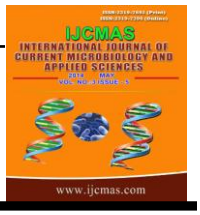
International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 3 Number 5 (2014) pp. 1038-1044**
http://www.ijcmas.com



Original Research Article

Study on moisture content of substrate (Sesamum oil cake and Rice chaff) on the yield of Citric acid

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Keywords

Aspergillus niger, Citric acid, Sesamum oil cake, Rice chaff, Initial moisture, Solid state fermentation.

A B S T R A C T

The maximum yield 82.6g/Kg in sesamum oil cake and 95.8g/kg was obtained with the increase in initial moisture contents of both the substrates up to 55% and up to 72 hours of fermentation period. The yield was decreased with increase in initial moisture content and duration of fermentation. A solid state fermentation method was carried out for the production of citric acid from sesamum oil cake and rice chaff by *Aspergillus niger* ATCC 9142 as control and ETGP 12 and ETGP18 isolated locally. Fermentation was carried out with the substrate moisture content, 9.3% (sesamum oil cake) and 2.3% (rice chaff), Poor yield was obtained.

Introduction

The sesamum oil cake and rice chaff produced as agricultural wastes, which are abundantly available in Shimoga region. They contain carbohydrates, lignin and fermentable sugars. For maximum production of citric acid initial moisture of the substrate plays a vital role. In this study efforts are made to know the effect of initial moisture content of substrate on the yield of citric acid by using sesamum oil cake and rice chaff with three strains of *A.niger* on solid state fermentation.

Citric acid is one of the largest fermentation products which is widely used in the food processing, beverage, cosmetic, pharmaceutical, chemical, textile and electroplating industry (Tran *et al* 1998) and bioremediation of heavy metal contaminated soil . The demand of citric acid is increasing from 4-5% every year (Vandenberghe *et al* 2000) that can only be met economically by using less expensive and renewable agro industrial residues as raw materials through solid state fermentation with *Aspergillus niger*.

Materials and Methods

Substrates (40 g) were taken separately and dried at 60°C for 6 hours, cooled and weighed until the constant weight was obtained. Then various conditions of substrate moisture were adjusted to 30, 35, 40, 45, 50, 55, 60, 65, 70 and 75% by the addition of required quantity of distilled water (Hang & Woodams 1986; Sreekanta 1991; Kamini *et al* 1998) and autoclave

sterilized at 121° C for 15 minutes. Then the fermentation media in each flask were inoculated with 1ml of inoculum and kept for fermentation for 7 days.

Results and Discussion

The results on the yield of citric acid on sesamum oil cake and rice chaff by different moisture content with ATCC 9142, ETGP 12 and ETGP 18 were represented in Fig.1 and 4 In the case of ATCC 9142, the yield of citric acid increased with the increase in initial moisture content of both the substrates upto 55% and also upto 72 h of fermentation period in both the substrates and thereafter, it decreased with increase in initial moisture content and duration of fermentation (1a to 1g). The highest yield of citric acid was at 55% moisture content and 72 h fermentation period, 82.6 g/kg in sesamum oil cake and 95.8 g/kg in rice chaff, whereas with the same fermentation period the least citric acid yield was observed to be 15.2 g/kg and 27.3 g/kg in the respective substrates in the 75% initial moisture content. In case of *Aspergillus. niger* ETGP12, the citric acid production in sesamum oil cake and rice chaff substrates at 50% moisture content and at 96 h fermentation period, the production of citric acid was found to be 88.6g/kg and 92.2 g/kg, respectively. In case of *A. niger* ETGP18, the citric acid production in sesamum oil cake and rice chaff at 50% moisture content was found to be 82.6 g/kg and 88.2 g/kg respectively during 96 h fermentation period. In each strain, the production of the citric acid was found high in rice chaff than from the sesamum oil cake, while *A. niger* ETGP18 has showed less amounts of citric acid than the ETGP12 strain. As the moisture content was increased to 75%, the reduction in the citric acid production was observed. At this moisture content, *A. niger* ETGP12 has showed 50.8 g/kg and 52.3 g/kg respectively from sesamum oil cake and rice chaff respectively, while *A. niger* ETGP18 has revealed less citric acid production in sesamum oil cake (41.9 g/kg) and high in rice chaff (51.2 g/kg).

Sugar conversion efficiency of all the strains showed similar trend in the production of the citric acid. The standard strain *A. niger* ATCC 9142 has converted 61.3 and 64.5% of the sugars from sesamum oil cake and rice chaff respectively. The sugar conversion of *A. niger* ETGP12 was observed to be 62.8 and 63.8% and ETGP18 was 59.9 and 62.8% from sesamum oil cake and rice chaff respectively.

