Biodecomposition of Jordan Phosphorite by phosphate-solubilizing fungi

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Abstract

The bio-solubilization of Jordan phosphorite by the phosphate-solubilizing fungi (*Aspergillus niger*) was investigated. The effect of the phosphate concentration in the liquid medium, the duration of biodecomposition, the concentration of citric acid generated from the fungus and the effect of the preliminary mechanical activation of the phosphate on the biodissolution has been studied. It was established that the lower was the phosphate concentration in the medium, the greater was the degree of P_2O_5 extraction. The results obtained showed a correlation between soluble phosphate and citric acid produced by *Aspergillus niger*.

A maximum degree 99.1 % of P_2O_5 extraction has been achieved on the 15^{-th} day when in the medium was added 0.5 % non-activated Jordan phosphorite. The mechanical activation of the phosphate had no positive affect on the bioconversion process. Investigations with mechanical-activated Jordan phosphorite showed that a maximum extent of 92.4 % of the phosphate solubilization has been observed on the 10^{-th} day at phosphorite concentration of 0.5 %

Experimental

Experiments have been carried out using mechanical activated Jordan Phosphorite (MAJP) and nonactivated Jordan Phosphorite (NAJP).

Incubation with *Aspergillus niger* was carried out in a shaking water bath at 30^0C for different time with a velocity of stirring at 150 /min. The concentration of NAJP and MAJP in the nutrient medium was 0.5, 1 and 2%. The mineral source was added in the fermentation suspension 3 days after beginning of the microorganism's cultivation.

After different time intervals, the samples were filtered and pH, sugar content, total acidity (calculated as citric acid) and the content of water-soluble $P_2O_{5\ w.s.}$ were determined. The precipitate (biomass and remaining mineral mass) was treated for 2 hours with 2% citric acid at room temperature. The obtained solution was analyzed for citrate-soluble $P_2O_{5\ c.s.}$. After filtration the precipitate was dried to a constant weight at 60^0C. The dried precipitate was ached to a constant weight at 500^0C. The loss of weight during heating is equal to the biomass produced during cultivation. The P_2O_5 content in the biomass ($P_2O_{5b.s.}$) was also determined.

Table 1 Change in culture pH, glucose concentration and citric acid at investigations with 1 % JP

Day	pH	Glucose (g/l)	Citric acid (g/l)
1% NAJP			
3	3,3	88,80	3,31
5	3,3	80,00	5,20
9	3,3	71,99	5,30
12	3,3	46,80	9,80
15	3,3	21,60	9,70
1 % MAJP			
2	3,3	102,72	4,43
4	3,1	100,17	5,49
6	3,1	97,9	6,08
8	3,0	76,56	7,03
10	2,9	56,16	11,88
12	2,8	35,91	11,74

