Optimizing spray-drying conditions for encapsulation of the next generation probiotic *Akkermansia muciniphila* DSM 22959

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Introduction

Probiotics are defined as "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host" [1]. Among those, ***Akkermansia muciniphila*** is one of the most promising candidates proposed as a **next generation probiotic**. This **commensal bacterium** has a high potential to be incorporated into **foods** or **pharmaceutical** formulations, due to its demonstrated relevant biological effects in several **metabolic conditions** [2, 3].

For its commercialisation as a probiotic, *A. muciniphila* must be successfully incorporated into a deliverable formulation. However, its **anaerobic** nature becomes important to develop a matrix that can confer them **protection** during the usually **aerobic storage** [4]. Among the several encapsulation methodologies, **spray-drying** is one of the most popular due to appealing characteristics in terms of **operation**, **scale-up**, **costs** and **efficiency** [5].

Objectives

- Establish a suitable procedure to encapsulate ***A. muciniphila* DSM 22959** using a spray-dryer, without prior encapsulation treatments, by **optimizing** the **spray-drying settings** and **matrices**;
- Evaluate spray-dried *A. muciniphila* **viability** during **storage** under **aerobic** conditions at **different temperatures**

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Methods

***A. muciniphila* DSM 22959**

Growth conditions:

PYGM medium, 37ºC, 24h

Anaerobiosis (85% N_2, 5% H_2 and 10% CO_2)

Centrifugation:

12000 x *g*, 30 min, 4ºC

Incorporation in matrices at 10%

- Skim milk
- Whey protein concentrate (WPC)
- Whey Protein Isolate (WPI)

Spray-drying procedure

Settings:

- Inlet temperature: 150ºC and 170ºC
- Oulet temperature: 65ºC and 75ºC

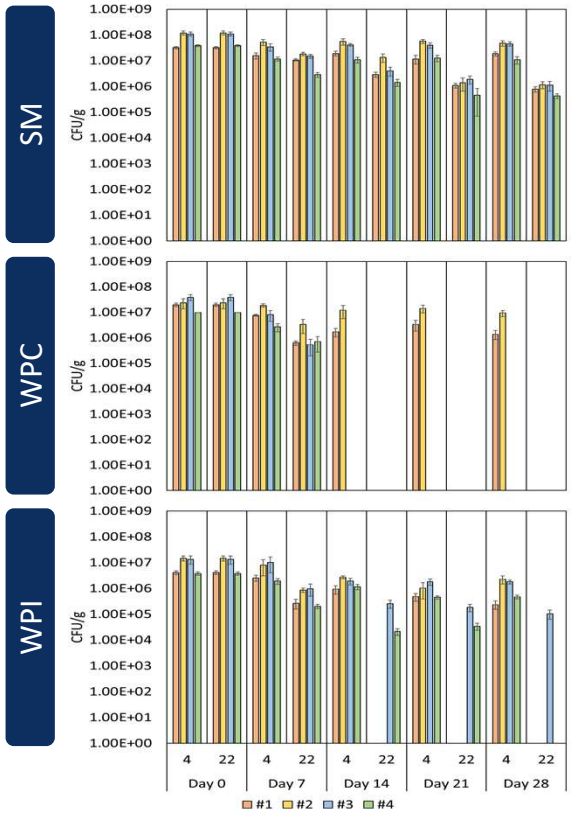
Aerobic storage:

- 4ºC and 22ºC, up to 28 days

Viability assessment:

- Plate count method

Results



Viability of spray-dried *A. muciniphila* cells in different matrices (SM, WPC and WPI) when stored aerobically at 4ºC and 22ºC up to 28 days using different spray-drying settings conditions:: #1) inlet/outlet temperatures: 150/75ºC (orange); #2) inlet/outlet temperatures: 150/65ºC (yellow); #3) inlet/outlet temperatures: 170/65ºC (blue) and #4) inlet/outlet temperatures: 170/75ºC (green).

Conclusions

- The most suitable matrix for *A. muciniphila* encapsulation by spray-drying was **skim milk**.
- Adequate conditions for spray-drying processing were established, considering inlet and outlet temperatures, to ensure maximum viability upon processing.
- Spray-drying seems to be a promising technique to encapsulate *A. muciniphila*, particularly using skim milk as encapsulating matrix, ensuring bacterial cells viability up to 1 month under common shelf-life conditions, both at 22ºC and, specially, at 4ºC. This formulation could be a promising therapeutic/prevention option in metabolic disorders.
- This strategy can possibly be extended to other next-generation probiotics and facilitate the incorporation of such probiotic bacteria into food bases, suitable for human consumption.