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EFFECT OF STEEPING TIME AND LACTIC ACID CONCENTRATION ON EXTRACTION OF STARCH FROM CORN FLOUR

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Abstract – The study was conducted to evaluate the effect of different steeping times (2h, 4 h, and 6 h), steeping temperature (40°C, 45 °C, 50 °C, and 55 °C) and lactic acid concentration (T0=control sample, T1=250µml, T2=350µml, T3=450µml and for T4=550µml) on starch recovery from corn flour. Corn flour was stepped with different lactic acid concentrations (T0=control sample, T1=250µml, T2=350µml, T3=450µml, and T4=550µml) and fixed SO_2 (0.2 g for all samples) over the different steeping time (2h, 4 h, and 6 h) and different steeping temperature (40 °C, 45 °C, 50 °C and 55 °C). The result showed that the maximum yield of starch obtained in sample T4 at 55 °C for 6 h of steeping, i.e 32.53%, and minimum amount of starch yield obtained in sample T0 at 40 °C for 2 h of steeping, i.e 19.10%. On the other side maximum amount of fiber yield was obtained in sample T0 at 40 °C for 2 h of steeping, i.e 61.56%, and the minimum amount of fiber yield was obtained in sample T4 at 55 °C for 6 h of steeping, i.e 30.15%.

INTRODUCTION

Corn flour is the basis of several popular fried products. It is a component of several batter and breading systems, and is used in corn and tortilla chips. For corn chips, the cornmeal dough is fried directly as fairly thick scoop-shaped pieces. The thinner tortilla chips are made from cornmeal that has been subject to nixtamalization, an alkali treatment that helps break down hemicelluloses and affects the flavor and nutritional quality of the corn.

Corn protein can form a visco elastic dough, although it is not extensively connected. Corn flour has 9–10% protein, mostly as a series of zein proteins. These relatively low molecular weight proteins have a fair amount of µ-helical and β-sheet secondary structure. They do not have the long polymeric structure found in wheat glutenins Working the masa dough is thought to begin unfolding the protein, allowing hydrogen bonding and hydrophobic bonding to occur amongst adjacent molecules. Studies also indicate that disulfide links, or other covalent bonding, is not likely in formation of the zein network. The properties of zein are more closely related to wheat gliadins, as they are both prolamins. The Tg for anhydrous zein was calculated to be 139 °C, lower than that found for wheat proteins (Kokini *et al.*, 1994). Zein is plasticized by the addition of water, with an 80 °C drop in Tg over 0–6% moisture content (Madeka and Kokini, 1996).

In India, corn is the most significant crop. Corn is used for human and animal feed based on its diversity and quality. The goal is to use corn flour, which could contain waste or low-quality maize, to extract corn starch. Corn has a highly useful quality called starch. Carbohydrates make up the majority of corn starch. It has no flavour when it isn't baked or fried. When no extra colour changes or flavour additives are necessary, it is a great thickening ingredient for baked goods or soup preparation because it appears clear and doesn't seem to alter colour. The study thus concentrated on the extraction of starch from maize flour and its application in a food product with added value. Several foods use corn flour as a base.

MATERIALS AND METHODS

The research work was conducted in the Department of Processing and Food Engineering,

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The required chemicals were lactic acid and sulfur dioxide. Corn flour was purchased from the local market of Prayagraj. Then filled the 100 g corn flour in a 500 ml conical flask with different concentrations of lactic acid (T0= Control Sample, T1= 250 l, T2= 350 l, T3=450 l, and T4= 550µml), a fixed amount of sulfur dioxide (0.2 g for all samples) and add 400 ml of water for all samples. After completion of this, the conical flask was kept for steeping for different times (2 hrs, 4hrs, and 6 hrs) in a water bath at different temperatures (40 °C, 45 °C, 50 °C and 55 °C). After an interval of every 2h, 4h, and 6 h conical flask was kept out from the water bath for starch separation. Then we used different sizes of sieve for starch separation. The sieve arrangement was 85 µ, 63 µ, and 53 µ from upper to lower. The Fiber was collected after the first and second stages of sieving. After the third stage of sieving, starch was collected. Finally, starch settled down on the container, and the water was removed. Wet starch was collected for drying at 50 °C Then finally starch was grinded and sieved.

RESULTS AND DISCUSSION

Studies were based on the effect of steeping time (2 h, 4h and 6h) and lactic acid concentration (T0= Control Sample, T1= 250 l, T2= 350µml, T3=450µml, and T4= 550µml) on starch recovery at different temperature (40 °C, 45 °C, 50 °C and 55 °C). Graphs have been prepared for each parameter. The results were reported under the following heads.

Effect of Steeping Time and Lactic Acid Concentration on Starch Recovery at 40 °C

From Figure 1 the maximum amount of starch and minimum amount of fiber was recovered in the T4 sample for 6 h of steeping, i.e. 27.90%, and 39.23%, and the minimum amount of starch and maximum of fiber was recovered in the T0 sample for 2 h of steeping, i.e 19.10%, and 61.56%.