Fig.1 Production of Citric Acid at Various Moisture Grades Using Sesamum Oil Cake as the Substrate Using Atcc9142 Strain

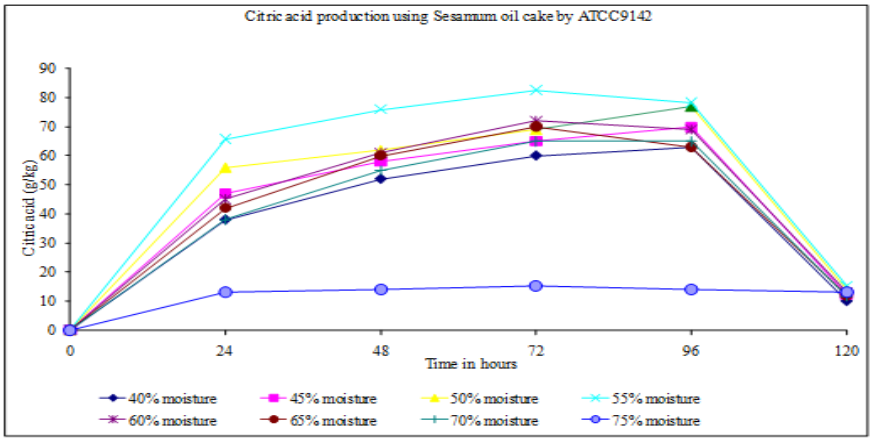


Fig.2 Production of Citric Acid at Various Moisture Grades Using Sesamum Oil Cake as the Substrate

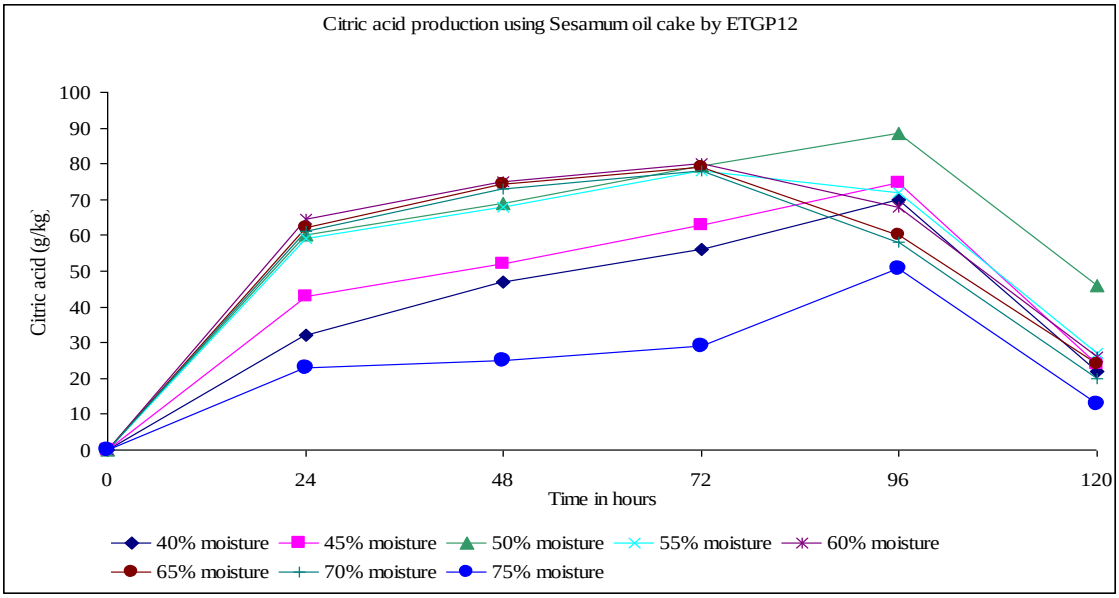


Fig.3 Production of Citric Acid at Various Moisture Grades Using Sesamum Oil Cake as the Substrate Using Etgp18 Strain