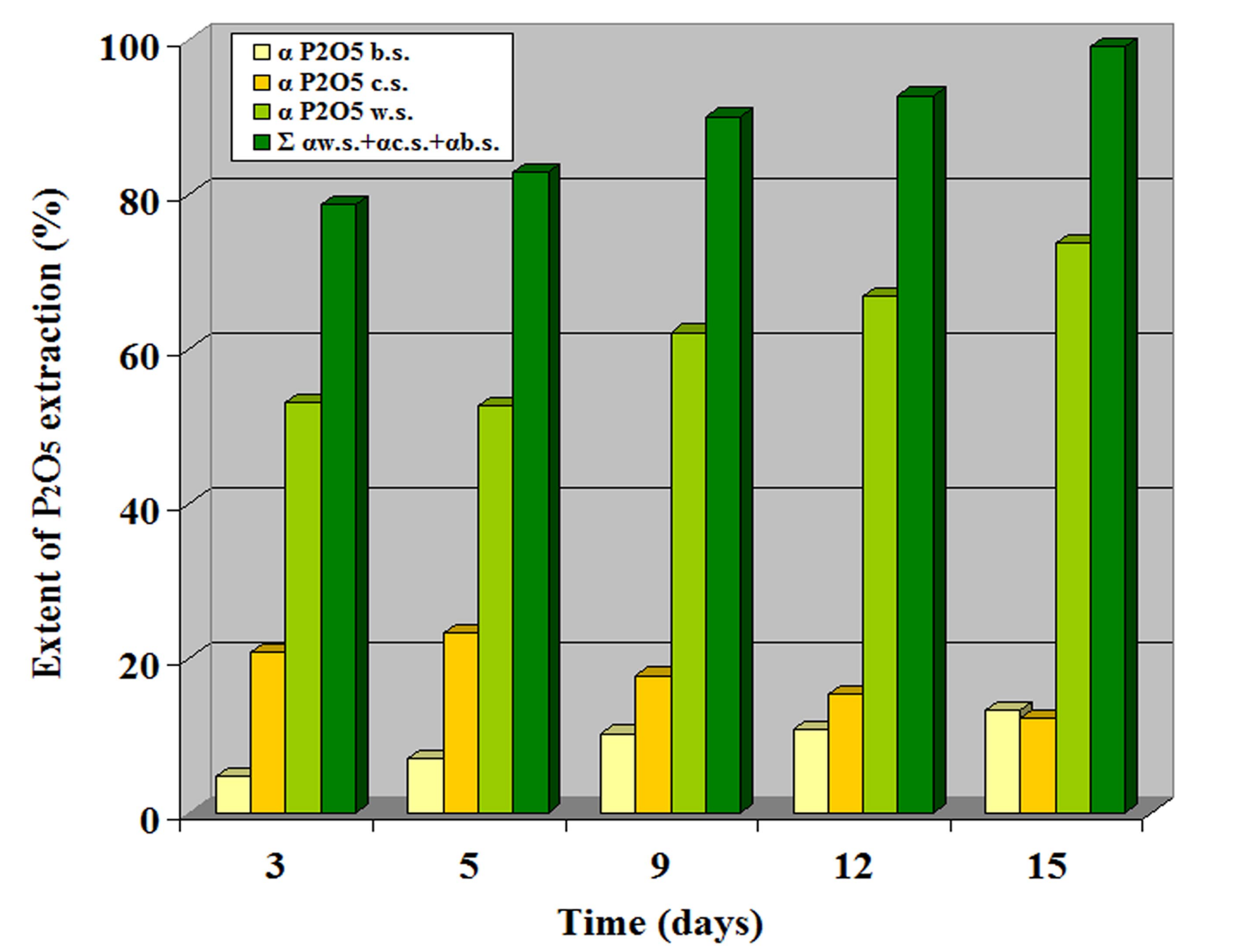

Fig. 1 Change in the extents of P_2O_5 extraction ($\alpha_{w.s.}$, $\alpha_{c.s}$, $\alpha_{b.s}$, and $\Sigma\ \alpha_{w.s.}+\alpha_{c.s}+\alpha_{b.s}$) in nutritive medium containing 0.5 % NAJP