Effect of Steeping Time and Lactic Acid Concentration on Starch Recovery at 45 °C

From Figure 2 the maximum amount of starch and minimum amount of fiber was recovered in the T4 sample for 6 h of steeping, i.e. 29.81%, and 32.13%, and the minimum amount of starch and maximum of fiber was recovered in the T0 sample for 2 h of steeping, i.e. 19.51%, and 45.92%.

Effect of Steeping Time and Lactic Acid Concentration on Starch Recovery at 50 °C

From Figure 3 the maximum amount of starch and minimum amount of fiber was recovered in the T4 sample for 6 h of steeping, i.e. 31.20%, and 30.44%, and the minimum amount of starch and maximum of fiber was recovered in the T0 sample for 2 h of steeping, i.e. 21.09%, and 41.84%.

Effect of Steeping Time and Lactic Acid Concentration on Starch Recovery at 55 °C

From Figure 4 the maximum amount of starch and minimum amount of fiber was recovered in the T4 sample for 6 h of steeping, i.e. 32.53%, and 30.15%, and the minimum amount of starch and maximum of fiber was recovered in the T0 sample for 2 h of steeping, i.e 23.82%, and 41.59%.

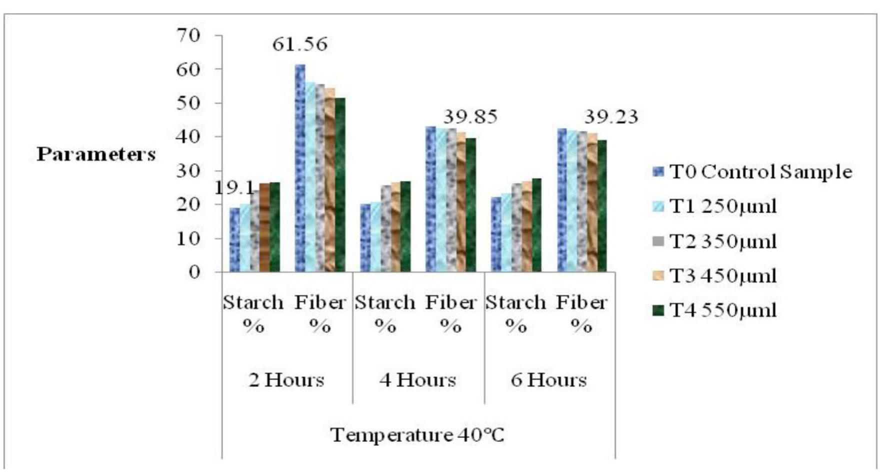

Fig. 1. Effect of steeping time and Lactic Acid Concentration on Starch Recovery at 40 °C

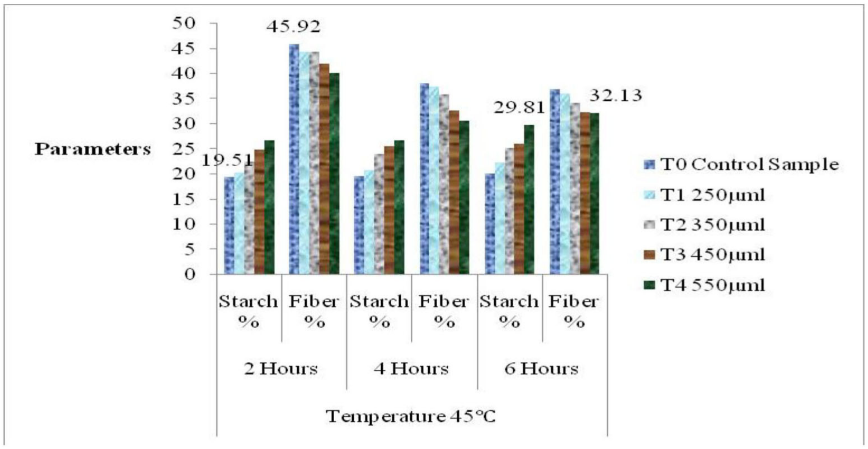

Fig. 2. Effect of steeping time and Lactic Acid Concentration on Starch Recovery at 45 °C

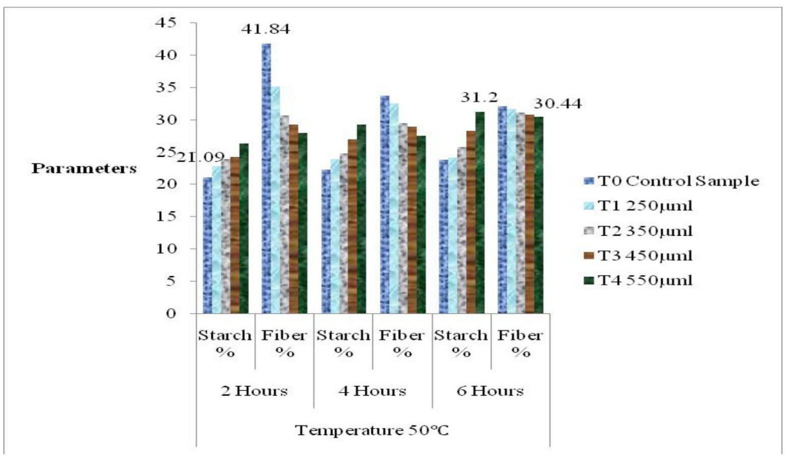

Fig. 3. Effect of steeping time and Lactic Acid Concentration on Starch Recovery at 50 °C

