

The influence of water activity on the development of probiotics

CLAUDIO ZIGERLIG

Novasina
A division of AxAir AG
Talstrasse 35-37
CH-8808 Pfaeffikon, Switzerland
Tel +41 55 416 66 60
Fax +41 55 416 62 62
info@novasina.ch
www.novasina.com

DEFINITION OF WATER ACTIVITY

Water activity is defined as the current volume and availability of "free" water in a sample and should not be directly compared with the water content (g water / g substance). The water activity is given as the a_w value and ranges between 0 (absolute dryness) and 1 (condensed humidity). Only this component takes an active part in the exchange with the ambient humidity and can possibly form the ideal medium for microbiological growth on the surface which influences the microbiological stability. The water activity also has an important effect on the chemical reactions in food.

The relative humidity is measured in % rH and relates to the a_w value as follows:

$$a_w = ERH / 100$$

(ERH: equilibrium relative humidity).

"Free" water in products is jointly responsible for the growth of undesirable organisms such as bacteria or fungi, which

produce "toxins" or other harmful substances. But also chemical / biochemical reactions, e.g. the Maillard reaction, increasingly take place and possibly change the following properties of a product:

- Microbiological stability (growth);
- Chemical stability (Figure 1);
- Content of proteins and vitamins;
- Colour, taste and nutritional value;
- Stability of the compound and durability;
- Storage and packing;
- Solubility and texture.

FUNCTIONAL FOODS

The term "Functional Foods" currently refers to foods which contain ingredients or micro-organisms which show a health maintaining or a disease preventing effect. In terms of the quality characterisation you can generally speak of a "health value" which complements the nutritional value in the broader sense. The

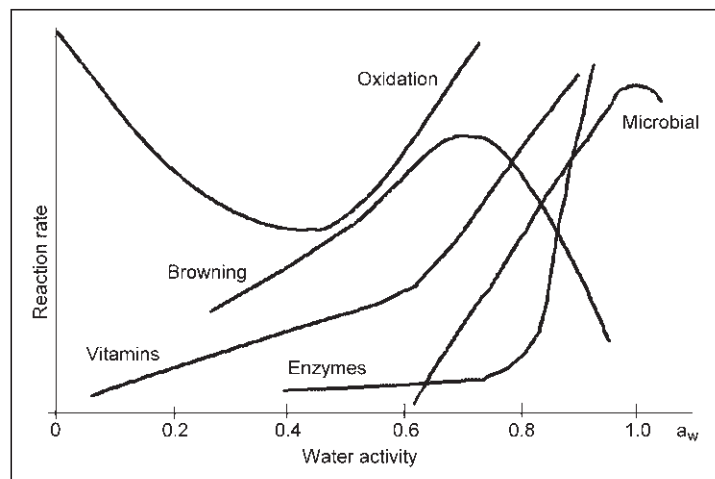


Figure 1 – Variation of oxidation, browning, enzyme activity, vitamin inactivation and microbial activity as a function of water activity

published by **B5** srl
Via Cesare da Sesto, 10
20123 Milano (Italy)
Tel. 0039 02 83241119
Fax 0039 02 8376457
www.b5srl.com

micro-organisms used for Functional Foods are mainly cultures originating from dairy products (lactic acid bacteria). These micro-organisms are called "Probiotics", and substances which support their growth are called "Prebiotics".

TECHNICAL DEMANDS IN DEVELOPMENT OF PROBIOTICS

For the selection of a suitable strain of Probiotics bacteria the following general criteria apply:

- from the human intestinal tract
- Resistance to gastric juice and secretion of bile so that sufficient viable organisms sustain in the intestine
- Indication on preferable properties such as the binding capacity of cells to the intestinal wall or production of anti-microbial substances
- Technical properties like a sufficient survival number of bacteria before and after fermentation and during storage

The majority of Probiotics used today belong to the *Lactobacillus* family which are active as facultative anaerobics in the lower small intestine and to the *Bifidobacteria* which are active in the colon as strict anaerobics.

CONDITIONS FOR PROBIOTICAL PREPARATION

The most important challenge during the formulation of probiotal

preparations is the environmental stabilisation that means the conservation of a large number of viable bacteria cells. A dehydrated probiotal product has to be stored at 5-10°C. The packaging should not contain any oxygen or carbon dioxide and the value of water activity should be between 0.1-0.25 a_w . A higher availability of "free" water could have an impact on enzymes which catalyse processes causing potentially disadvantageous effects, while lower a_w values could cause irreversible damage of the bacterial cell.

The production of probiotal products starts in general from one strain of bacteria. The culture media are filled into a fermenter and inoculated with preparatory cultures. The micro-organisms will be separated from the medium by centrifugation or filtration, washed and formulated with excipients. As a final product the strain can be available in liquid, deep-frozen or dehydrated form. Spray drying or freeze drying are the most frequently applied drying processes for Probiotics. After the dehydration the probiotal powder might be encapsulated or made in tablet form but you may also find other applications for powder as sachets.

During the fabrication of capsules you have to consider that the remaining water activity inside the capsule is a determining factor for the



The LabMaster-a_w – the latest water activity instrument from Novasina

storage stability. The parameters during the fabrication of tablets have to be selected in the way that the bacterial cell will not be excessively damaged by mechanical forces.

Most of the Probiotics on the market at the moment are either used in yoghurts or processed with the help of pharmaceutical standard techniques as capsule fillings, sachets or tablets.

Water activity (a_w) is an important factor affecting the stability of dry and dehydrated products during process or storage. The control of water activity in dry or dehydrated products preserves correct structure, texture, stability, density and re-hydration properties.

Do you have any problems with the quality of dry or dehydrated products? Water activity measurement could support you to find an answer!

Further information can be found on our web page www.novasina.com.