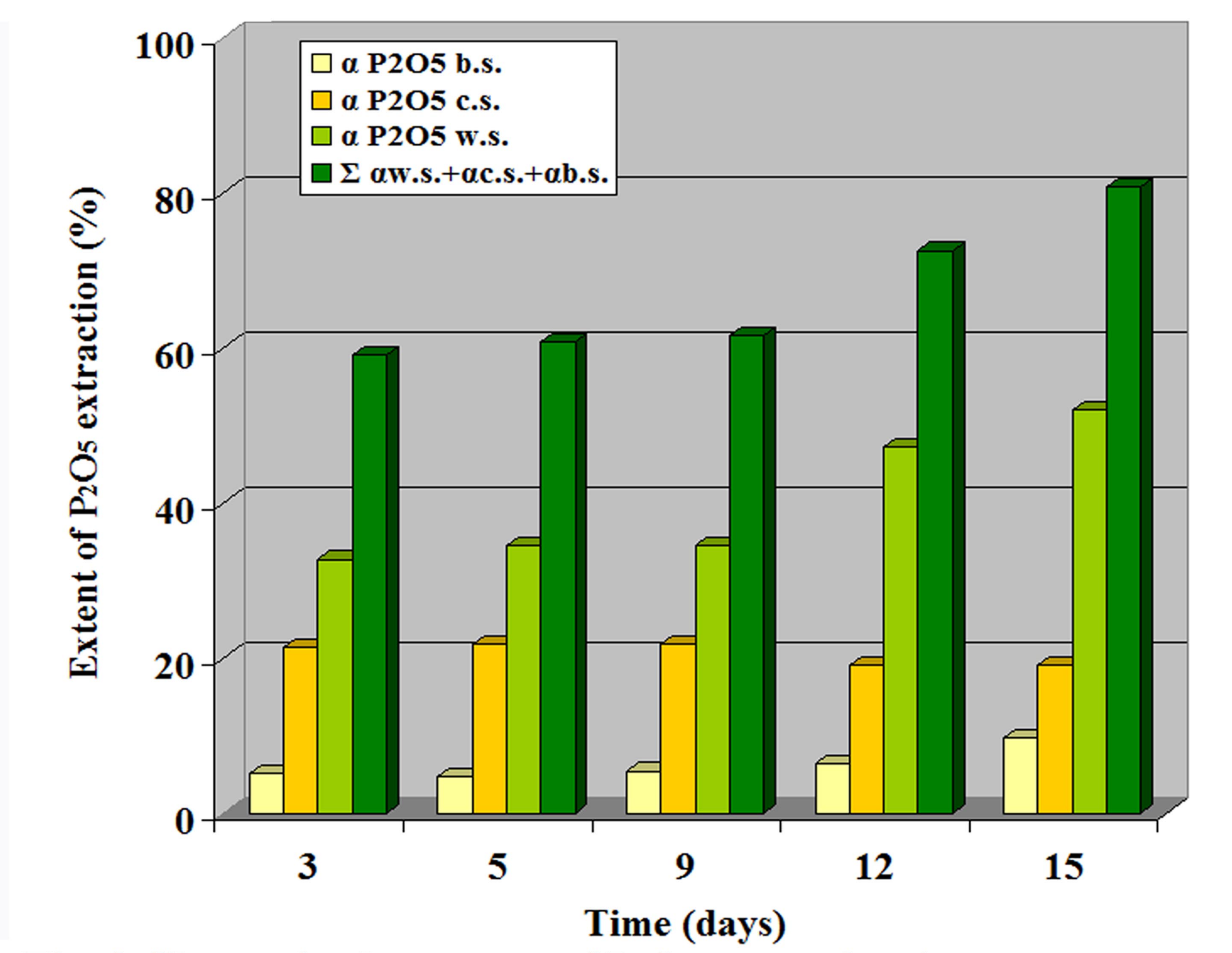

Fig. 2 Change in the extents of P_2O_5 extraction ($\alpha_{w.s.}$, $\alpha_{c.s}$, $\alpha_{b.s}$, and $\Sigma\ \alpha_{w.s.}+\alpha_{c.s}+\alpha_{b.s}$) in nutritive medium containing 1 % NAJP

