SEPARATION AND DRYING OF SLURRY FROM SWEET POTATO FERMENTATION

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Introduction

Sweet potato is an interesting possibility for ethanol production due to its high starch content and favorable agronomic characteristics. Fermentations with sweet potatoes have the peculiarity of forming a high amount of residual slurry, which is formed mainly by pectic substances, but also by cellulose and hemicellulose. The high viscosity caused by these polysaccharides is a problem during fermentation, thus enzymes have been employed to disintegrate them. Using a pectinase in a sweet potato broth Schweinberger (2016) reduced the medium viscosity by 81 %. Although the solids degradation was notable when the wine was filtered 43 % of the mass was retained in the slurry. Therefore, this is an opportunity that can be harnessed in the production of value-added food.

Sweet potatoes have a low-fat content and more than 90 % of the carbohydrates are converted into ethanol. Thus the major nutrients left in the slurry are fibers and proteins (from both sweet potatoes and yeast). Emphasizing that fiber + protein combination is interesting for the low-calorie food market. Considering this scenario, the study presented here consists the continuity of the research developed by Schweinberger (2016), now with the focus upon flours production with the slurry, instead of ethanol production.

The goal of this work is slurry drying and its yields. Therefore, fermentations were carried out, the slurry separated and thus dried with three drying methods: **hot air** , **freeze-drying** and **microwave oven**.

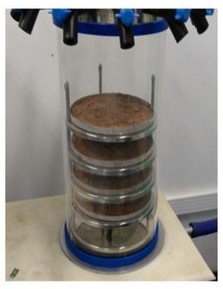
Materials and Methods

Orange-fleshed sweet potato → Preheated to 76°C, Shape: Cubes → SVHF in orbital agitation

SVHF (Simultaneous Viscosity reduction, Hydrolysis, and Fermentation)			
Conditions:			
Time (h)	19	Enzyme for hydrolysis (µL/g): Stargen 002 (Du Pont)	1.0
Temperature (°C)	34	Enzyme for pectic substances degradation (µL/g): Pectinex Ultra AFP (Novozymes)	0.1
pH	4	Yeast (mg/g)	3.33
Mass of substrate (g)	200	Doxycycline (mg/g)	0.28
Agitation speed (rpm)	175		

Hot air drying at 60°C

Microwave drying with rotary drum (speed = 60 rpm)



Freeze-drying (LS 6000 Torroni)

- After fermentation, the broth was centrifuged at 3600 rpm for 5 minutes.
- The slurry and fermented liquid were separately weighted to quantify the yield.
- Ethanol and sugars determination was carried out by HPLC, with Hi-Plex H Agilent column.
- The separated slurry was dried by three different drying methods: hot air , freeze-drying and microwave.
- The analysis of the ashes was done through the traditional method, the flour was placed in a muffle at 500 degrees Celsius for 8 hours.
- The lipids were extracted from the flour using a Soxhlet extractor, then the solvent was removed through the use of Rotary Evaporator and soon after the extract was dried in oven at 105 ° C.
- The flour was submitted through Kjeldahl digestion to quantify the proteins in the sample.

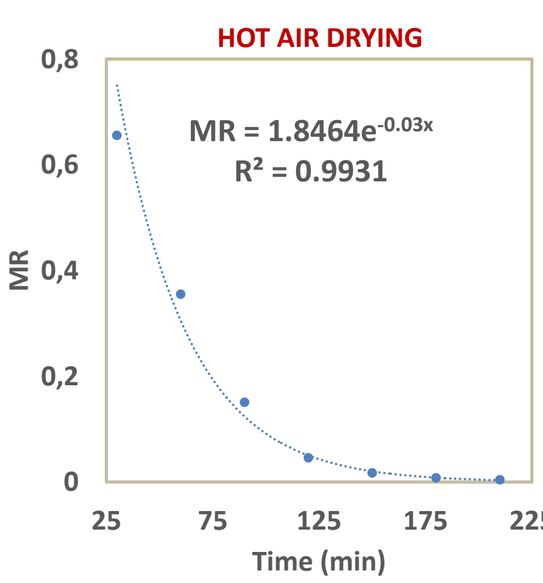
The moisture relation (*MR*) was the assumed variable for the kinetic drying curves construction:

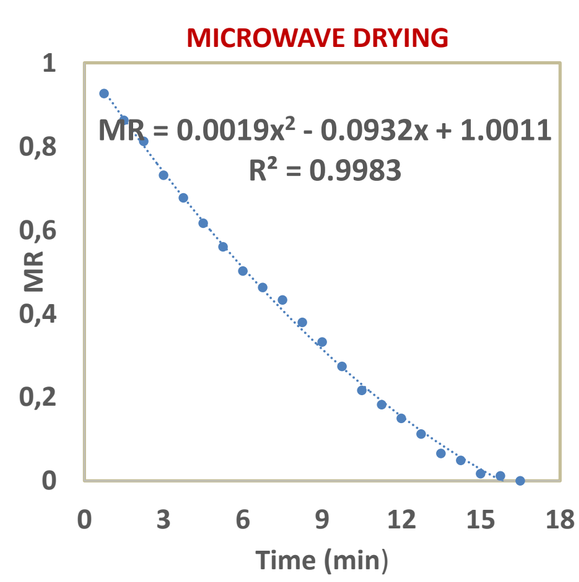
$$MR = \frac{X_t - X_e}{X_o - X_e}$$

where
Xt - moisture at any instant of time
Xe - equilibrium moisture
Xo - initial moisture

Results and discussion

Sweet Potato	
Moisture content (%)	83.3
Total Reducing Sugars (%)	17.18
Ethanol calculated % (v/v)	6.91
Ethanol experimental % (v/v)	4.19
Fermentative efficiency (%)	61
Residual glucose content (g/L)	0.01
Slurry	
Moisture content (%)	87.43





FLOURS	Hot Air Drying	Microwave Drying	Freeze-Drying
Ashes [%]	9,31 ±0,15	9,22 ±0,14	8,59 ±0,18
Proteins [%]	12,30 ±0,19	11,62 ±0,25	11,70 ±0,04
Lipids [%]	3,73 ±0,25	4,29 ±0,36	4,10 ±0,35
β-Carotene [µg/g]	501,4 ±100,76	756,0 ±66,0	663,2 ±56,6
Lycopene [µg/g]	305,4 ±43,67	488,0 ±20,15	401,9 ±12,46

* Dry Base

- Slurry: **26 %** of the fermented mass. This value is lower than the value quantified by Schweinberger (2016), 43 %. A reason that can be assigned to this difference is that the sweet potato used by Schweinberger (2016) had a higher solids content (75 – 77 % of moisture), which increases the susceptibility to the slurry formation. The employment of the enzyme Pectinex Ultra AFP is another factor related to the amount of slurry formed, but verifying its effect was not an objective of this study.
- All samples were analyzed at least in triplicate.
- Analysis of starch and fibers still in progress, but the results so far are satisfactory, the flour has high levels of carotenoids regardless of the drying method, other parameters as texture and visual characterization are expected to be carried out until the end of the project.

References: Schweinberger, CM. 2016. Inovação e Otimização no Processo de Produção de Etanol a Partir de Batata-doce, Ph.D. Thesis in Chemical Engineering, Federal University of Rio Grande do Sul (UFRGS). Porto Alegre.