PREPARATION OF YEAST DERIVATIVES FROM ALCOHOL DISTILLERY YEAST (*SACCHAROMYCES SP*) FOR USE AS MEAT PRODUCT INGREDIENT

YAMADA, E.A.[1]; ALVIM, I.D.[2].; SANTUCCI, M.C.C.[1].; SGARBIERI, V.C.[2]

[1] Centro de Tecnologia de Carnes, ITAL, Campinas, São Paulo, Brasil. E-mail: eyamada@ital.sp.gov.br
[2] Faculdade de Engenharia de Alimentos, Universidade Estadual de Campinas, Campinas, São Paulo, Brasil

Key words: Autolysate, extract, protein concentrate, yeast

Background

Brazil is worldwide one of the greatest producer of alcohol from sugar cane, with a production of 12 billion liters of anhydrous and hidrated alcohol in 1999/00 (IEE, 2002) and use yeast in the transformation of sugar to alcohol. Normally, part of the yeast is withdrawn (about 20%) in each new cicle of fermentation, generating 240,000 ton of dry yeast anually which is used basically in animal feeding. Aiming at better use of this yeast and reducing environment polution, studies have been carried out for extraction and recovering of yeast protein (SALGADO & SARRUGE, 1976; BENASSI *et al.*, 1996). The use of whole yeast in food processing is limited by the dried yeast off flavors (HALÁSZ & LÁSZTITY, 1991). Autolysis and fractionation yield derivatives as yeast autolysate, the extract (autolysate soluble fraction) and protein concentrate that can be added to foods.

Objective

The purpose of this work was to obtain yeast derivatives from alcohol distillery for use as meat product ingredient.

Material and Methods

The washed and dried whole yeast water suspension (10%w/w) added by 15% pre-autolysed yeast, 7% ethanol and 2% NaCl was adjusted to pH 5.5, mantained at 55ºC during 24h in 250L New Brunswick – IF250 fermentor. The autolysis was stopped by heating 85ºC/15 min and spray dried (Niro Atomizer CB3 104D) obtaining the autolisate (AUT). Part of autolisate was centrifuged (3500xg) to obtain the soluble fraction, concentrated under vacuum to achieve 20 to 25% dry matter, added by 25% maltodextrin based on total dry matter and spray dried – the yeast extract (EXT). The phosphorylated protein concentrate was obtained after yeast wall mechanical rupture using a Dyno Mill KDL-PILOT, at 2,400 rev.min^{-1}, 0.6 to 0.9mm diameter glass spheres, occupying 70% of mill chamber volume, 10% yeast suspension, adjusted to pH 9.5 with NaOH, yield 4.8L/h. The ruptured yeast cells suspension was centrifuged (5300xg) and the soluble fraction was adjusted to pH 11.0 with NaOH, and then added by Solutia sodium trimetaphosphate (4% w/w), and kept at 35ºC for 3 h. The phosphorylated protein was precipitated at pH 3.2 , and centrifuged. The precipitate after washing, was resuspended in water, neutralized to pH 7.0 and freeeze dried. Texturized soy protein (TSP) and isolated soy protein (SPI) were commercial products, respectivelly MAXTEN R-100 and SAMPROSOY MP-90 were used for comparison.

Proximate composition – Water content, ash, crude protein (Nx5.8) and soluble and insoluble fibre were determined by AOAC (2000), total lipids by BLIGH & DYER (1959) and ribonucleic acid was determined by HERBERT *et al.*, (1971) procedure.**Viscosity** was carried out in RVA Rapid Visco Analyser, Newport Scientific at 160 rev min^{-1}. **Water holding capacity (WHC)** of protein were determined according to REGENSTEIN *et al.*, (1979), **solubility** of derivatives protein as MORR *et al.* (1985), **emulsifying capacity (EC)** determination as DE KANTEREWICZ *et al.* (1987) procedure, using Ultra-Turrax T-25 (Junkel & Kunkel) homogenizer at 9500 rev min^{-1} and **emulsion stability (ES)** was determined according to methodology of ACTON & SAFLE (1970).