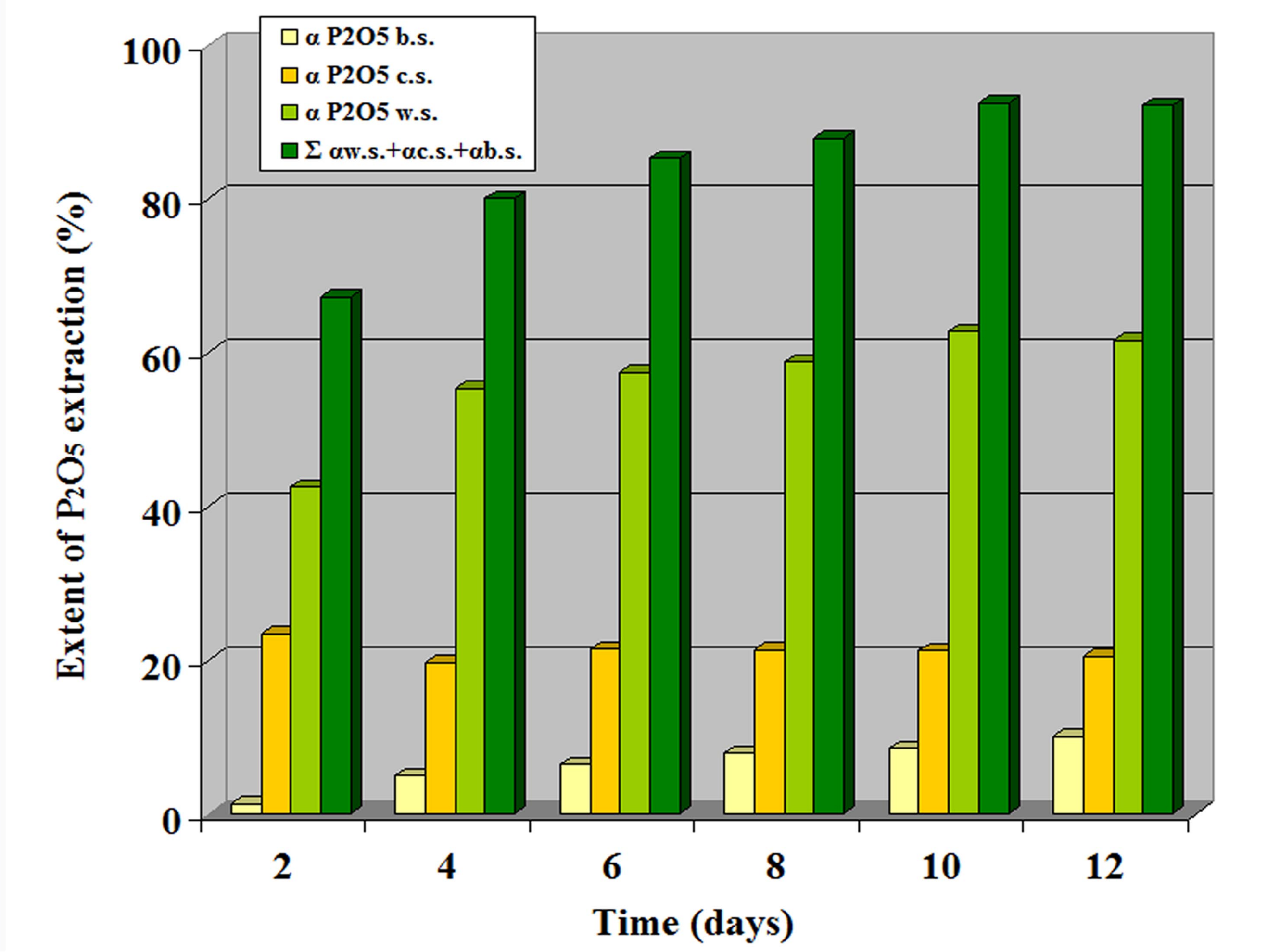

Fig. 3 Change in the extents of P_2O_5 extraction ($\alpha_{w.s.}$, $\alpha_{c.s}$, $\alpha_{b.s}$, and $\Sigma\ \alpha_{w.s.}+\alpha_{c.s}+\alpha_{b.s}$) in nutritive medium containing 0.5 % MAJP

