4 cycles. All analyses were carried out in triplicate except pasting properties, which were determined only twice.

Table 1: Physical and functional characteristics of native and kanwa-modified cassava starches.

Starch treated with:	Yield (%)	Swelling power (%)	Solubility (%)	M.C. (%)	Paste clarity (%T)
0.1% kanwa	90.5	5.2	4.2	10.3	80.6
0.5% kanwa	95.7	5.3	5.0	11.3	80.6
1% kanwa	94.2	4.9	7.0	11.6	82.4
0% kanwa (native)	NA	3.5	7.7	11.0	78.3

Values are means of triplicate determinations; NA = Not applicable

RESULTS AND DISCUSSION

The yield of the modified starches was high and varied with kanwa concentration ranging between 90.5 – 95.7% (Table 1). This result shows that leaching of the starch constituents is reduced at alkaline conditions unlike acidic conditions, which reduce yield through thinning of

the starch (Lawal *et al.*, 2004; Ahmed *et al.*, 2005). Increase in kanwa concentration from 0.1 to 1.0% increased yield. The swelling power of the modified starches (4.9 - 5.3) was higher than that of native (unmodified) starch (3.5). This change is caused by

weakening of the starch granules by the substituent ions, which allows penetration of water molecules into the granules.

The solubility of the modified starch was lower (4.2 - 7.0%) compared to native starch (7.7%). The lower solubility of the modified starches may be attributed to the non-thinning effect of the alkaline salt used. Acids and acidic materials have been reported to create a thinning effect which results in greater fluidity and introduction of the hydrophilic substituent group which allows retention of water molecules because of their ability to form hydrogen bonds which increases solubility (Khalil *et al.*, 1995; Betancur *et al.*, 1997; Lawal *et al.*, 2004). The paste clarity of the modified starches was higher (80.6 - 82.4%) than that of native starch (78.3%). Improved paste clarity has been reported for other modified starches (Khalil *et al.*, 1995; Alummoottil *et al.*, 2005), which reflects higher swelling power of the modified starches. The paste clarity increased as the kanwa concentration increased from 0.1-1.0%. The pH of the modified starches (10.1 -10.3) was higher than that of native starch (8.0), an indication of the alkaline nature of the modifying agent.

A pasting temperature range of 67- 68°C was obtained for the modified starches compared to 68°C for the native starch (Table 2), which shows that addition of

kanwa had no effect on this attribute. The gelatinization time was 22-23 min and 24 min for modified starches and native starch, respectively. These parameters are critical because cooking time has energy-cost implications during industrial starch applications. The setback viscosity of modified starches (105-170BU) was higher compared to 85BU for native starch, with cassava starch treated with 1.0% kanwa having the highest setback viscosity of 170BU.

This result reflects the instability of the cooked paste of the modified starches against retrogradation. The modified starches exhibited increased viscosity when cooled from 95 to 50°C and higher peak viscosity compared to native starch. This indicates that the modified starches could be used for pie filling where thickening and stability are required.

The functional properties of cassava starch can be modified using low (0.1-1%) kanwa concentration. Kanwa improved the swelling power, paste clarity and freeze-thaw stability of the starch. In addition, it also reduced the gelatinization time and increased the peak viscosity. A better viscosity on cooling from 95 to 50°C and high set back viscosity were exhibited by the modified starches. These improved properties can be employed in pie filling and some other related applications that require thickening and stability.

Table 2: Brabender Amylograph reading for native and kanwa-modified cassava starches.

Starch treated with:	Pasting Temp. (°C)	Peak viscosity	Viscosity at 95°C	Viscosity at 50°C	Setback viscosity	Time (min)
0.1% kanwa	67	370	220	200	170	23
0.5% kanwa	68	395	160	290	105	22
1% kanwa	68	335	180	200	135	23
0% kanwa (native)	68	195	165	110	85	24

Values are means of duplicate determinations. Viscosity units are BU.

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