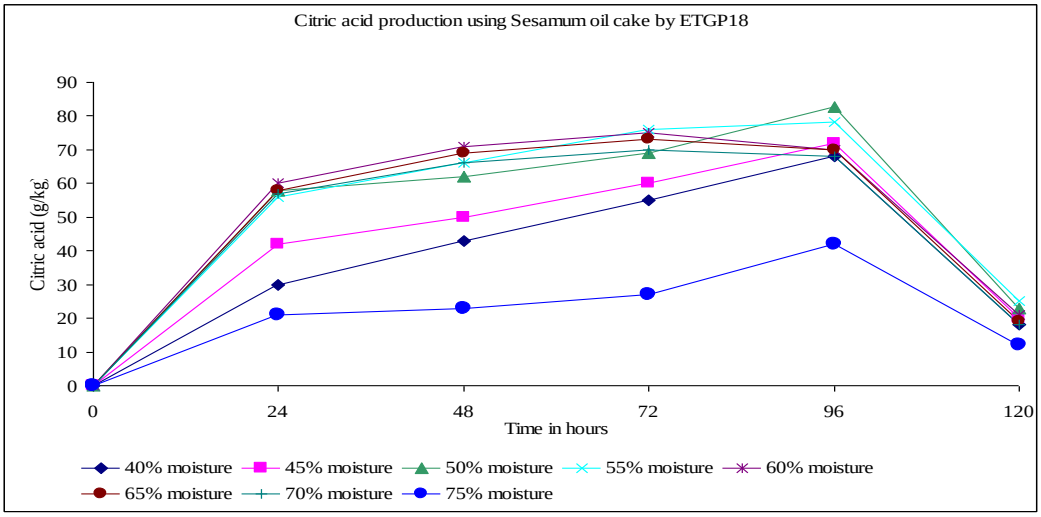


Fig.4 Production of Citric Acid at Various Moisture Grades Using Rice Chaff as the Substrate Using Atcc9142 Strain

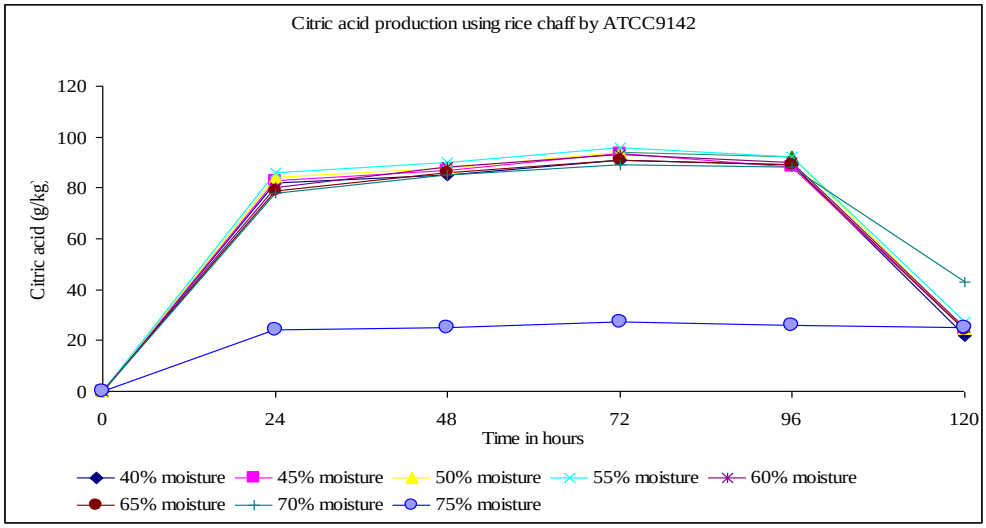


Fig.5 Production of Citric Acid at Various Moisture Grades Using Rice Chaff as the Substrate Using Etgp12 Strain