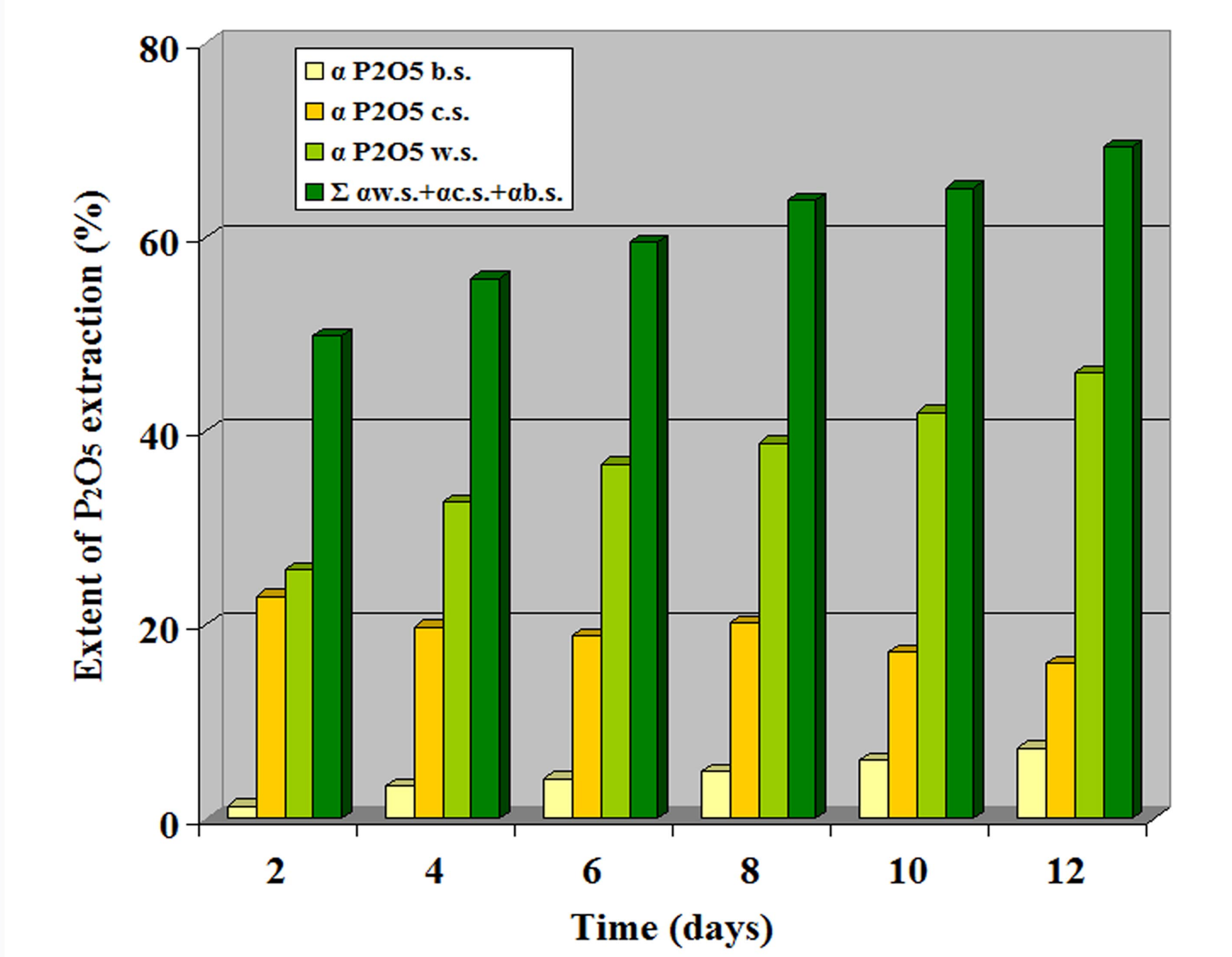

Fig. 4 Change in the extents of P_2O_5 extraction ($\alpha_{w.s.}$, $\alpha_{c.s}$, $\alpha_{b.s}$, and $\Sigma\ \alpha_{w.s.}+\alpha_{c.s}+\alpha_{b.s}$) in nutritive medium containing 1 % MAJP

