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SPINOSAD: A COMPREHENSIVE OVERVIEW WITH YIELD PERCEPTIVE

Pooja D.V., Amaresh Hadimani, Shreedhar Desai, Mahesh G. Shetty and S.K. Ghosh*

Multiplex Biotech Private Limited, R&D Lab, C-428, Peenya 1st Phase, Bangalore-560058, Karnataka, India.

*Corresponding author E-mail: trainingmbt@multiplexgroup.com

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ABSTRACT

Spinosad, derived from *Saccharopolyspora spinosa*, is a potent bio-pesticide with broad-spectrum insecticidal activity. This review underscores the impact of genetic variability and media composition on Spinosad production. Microscopic and cultural characterization reveals the distinctive features of *S. spinosa*, including its Gram-positive nature and cocci morphology. Biochemical characterisation of the organism showed positive results for Starch, Gelatine liquefaction, Citrate utilization, Catalase, Urease, Nitrate reduction and Voges-Proskauer test. Through literature mining, it is evident that altering fermentation media composition significantly affects Spinosad yield, with glucose as a carbon source yielding the highest production. These findings underscore the importance of substrate selection and strain optimization for enhancing Spinosad production. This short communication gives an idea of the yield range obtained by in-house fermentation of *Saccharopolyspora spinosa*. Understanding the interplay between genetic factors and environmental conditions is crucial for standardizing Spinosyn production processes, offering insights into sustainable pest management strategies.

***Key words*:** Actinomycetes, *Saccharopolyspora spinosa*, Fermentation media and Yield

Introduction

Spinosad, novel macrolides, are natural metabolites produced under aerial fermentation conditions by the actinomycete *Saccharopolyspora spinosa* with high insecticidal activity and can be widely used in crop pests such as Coleoptera, Hymenoptera, and Diptera [Sparks *etal*., 2013]. It is a promising biopesticide which has strong insecticidal activity and broad pesticidal spectrum. The most active and abundant Spinosyn from *S. spinosa* fermentation media are Spinosyn A and D. The mixture of spinosyn A (85% of spinosad) and spinosyn D (15% of spinosad) is called spinosad, which has no negative effects and low toxicity on non-target insects and mammals compared with traditional chemical pesticides [Luo, 2012]. Present short communication aims to highlight the researcher that genetic variability and media composition plays a significant role in standardizing the metabolite production process of Spinosad.

Microscopic and Cultural characterisation

In one of the studies conducted within our Research and Development (R&D) unit, it has been established that the cultivation of the organism requires an incubation period of 8 to 10 days for optimal growth on Yeast Extract Malt Extract Glucose (YMG) agar plates. Upon reaching maturity, as demonstrated in Fig.1, the ten-day-old culture cultivated on YMG agar plates exhibits distinctive characteristics. The morphology of the culture manifests as dry and powdery in texture, accompanied by an earthy or musty odour, indicative of its microbial nature. This visual and olfactory profile provides initial insight into the organism's physiological properties. Further microscopic examination of the culture reveals significant details. Notably, the culture retains a purple coloration stain when subjected to a Gram stain reaction, signifying its Gram-positive nature. Moreover, microscopic characterization elucidates the presence of cells exhibiting either cocci morphology or chains of cocci structures.

Biochemical characterisation of *Saccharopolyspora spinosa* (DSM 44228)

The biochemical characterisation of the culture

Table 1: Results of biochemical test for *Saccharopolyspora spinosa* (DSM 44228) culture.

S. No.	Tests	Obtained result	Expected result
1	Caseinhydrolase	-	-
2	Starch degradation	+	+
3	Gelatineliquefaction	+	+
4	Citrateutilization	+	+
5	Indole test	-	-
6	Kliger's IronAgar	-	-
7	Catalase	+	+
8	Methylred	-	-
9	Urease	+	+
10	Nitrate reduction test	+	+
11	Voges-Proskauer test	+	+

revealed that the strain has showed positive results for Starch, Gelatine liquefaction, Citrate utilization, Catalase, Urease, Nitrate reduction and Voges-Proskauer test. The results obtained were in agreement with the results of DSM website for the particular strain (Mertz and Yao, 1990).

An Insilco mining of literature from 2006-2022, revealed a significant difference in the yield of spinosad by altering the composition of the fermentation media under controlled production conditions. From the table it was clear that the highest yield was obtained when glucose was used a source of carbon for growth of organism. Overall, the interventions demonstrate the importance of substrate composition and strain selection in optimizing yield in *S. spinosa* fermentation processes. Additionally, variations in yield highlight the influence of specific genetic backgrounds and environmental factors on secondary metabolite production.