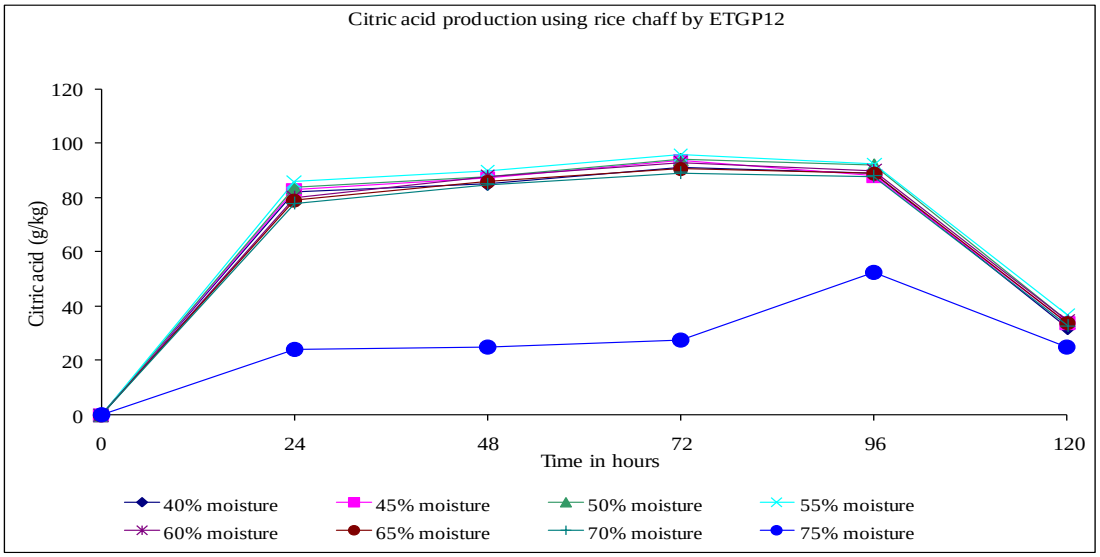


Fig.6 Production of Citric Acid at Various Moisture Grades Using Sesamum Oil Cake as the Substrate Using Etgp18 Strain

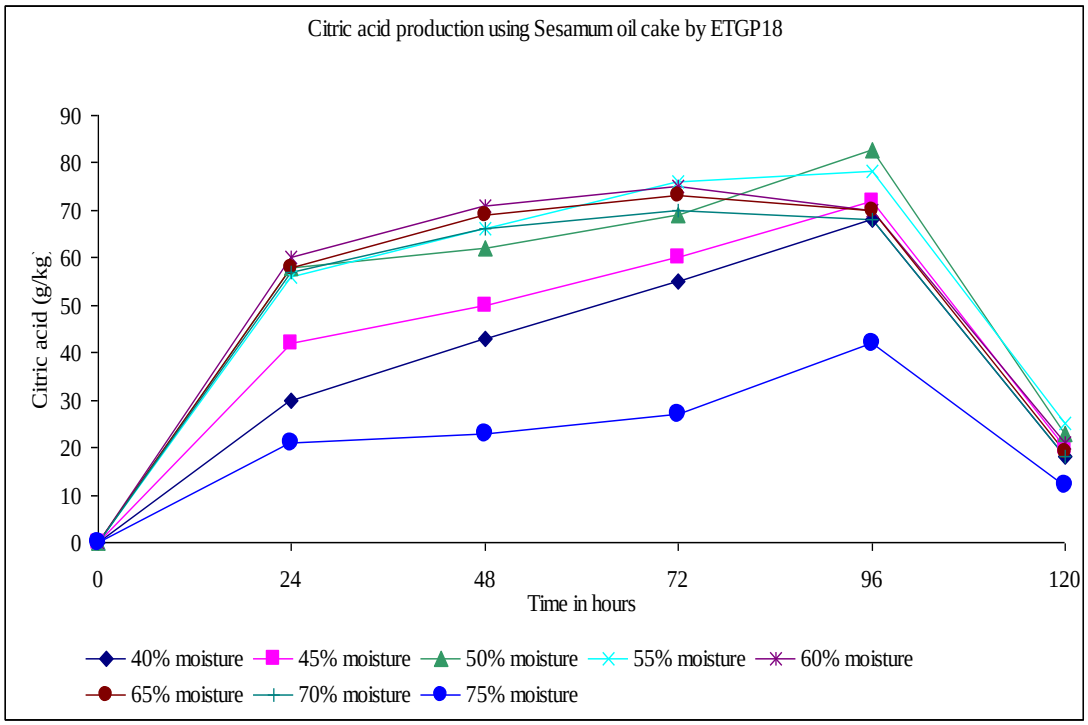
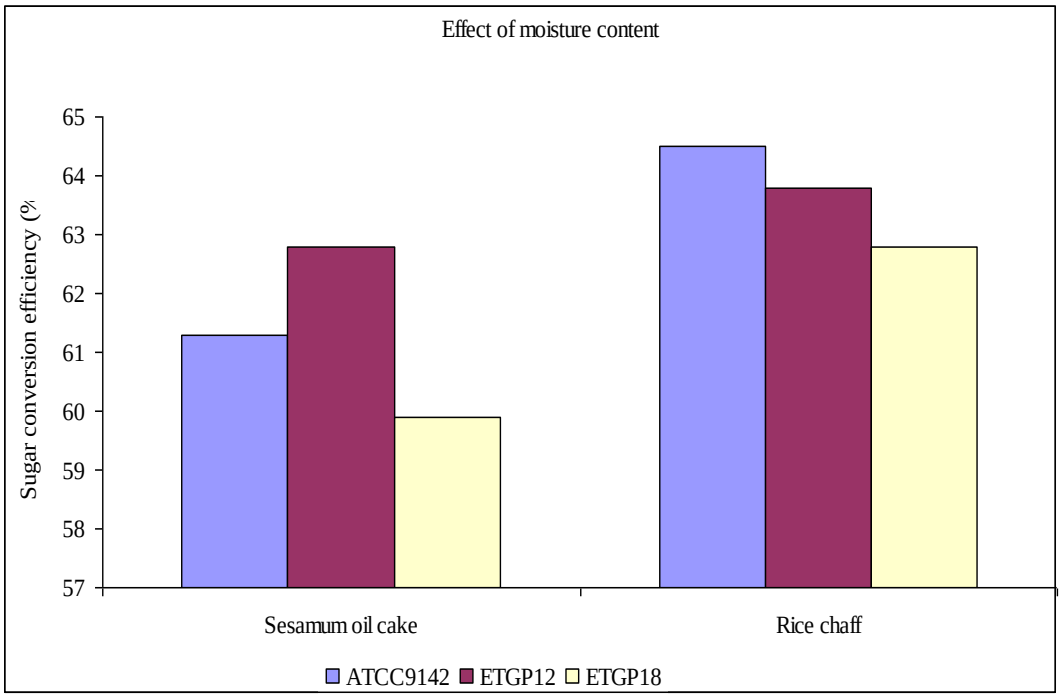