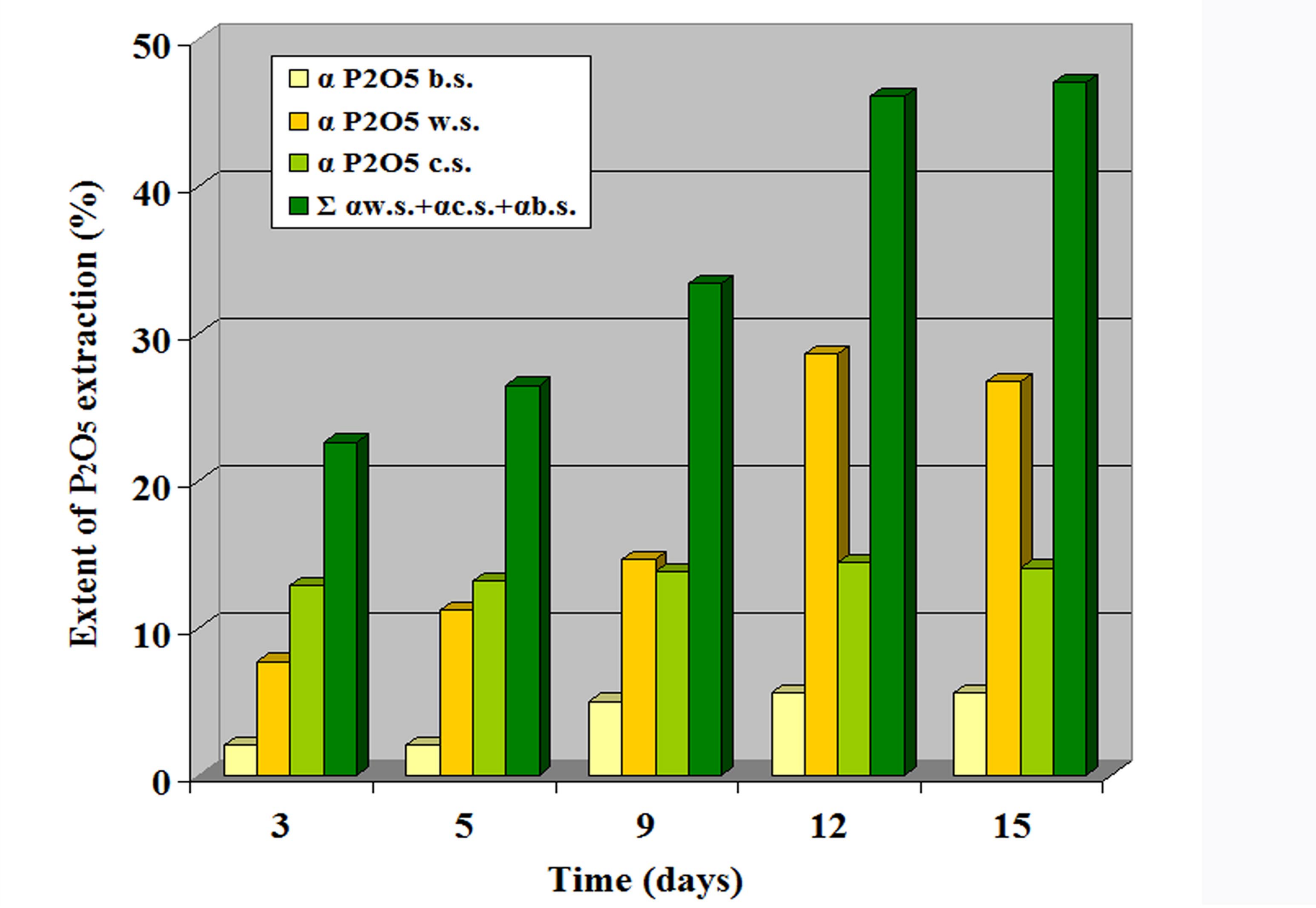

Fig. 5 Change in the extents of P_2O_5 extraction ($\alpha_{w.s.}$, $\alpha_{c.s}$, $\alpha_{b.s}$, and $\Sigma\ \alpha_{w.s.}+\alpha_{c.s}+\alpha_{b.s}$) in nutritive medium containing 2 % NAJP

