P-035

Encapsulation for Delactozation Purposes

Ciric Al.
ICA Research&Development, Bucharest, Romania
a.ciric@ccai-ro.com

INTRODUCTION AND OBJECTIVES

Human digestive system is using β-galactosidase (also known as lactase) to break the molecule of lactose – the most important sugar in the composition of milk. Lactose is present in concentrations of about 5% in milk and in the whey resulting from the technological process of cheese manufacturing. Its presence restricts milk consumption among the adult population. Generally, it is considered that approximately 70% of the world adult population shows a form of lactose intolerance.

Lactose intolerance is commonly treated in one of several ways. Many lactose intolerant individuals avoid the consumption of milk products, but this is not a rational behavior, because milk is an important food source of calcium. Others prefer to consume milk pre-treated with lactase, product that is commercially available some areas, but whose production costs are relatively high. Another disadvantage that should be taken into consideration is the sweeter taste of glucose resulted from the enzymatic hydrolysis comparing with the taste of lactose. In addition, the product has a more viscous consistency than the untreated milk. A third method to treat lactose intolerance is to ingest lactase-containing tablets shortly before consumption of dairy products. These tablets are available in some pharmacies and they have an undesired social effect. It is therefore obvious the need for developing food ingredients to successfully meet the need of people with lactose intolerance, without changing the taste, appearance or rheology of the milk product and without the need of separately ingesting lactose in different forms (pills, solutions, etc.).

Listed above are the deficiencies of the lactose hydrolysis processes that is currently used, deficiencies that may be avoided, from our point of view, by using microencapsulation techniques. Thus lactase will be entrapped in a substance which will provide it a controlled release in the small intestine, being resistant to digestive juices found in the tract until that moment. The microcapsules obtained through this procedure will be mixed in the milk or in the lactose-containing products offered to the subjects with lactose intolerance. The ingested product will contain lactase, which will be released in the small intestine without affecting the taste or the aspect of the original product. This actually implies that the technology of producing the microcapsules is conducted so that their size results below the perception limit of human tongue.

The experimental part presented bellow is part of the preliminary work made for this research. The main objective

of this part was selecting at least two different methods, from the methods described in the recent bibliography, methods that suit both our scope and the equipment existing in the lab/pilot station.

MATERIALS AND METHODS

The trials were carried out using three different atomization units, each different unit having a different type of atomization nozzle. The first equipment used was a Buchi B 290, having a two fluid stationary nozzle. The second was a macro-pilot Niro spay-dryer with a centrifugal nozzle, and the third was a SonoDry 750, unit using an ultrasonic nozzle.

Two types of galactosidase were used: β-galactosidase from *Aspergillus oryzae* (Sigma) and Lactozyme 2600 L (Sigma-Novozyme). Both enzymes were brought in solution to an activity of 10 units/ml.

As recommended in literature (Branchu 1999, Broadhead 1994), we started our tests with drying galactosidase on two different stabilized support-materials: (2-hydroxypropyl)-β-cyclodextrin (Sigma) – sucrose (Sigma) and trehalose (Sigma). Additionally was added sodium alginate (scienTest) (for stabilizing the capsules) and maltodextrins (scienTest). The two formulas obtained were:

- enzyme solution, 2% alginate, 2% maltodextrin, 1% (2-hydroxypropyl)-β-cyclodextrin and 1% sucrose
- enzyme solution, 2% alginate, 4% maltodextrin, 10% trehalose

For the two formulas, different temperatures were applied during the spray-drying process for all three atomization units. The first formula was dried at inlet temperature of 190±5°C and outlet temperature of 60±5°C and the second at 140±5°C (inlet) and 60±5°C (outlet).

All the products obtained were checked for water content, particle size (medium diameter) and loss of enzymatic activity during process.

Three different batches were made for each trial. All the analyses were made in double. The values represent the medium value of the three batches.

RESULTS AND DISCUSSION

Buchi B290

The results obtained could be considered the best results among our trials. The advantages came mainly from the easiness of operating the device. A good control of temperatures and of the flow (4 ml/min) was possible and, as result, a good particle size with a narrow distribution was achieved. The loss in enzymatic activity was also very low for some of the powders obtained.

Table 1: Results obtained using Buchi B290

	%water	particle size (đ), µm	% activity loss
β-galactosidase, 190°C	12.47	28	86
β-galactosidase, 140° C	17.63	47	78
Lactozyme, 190°C	12.34	34	68
Lactozyme, 140°C	14.17	39	54

Niro spray-dryer

All the powders obtained using the macro-pilot Niro dryer had the medium diameter over 100 µm. At this dimensions the powder can not be used as a food additive in liquid products, as the sensitivity threshold of the human tongue is at approximately 30 µm. The spray dryer was relatively difficult to operate; the air outlet temperature could not be kept constant for small batches.

Table 2: Results obtained using macro-pilot Niro spray-dryer

	%water	particle size (đ), µm	% activity loss
β-galactosidase, 190°C	23.05	103	>90
β-galactosidase, 140° C	27.76	379	79
Lactozyme, 190°C	22.44	162	83
Lactozyme, 140°C	30.89	438	62

SonoDry 750

Results obtained with SonoDry 750 were also unsatisfactory due to the loss of activity recorded for all the batches produced. In case of batches "β-galactosidase, 140° C", no enzymatic activity was detected in either one of three batches produced.

Table 3: Results obtained using SonoDry 750

	%water	particle size (đ), µm	% activity loss
β-galactosidase, 190°C	9.22	16	>90
β-galactosidase, 140° C	12.36	28	>90
Lactozyme, 190°C	8.82	21	>90
Lactozyme, 140°C	15.48	22	>90

In case of SonoDry 750 possible major loss of activity could be the effect of the ultrasonic activity of the nozzle. Further studies will be made on this type of nozzles using lower frequencies (in our study the 120kHz nozzle was used). The centrifugal nozzle used in Niro spray dryer proved his limits and this type of drying will be no longer tested for this application. Best results were obtained with Buchi B290.

CONCLUSIONS

The methods selected for further development are using Buchi B290. The selected enzyme between the two tested was Lactozyme 2600 L (β-galactosidase from *Kluyveromyces lactis*), because of its stability during the drying process.

More trials will be made with a 60 kHz nozzle on SonoDry 750 as the results of water content and particle size were encouraging.

REFERENCES

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