Fig.7 The Moisture Content at Which the Sugar Conversion Efficiency Observed for Standard and Experimental Fungal Strains in the Substrates



The substrate moisture level is one of the key factors greatly influencing the outcome of solid state fermentation. Generally, the initial moisture content is ranges from 30-80% in the solid state fermentation (Lonsane *et al* 1985, Oriol *et al* 1988). High moisture level of substrate leads to decreased porosity, lower oxygen diffusion, increased risk of bacterial contamination, enhanced aerial mycelium formation, decreased gaseous exchange in the rate of degradation of lignin (Schanel & Rypacek 1958 Silman *et al* 1979, Zadrazil & Burnnet, 1981). Low moisture level cause sub optimal growth, a lower degree of substrates swelling and higher water tension (Silman *et al* 1979).

The results on the yield of citric acid on sesamum oil cake and rice chaff by different moisture content with ATCC 9142, ETGP 12 and ETGP 18 is noted . In case of ATCC 9142, the yield of citric acid increased with the increase in initial moisture content of both the substrates upto 55% and also upto 72 h of fermentation period in both the substrates and thereafter, it decreased with increase in initial moisture content and duration of fermentation. The highest yield of citric acid was at 55% moisture content and 72 h fermentation period, 82.6 g/kg in sesamum oil cake and 95.8 g/kg in rice chaff, whereas with the same fermentation period the least citric acid yield was observed to be 15.2 g/kg and 27.3 g/kg in the respective substrates in the 75% initial moisture content. In case of *A. niger* ETGP12, the citric acid production in sesamum oil cake and rice chaff substrates at 50% moisture content and at 96 hr fermentation period, the production of citric acid was found to be 88.6g/kg and 92.2 g/kg respectively. In the case of *A. niger* ETGP18, the citric acid production in sesamum oil cake and rice chaff at 50% moisture content was found to be 82.6 g/kg and 88.2 g/kg respectively during 96 hr fermentation period. In each strain, the production of the citric acid was found high with rice chaff than from the sesamum oil cake, while *A. niger* ETGP18 has showed less amounts of citric acid than the ETGP12 strain. As the moisture content was increased to 75%, the reduction in the citric acid production was observed. At this moisture content, *A. niger* ETGP12 has showed 50.8 g/kg and 52.3 g/kg respectively from sesamum oil cake and rice chaff respectively, while *A. niger* ETGP18 has revealed the citric acid production was less in sesamum oil cake (41.9 g/kg) and high in rice chaff (51.2 g/kg). A similar observation has also been made by Lu *et al* (1995).

Sugar conversion efficiency of all the strains showed similar trend in the production of the citric acid. The standard strain *A. niger* ATCC 9142 has converted 61.3 and 64.5% of the sugars from sesamum oil cake and rice chaff respectively. The sugar conversion of *A. niger* ETGP12 was observed to be 62.8 and 63.8% and ETGP18 was 59.9 and 62.8% from sesamum oil cake and rice chaff respectively. Observations also reveal that rice chaff is a better substrate than sesamum oil cake for producing citric acid employing both the strains of *A. niger* under study. This may be due to the fact that, rice chaff has higher levels of carbohydrates, metal ions, proteins and fats.

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