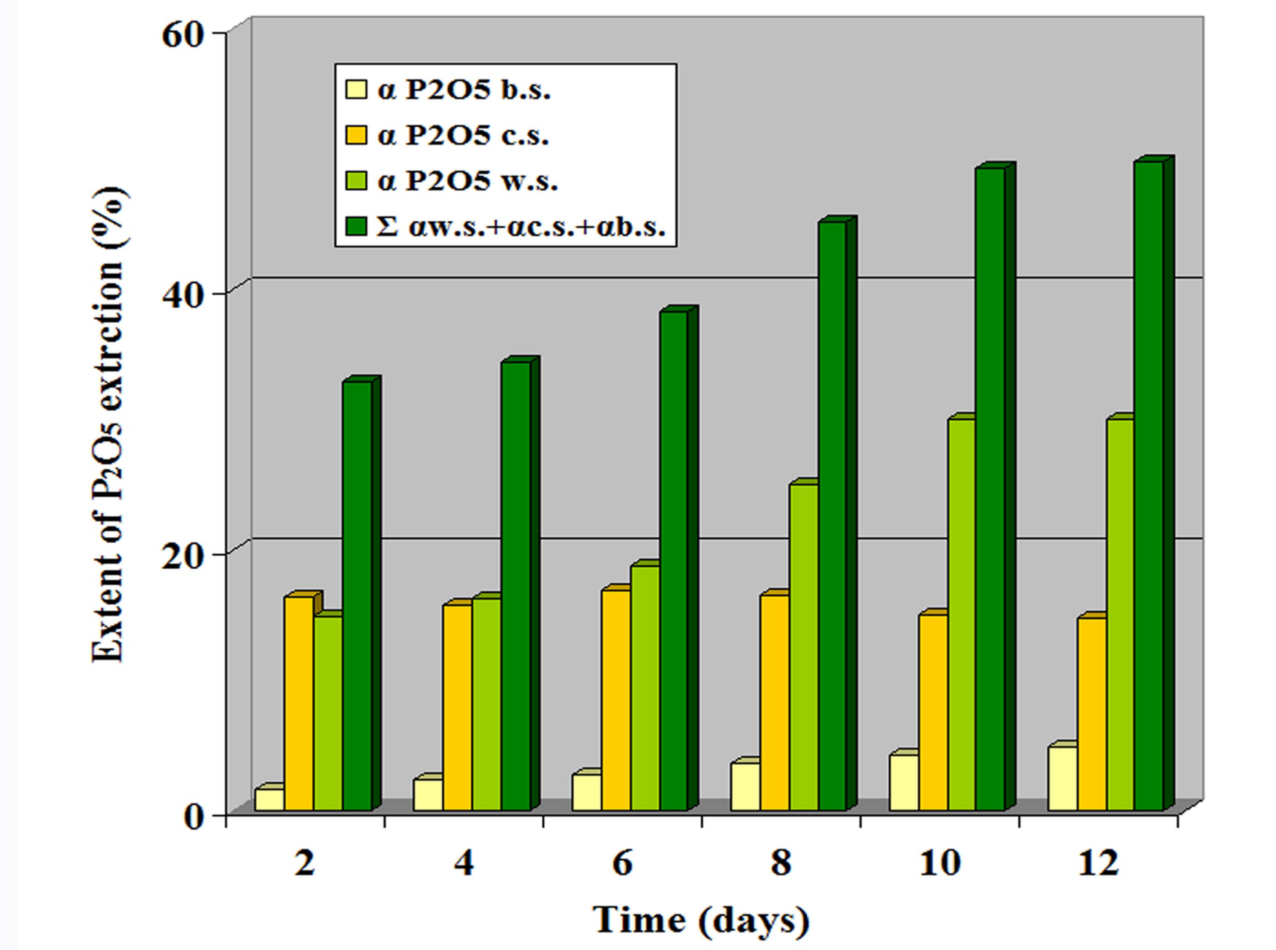

Fig. 6 Change in the extents of P_2O_5 extraction ($\alpha_{w.s.}$, $\alpha_{c.s}$, $\alpha_{b.s}$, and $\Sigma\ \alpha_{w.s.}+\alpha_{c.s}+\alpha_{b.s}$) in nutritive medium containing 2 % MAJP