From Figure 1, 2, 3 and 4 it was observed that starch yields were increased when the amount of lactic acid, steeping time, and the temperature was increased in the corn flour sample, while fiber was decreased as the amount of lactic acid, steeping time and temperature increases.

Time of steeping improves starch isolation from those corn samples steeped in sulfur dioxide alone and sulfur dioxide + lactic acid. Corn grains steeped in sulfur dioxide mixed with lactic acid gave much higher starch yields than those corn kernels steeped in sulfur dioxide alone. The highest starch yields obtained from corn kernels steeped in sulfur dioxide alone were less than those for 8 h of steeping when lactic acid was present in steep water. It is also noted that time has a beneficial effect on starch yield when lactic acid is present in steep water, even for the longest steeping time investigated (Perez *et al.*, 2001).

The beneficial effect of lactic acid in steep water is usually attributed to the action of this chemical on the cell walls of corn endosperm (Roushdi *et al.*, 1981). Lactic acid also enhances sulfur dioxide absorption within kernels, facilitating the dispersing effect on the matrix in which starch granules lie embedded (Shandera *et al.*, 1995). The increase in the total amount of solids leached, when lactic acid was present in the steep water would corroborate the increase in the proteolytic activity resulting from the action of that chemical. The main contribution to the increase of leached solids was due to increased solubility of protein because of the lactic acid treatment (Perez *et al.*, 2000).

(Oliever *et al.*, 2000) found that starch yield increased with adding lactic acid to corn steep liquor, which made many potholes on the cell wall to accelerate the absorption of water in Maize endosperm, promoting the separation of starch and protein. Singh *et al.*, (1999) also found that when

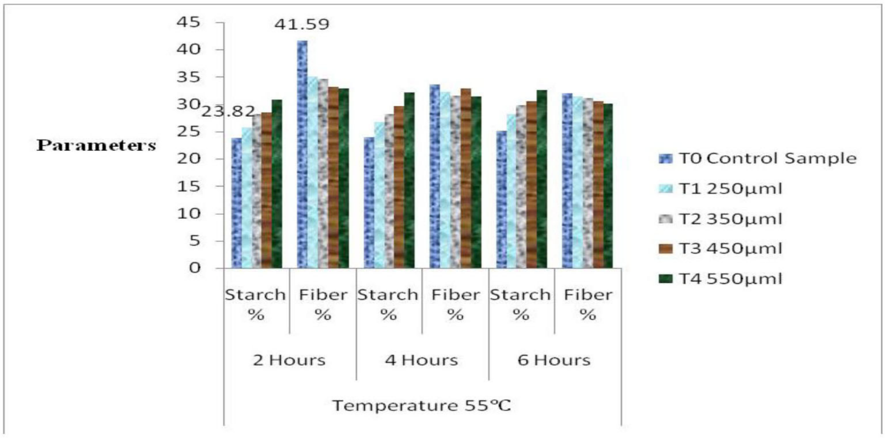

Fig. 4. Effect of steeping time and Lactic Acid Concentration on Starch Recovery at 55 °C

lactic acid and sulfurous acid were simultaneously added to corn steep liquor, the starch yield was higher than sulfurous acid immersion alone and the separation of starch was also much easier, and the protein content of the starch was reduced. Thus it can be seen that the key to starch extraction was breaking the combination between gluten and starch.

So, we obtained maximum starch yields in the T4 sample which was steeped at 55 °C for 6 h, i.e 32.53%, which was maximum than other treated corn flour samples. When the concentration of lactic acid is higher, the potential hydrogen value will be smaller. During the time of steeping lactic acid weakens the hydrogen bonds of starch which causes starch molecular weight to be lower and the structure becomes tenuous and soft. Starch with lower molecular weight was mostly amylose. The longer the reaction with lactic acid the hydrogen bonds in starch becomes weak so that the bonds between water molecules with various other components in the material are easily broken. So lactic acid breaks down the protein matrix of corn flour and helps in the better separation of starch.

CONCLUSION

The result showed under the action of different concentrations of lactic acid, the measured value of extracted starch in corn flour was increased and was highest than in the control sample, with the extension of the steeping time, temperature, and increase of lactic acid concentration. So we concluded that the maximum amount of starch was obtained in the T4 (lactic acid 550 l) sample which was stepped at 55µ for 6 h and the minimum amount of starch was obtained in T0 (control) sample which was stepped at 40! for 2 h.

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