Results and discussion

The yield of yeast derivatives in the pilot plant (d. m. b.) was: 94.5kg of AUT/100kg whole dried yeast; 45.3 kg EXT/100kg dried autolysate. Phosphorylated protein concentrate (PYC) yield was 19.8kg/100kg whole dried yeast (WDY). The WDY and AUT composition is very similar, since in the transformation of yeast to AUT there is no celular material fractionation, only chemical and enzymatic transformations. In general, the composition presented in Table 1 is similar to the literature (SGARBIERI *et al.*, 1999), even though the protein in the WDY, AUT, EXT and PYC from alcohol distillery were lower than brewer's yeast (SGARBIERI *et al.*, 1999; CABALLERO-CÓRDOBA & SGARBIERI, 2000). The high ash content in EXT is due, mainly to the added sodium chloride for the autolysis and concentration processes. The autolysis process provided high solubility (Table 2) to yeast derivatives, independent of pH (3 to 7), higher in the EXT, followed by the AUT. The PYC presented solubility at pH from 5 to 7 that compares to SPI and TSP. The WHC is presented in the Table 3. The EXT viscosity values (Table 4) were the lowest among the derivatives at the concentration and temperature studied. The SPI presented highest viscosity values among the derivatives studied, followed by TSP, PYC, AUT and in the last the EXT. The values of EC (424.6 ± 10.5 and 424.6 ± 10.5 mL oil/g protein) and ES (83.5 ± 5.1 and 73.2 ± 5.1%) respectivelly for PYC and SPI did not differ, while under the used methodology conditions, AUT, EXT and TSP did not form emulsions.

Conclusions

The yeast processing altered the functional properties of each yeast fraction in a different way. The functional properties (solubility, water holding capacity, emulsifying capacity, emulsion stability and viscosity) presented by yeast derivatives can be considered useful ingredients for meat products.

References

ACTON, J.C.; SAFLE, R.L. Stability of oil-water emulsion 1. Effects of surface tension, level of oil, viscosity and type of meat protein. *J. Food Sci*, v. 35, n.9, p. 852-855, 1970. AOAC – Association of Official Analytical Chemists. *Official Methods of Analysis of AOAC International*. 17th ed. Gaithersburg, Maryland, 2000. BENASSI, V.T.; CAMARGO, C.R.O.; CIACCO, C.F. Caracterização química e redução do conteúdo de ácidos nucléicos das células de levedura (Saccharomyces spp) provenientes da produção de álcool de cana. *Ciência Tec.Alim.*, Campinas, v.10, n.2, p.249-260, 1990. BLIGH, E.G. & DYER, W.J. A rapid method of total lipid extraction and purification. *Can. J. Bioch. and Phys.*, v.37, n.7, p.911-917, 1959. CABALLERO-CÓRDOBA, G.M.; SGARBIERI, V.C. Nutritional and toxicological evaluation of yeast (*Saccharomyces cerevisiae*) biomass and a yeast protein concentrate. *J. Sc. Food Agr.*, v.80, n.3, p. 341-351, 2000. DE KANTEREWICZ, R.J.; ELIZALDE, B.E.; PILOSOF,A.M.R.; BARTHOLOMAI, G.B. Water-oil absorption index (WOAI): A simple method for predicting the emulsifying capacity of food proteins. *J. Food Sc.*, v. 52, n.5, p. 1381-1383, 1987. HALÁSZ, A.; LÁSZTITY,R. *Use of yeast biomass in food production*. CRC Press, Boca Raton, 1991, 312p. HERBERT, D.; PHIPPS, P.J.; STRANGE, R.E. Chemical analysis of microbial cells. In: NORRIS, J.R. & RIBBONS, P.W. *Methods in Microbiology*, Academic Press, London, V.5B, 1971, 695p. IEE – INSTITUTO DE ELETROTECNICA E ENERGIA DA

UNIVERSIDADE DE SÃO PAULO. *Cana-de-açúcar no Brasil.* [online]. [extracted in 26.08.02] URL: <http//infoener.iee.usp.br/scripts/biomassa/br_cana.asp> MORR, C.V.; GERMAN, B.; KINSELLA, J.E.; REGENSTEIN, J.M.; VAN BUREN, J.M.; VAN BUREN, J.P.; KILARA, A.; LEWIS, B.A.; MANGINO, M.E. A collaborative study to develop a standardized food protein solubility procedure. *J. Food Sc.*, v.50, n.6, p. 1715-1718, 1985. REGENSTEIN, J.M.; GORIMAR, T.S.; SHERLON, J.W. Measuring the water holding capacity of natural actomyosin from chicken breast muscle in the presence of pyrophosphate and divalent cations. *J. Food Bioch.*, v.3, n.4, p. 205-211, 1979. SALGADO, J.M.; SARRUGE, J.R. Efeito da lavagem sobre a qualidade de concentrado protéico obtido em destilaria de álcool. ***Rev. Brasil. Tecn.***, São Paulo, v.7, p.339-344, 1976. SGARBIERI, V.C.; ALVIM, I.D.; VILELA, E.S.D.; BALDINI, V.L.S.; BRAGAGNOLO, N. Produção piloto de derivados de levedura (*Saccharomyces sp.*) para uso como ingrediente na formulação de alimentos. *Brazilian J. Food Techn.*, Campinas, v.2, n.1,2, p.119-125, 1999.

