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# FORMATION OF FURFURAL FROM 'SARKANDA' (*Saccharum munja*)

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## ABSTRACT

The present investigations were carried out to study the effect of various concentrations of hydrochloric acid at different time periods on the yield of furfural from 'Sarkanda'. The maximum yield (8.89%) was obtained when the material was digested with 12 percent hydrochloric acid at 100 ± 1°C for a period of 150 minutes. A considerable increase in the yield of furfural (from 8.89 to 23.09%) was also observed when aluminium chloride was used as the catalyst at optimum conditions.

## INTRODUCTION

A great deal of interest has been manifested in the utilization of agricultural wastes and vegetative materials for the production of furfural, a chemical of industrial importance. For such studies, corn cobs, bagasse, rice husk, wheat straw and cotton sticks have been used in the past. In recent communications, DHABB (Chughtai *et al.*, 1985) and KAI (Chughtai *et al.*, 1986) have been reported as good sources of furfural. In continuation, the present study was undertaken to extract furfural from other suitable indigenous material, SARKANDA, one of the most abundantly available self growing swampy plants, was selected for this study. The findings of these investigations are reported in this paper.

## MATERIALS AND METHODS

Preparation of sample: SARKANDA was collected from canal banks of the University fields. It was washed with water, chopped to 2 cm pieces and sun dried for fifteen days. Sun dried material was again dried to a constant weight in an electric oven at 105°C and ground to mesh of 0.78 mm. It was then stored in a desiccator as a stock sample.

Digestion and distillation: Stock sample (10g) was digested at 100 ± 1°C by refluxing the substrate with 8,10,12,15 and 18 percent v/v hydrochloric acid for a period of 60,90,120,150 and 180 minutes keeping solid liquid ratio 1:10, The digested material was then distilled and the distillate was liquid till it gave a negative test with aniline acetate.

Estimation and separation of furfural: The distillate obtained was neutralized with sodium hydroxide using phenolpbthalein as an indicator. Estimation and separation of furfural form the distillate was made according to the method described by Chughtai *et al.* (1985).

Identification of the separated furfural: Some characteristic propetties like colour, odour, boiling point and refractive index of the separated furfural were noted and compared with standard sample. For further verification a derivative, furfural phenyl hydrazone, was prepared by treating the isolated furfural with phenyl hydrazine in glacial acetic acid and its melting point was compared with that of the standard compound.

## RESULTS AND DISCUSSION

The results (means of three replicate experiments) pertaining to the effect of various concentrations of hydrochloric acid and digestion periods at 100 ± 1°C on the yield of furfural are presented in Table 1.

Table 1. *Average percentage yield of furfural at various acid concentrations and digetion sperlod.*

| Digestion time in minutes | Acid concentration (% v/v) | | | | |
|---|---|---|---|---|---|
| | 8 | 10 | 12 | 15 | 18 |
| 60 | 3.27 | 3.76 | 4.78 | 6.97 | 6.45 |
| 90 | 3.97 | 5.22 | 6.27 | 7.20 | 6.62 |
| 120 | 4.00 | 6.70 | 8.66 | 8.06 | 7.82 |
| 150 | 6.27 | 8.33 | 8.98 | 7.74 | 7.51 |
| 180 | 3.42 | 4.90 | 6.26 | 6.25 | 6.09 |

A perusal of the data revealed that the highest yield (8.98%) of furfural was obtained at 12 percent hydrochloric acid and 150 minutes digestion time, whereas it was the lowest (3.27 %) with 8 percent hydrochloric acid at

digestion period of 60 minutes. Similar results have been reported by Utomo (1973) who obtained 16.3 percent, the highest yield, of furfural from bagasse using 12 percent sulphuric acid, solid liquid ratio 1:9 and digestion time 3.5 hours. Considering the effect of acid concentration, it is evident from the data that yield of furfural gradually increased with increasing acid concentration but beyond 15 percent acid concentration it started decreasing. These results are in accordance with the findings of Khundar and Islam (1960) who reported that an increase in acid concentration (within limits) caused an increase in the yield of furfural. Low percentage at low acid concentration could be due to incomplete hydrolysis of pentosans into pentoses, while low yield at high acid concentration could be attributed to the destructive effect of concentrated acid on furfural formation.

Keeping in view the effect of digestion time, it is seen that the yield first increased with increasing digestion period upto 150 minutes which thereafter decreased. These observations are in agreement with those of Sharma and Sahgal (1983) who reported that concentration of furfural increased initially with time and then decreased after reaching a maximum value. Low percentage yield at 60 and 90 minutes digestion time could be accounted for slow process of formation af furfural from pentoses in the initial stage. However, beyond 150 minutes polymerization and decomposition of the chemical is started resulting in a decrease in its yield.

Catalytic effect of aluminium chloride in various concentrations of 0.25, 0.5, 1 and 2 percent was also studied on the yield of furfural at optimal conditions of 12 percent acid and 150 minutes digestion time. The data thus obtained (Table 2) revealed that 1 percent aluminium chloride increased the yield from 8.98 to 23.09 percent. This optimum yield is comparable with the highest yield of furfural (23.09 percent) obtained so far from corn cobs measured by A.O. A.C. method (1975).

Recovery of furfural was about 55.5 percent. Recovered furfural was a colourless oily liquid which boild at 161-162°C with refractive index of 1.528 at $25^{6}$ (lit. 1.521 at 25°C)

## CONCLUSION

'Sarkanda' is a potential source of furfural and may be used in place of corn for the extraction of furfural

Table 2. *Catalytic effect of aluminium chloride on the maximum yield of furfural at optimum conditions of 12 percent (v/v) acid and 150 minutes digestion time*

| Percentage of aluminium chloride used | Percentage yield of furfural |
|---|---|
| 0.00 | 8.98 |
| 0.25 | 12.89 |
| 0.50 | 16.73 |
| 1.00 | 23.09 |
| 2.00 | 18.36 |

## REFERENCES


A.O.A.C. 1975. Official Methods of Analysis of the Association of Official Analytical Chemists. Washington 4-D.C., USA.

Chughtai, F.A.,M.A. Rashid, A.A. Chattha and A. Hussain. 1986. Preparation of furfural from Kai (Saccharum spontaneum). Pak. Jour. Agri. Sci. 23 (1) : 1-4.

Chughtai, F.A., M. Nazir, A.S. Hashmi, A. Hussain. 1985. Utilization of agricultural wastes and vegetative materials for the production of furfural-II. Production of furfural from Dhabb (*Typha angustata*). Sarhad Jour. of Agri. 1(2) : 417-422.

Khundar, M. H. and M. A. Islam. 1960. Recovery of furfural from jute stalk. J. Sci. Res. 12 (3) : 97.

Sharma, D. K. and P. N. Sahgal. 1983. Elevated temperature hydrolysis of rice husks with pressurized water in a semibatch process. Cellul. Chem. Technol. 17 (6) : 655-658 (Chem. Abst., 101 (4) : 26175, 1984).

Utomo, T. 1973. Manufacture of furfural from Indonesian industrial wastes, Res. Jour. Higher Educ. Indonesia, 3(1) : 20-30. (Chem. Abst., 80 (6) : 28720, 1974).