Madras Agric. J., 86(7-9): 373 - 374 July - September 1999
https://doi.org/10.29321/MAJ.10.A00621

GIBBERELLIC ACID PRODUCTION BY FUNGI

P.M. SARAVANAN and K. GOVINDARAJAN

Department of Agricultural Microbiology
Tamil Nadu Agricultural University
Coimbatore - 641 003.

ABSTRACT

Fifteen fungal cultures including one type strain, *Gibberella fujikuroi* were screened for gibberellic acid production using Liquid Surface Fermentation (LSF) and Submerged Fermentation (SmF) techniques. *G. fujikuroi* produced the highest quantity of GA_3 followed by *Botryodiplodia theobromae* in both the fermentation processes. In general gibberellic acid production was more in SmF when compared to LSF.

KEY WORDS: Fungal cultures, Gibberellic acid, Liquid surface fermentation, Submerged fermentation

Gibberellic acid (GA_3) is a potent plant growth regulator and is extensively used in agriculture for a variety of beneficial effects. Several microorganisms have been reported to produce GA_3 and GA like substances. Among them fungal cultures are able to give higher yields (Kumar and Lonsane, 1989). At present GA_3 is produced through industrial fermentation using the fungus *Gibberella fujikuroi*. Because of low yield, the cost of GA_3 is very high. Hence attempts were made during the year 1996 for screening and selection of fungal cultures for increased GA_3 production.

MATERIALS AND METHODS

Fifteen fungal cultures isolated from soil or infected plant materials were used in the present study. *Gibberella fujikuroi* 1019 obtained from the National Collection of Industrial Microorganisms, Pune was used as type strain. The cultures were screened for GA_3 production using Liquid Surface Fermentation and Submerged Fermentation processes.

Liquid Surface Fermentation (LSF)

One hundred ml aliquots of Czapek-Dox medium with pH 5.0 was taken in 250 ml flasks and sterilized. The fungal cultures were grown in petri dishes. One cm diameter discs were made and aseptically transferred to the flasks at the rate of one disc per flask. After 9 days of incubation at 30° C, the mycelial mat formed over the surface of the broth was removed through filtration by using dried pre-weighed filter paper. The GA_3 content of the culture filtrate was estimated spectrophotometrically with the help of standard graph (Mahadevan and Sridhar, 1982). The filter paper containing the fungal biomass was dried to a constant weight at 60° C and weight of the fungal biomass was calculated.

Submerged Fermentation (SmF)

In submerged fermentation the flasks after inoculation of the fungal discs were kept in a psychrotherm incubator shaker (120 rpm) for 9 days. The other steps were same as that of LSF.

RESULTS AND DISCUSSION

From the results it is clear that all the 15 fungal cultures were able to produce GA_3. However the quantity of GA_3 produced varied with the cultures (Table 1). The type culture *G. fujikuroi* recorded the highest quantity of GA_3 followed by *Botryodiplodia theobromae* in both LSF and SmF processes. *Colletotrichum gloeosporioides* produced the highest quantity of fungal biomass followed by *Fusarium semitectum* in LSF as well as SmF processes.

Rademacher (1994) observed that the capability of GA formation was not widespread among microorganisms. However, the detection of GA_3 in all the fungal cultures screened indicated that GA formation was more widely spread among fungi. Significant variations observed in the quantum of GA_3 produced by different fungi might be due to the genetic make up of the fungi. The results also revealed no correlation between the biomass production and GA_3 syntheses. SmF recorded higher GA_3 yield than LSF. Limited

Table 1. GA_3 production by fungi under LSF and SmF conditions

S.No., Fungal cultures	LSF		SmF	
	GA_3 yield (g l^{-1})	Biomass yield (g 100 ml^{-1})	GA_3 yield (g l^{-1})	Biomass yield (g 100 ml^{-1})
1. *Pleurotus salmoneostramineus*	0.07	0.17	0.22	0.16
2. *Colletotrichum gloeosporioides*	0.23	0.27	0.48	0.22
3. *Colletotrichum lindemuthianum*	0.13	0.20	0.35	0.13
4. *Aspergillus niger*	0.11	0.16	0.34	0.14
5. *Aspergillus flavus*	0.10	0.15	0.32	0.13
6. *Botryodiplodia theobromae*	0.26	0.20	0.61	0.18
7. *Neurospora crassa*	0.06	0.16	0.23	0.13
8. *Rhizoctonia solani*	0.04	0.14	0.20	0.12
9. *Alternaria solani*	0.06	0.14	0.28	0.13
10. *Trichoderma viride*	0.10	0.14	0.33	0.12
11. *Macrophomina phaseolina*	0.20	0.16	0.46	0.13
12. *Fusarium semitectum*	0.24	0.24	0.54	0.20
13. *Helminthosporium oryzae*	0.10	0.13	0.32	0.10
14. *Helminthosporium turcicum*	0.11	0.20	0.34	0.19
15. *Gibberella fujikuroi* -1019	0.28	0.23	0.77	0.20
SEd	0.02	0.02	0.03	0.02
CD (P=0.05)	0.04	0.04	0.06	0.04

contact of the cells with the nutrients leading to inefficient utilization of the nutrients, creation of O_2 limited and CO_2 enriched atmosphere due to the barrier formed by the mycelial mat might be the reasons for the low yields recorded with LSF (Kumar and Lonsane, 1989). Kumar and Lonsane (1987) recorded GA_3 yield of 0.218 g l^{-1} in wheat bran medium under SmF condition. Bruckner et al (1989) obtained GA_3 yield of 1 g l^{-1} in SmF using the fungus *G. fujikuroi* Acc 917. In the present study the fungus *G. fujikuroi* 1019 recorded the highest yield of 0.770 g l^{-1} followed by *B. theobromae* (0.610 g l^{-1}) under submerged conditions. Nutritional factors especially carbon and nitrogen and growth conditions play a significant role in the elaboration of GA_3 by fungi (Kumar and Lonsane, 1990). Hence yield of GA_3 can be substantially improved by rigorous screening and selection for high yielding strains of fungi combined with judicious selection of physical and nutritional factors.

REFERENCES

BRUCKNER, B., BLECHSCHMIDT, G., SEMBDNER, G AND SCHNEIDER, G. (1989). Fungal gibberellin production. In : Biotechnology of Vitamins, Pigments and Growth Factors (ed.) E.J. Vandamme, Elsevier Applied Science, London, pp. 383-429.

KUMAR, P.K.R. and LONSANE, B.K. (987). Gibberellic acid by solid state fermentation. Consistent and improved yields. **Biotechnol. Bioeng., 30:** 267-271.

KUMAR, P.K.R. and LONSANE, B.K. (1989). Microbial production of gibberellic acid: State of the art. **Adv. Appl. Microbiol., 34:** 29-139.

KUMAR, P.K.R. and LONSANE, B.K. (1990). Solid state fermentation: Physical and nutritional factors influencing Gibberellic acid production. **Microbiol Biotechnol., 34:** 145-148.

MAHADEVAN, A and SRIDHAR, R. (1982). **Methods in Physiological Plant Pathology.** Sivagami Publications, Madras, p.316.

RADEMACHER W. (1994). Gibberellin formation in microorganisms. **Plant Growth Regulation, 15** : 303-314.

(Received : January 1998 Revised : September 1998)