Acknowledgements

The authors acknowledge the partial financial support for this research by FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo), Brazil and COPERSUCAR (Cooperativa dos Produtores de Açúcar e Álcool)

Table 1. Percent composition (dry matter basis) of whole yeast (WDY), autolisate (AUT), extract (EXT) and phosphorylated protein concentrate (PYC).

Component (%)	WDY	AUT	EXT	PYC
Protein (N x 5,8)*	39.6±0.2^{c}	40.4±0.2^{c}	48.6± 0.6^{b}	62.6±0.8^{a}
Total fat*	0.5±0.1^{c}	1.2±0.1^{b}	0.4±0.1^{c}	8.5±0.2^{a}
Ash*	4.6±0.3^{d}	6.2±0.1^{c}	11.7±0.1^{b}	13.2±0.0^{a}
Total food fibre**	31.4	33.2	3.3	6.0
Insoluble**	1.09	0.98	nd	nc
Soluble**	30.3	32.2	3.3	nc
Ribonucleic acid**	9.0	5.6	8.3	10.4
Others	14.9	13.4	27.7	0.0

nd= not detected ; nc=not carried out
*Means±st deviation (row) with same superscripted letter did not differ (p>0.05)
**Results are the mean of 2 analytical determinations

Table 2: Water solubility (%) of autolisate (AUT), extract (EXT) and phosphorylated protein concentrate (PYC), textured soy protein (TSP) and soy protein isolate (SPI) at 25°C.

	pH			
Derivative	3.0	4.0	5.0	7.0
EXT	88.7±2.4^{aA}	91.1±0.0^{aA}	90.3±1.4^{aA}	91.5±0.7^{aA}
AUT	66.1±2.9^{bA}	66.4±3.0^{bA}	67.4±1.7^{bA}	67.9±1.6^{bA}
PYC	3.1±1.0^{dC}	5.9±0.5^{cB}	8.1±0.5^{cB}	16.2±1.4^{dA}
TSP	4.1±1.8^{dB}	4.1±0.7^{cB}	5.3±1.4^{cdAB}	8.2±1.9^{eA}
SPI	14.9±2.2^{cB}	3.2±0.4^{cC}	2.7±0.4^{dC}	20.7±0.4^{cA}

Means±st deviation with same small superscripted letter (column) did not differ (p> 0.05)
Means±st deviation with same capital superscripted letter (row) did not differ (p> 0.05)

Table 3. Water holding capacity (g water/ g protein) of autolisate (AUT), phosphorylated protein concentrate (PYC), textured soy protein (TSP) and soy protein isolate (SPI).

pH	AUT	PYC	TSP	SPI
5.0	9.0±1.7^{aA}	4.6±0.6^{bB}	7.7±0.7^{aBC}	5.6±0.4^{bC}
6.0	8.0±1.4^{aA}	8.4±1.1^{aA}	9.2±1.2^{aAC}	9.8±1.0^{aB}
7.0	9.7±2.0^{bA}	9.2±0.7^{bA}	10.2±1.6^{bA}	16.8±2.9^{aA}

Means±st deviation with same small superscripted letter (row) did not differ (p> 0.05)
Means±st deviation with same capital superscripted letter (columm) did not differ (p> 0.05)

Table 4. Viscosity (cp x 10^{-2}) of autolisate (AUT), extract (EXT) and phosphorylated protein concentrate (PYC), textured soy protein (TSP) and soy protein isolate (SPI) at 6% suspension

Derivative	25°C	33° C	60°C	70°C	80°C	30° C*
AUT	34.7	25.7	22.0	17.0	18.0	21.7
PYC	44.0	24.0	19.0	17.5	17.0	18.0
EXT	29.5	20.5	15.2	15.0	13.5	15.5
TSP	51.0	31.0	27.0	24.5	25.0	29.0
SPI	134.5	106.0	76.0	51.0	24.0	13.5

Results are means of 2 determinations
*Viscosity at 30°C in the cooling phase after the samples were heated to 80°C