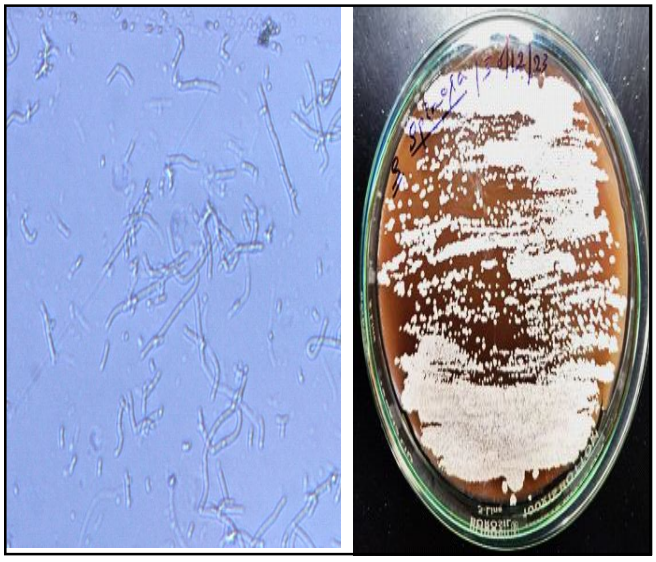

Fig. 1: Microscopic and cultural morphology of *Saccharopolyspora spinosa* (DSM44228).

Table 2: Literature survey on yield improvisation of spinosad by intervention of Fermentation broth (FB).

S. no	*S. spinosa*	Intervention in Fermentation broth	Yield (mg/L)	References
1	Strain -*acuC*	CSM medium	125.65	Liu *et al.*, 2021
2	*S. spinosa*	Glucose and phosphate	507.00	Jin *et al.*, 2006
3	Strain 1733	Glucose and phosphate	520.00	Wan *et al.*, 2022
4	*S. spinosa*	Camellia oil @30g/L	520.00	Huang *et al.*, 2018
5	Strain Co121	Glucose	310.00	Guojun *et al.*, 2016
6	Strain Co121	Mannitol	549.00	Guojun *et al.*, 2016
7	Strain C4-10-8B	Glucose	395.00	Neing Wei *et al.*, 2010
8	Strain C121	Glucose	586.00	Peng *et al.*, 2006
9	*S. spinosa*	Glucose	583.86	Liu *et al.*, 2016

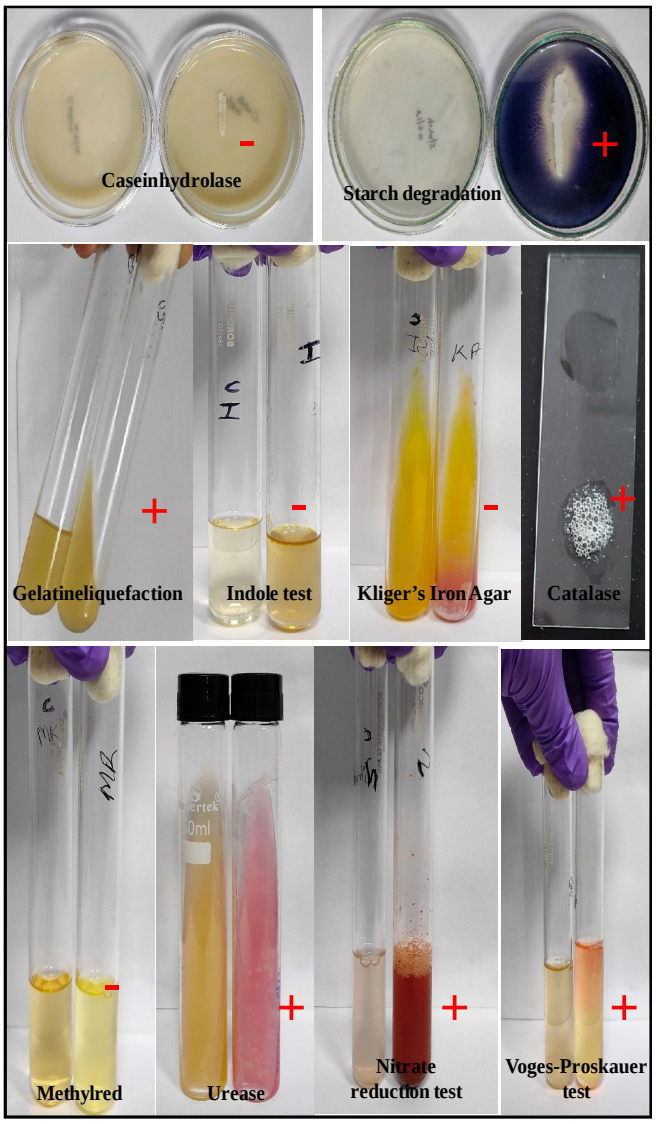

Fig. 2: Biochemical characterisation of *Saccharopolyspora spinosa* (DSM 44228).

Conclusion

These observations provide valuable insights into the cellular composition and arrangement of the cultivated organism. Overall, the detailed examination of the culture grown on YMG agar plates offers comprehensive insights into its macroscopic and microscopic attributes, facilitating a deeper understanding of its biological characteristics and potential applications within various research domains.

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