



Effect of mechano-chemical activation on bioleaching of Jordan Phosphorite

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The objective of the present study is to establish the effect of preliminary mechanical activation of Jordan Phosphorite, the rock phosphate concentration in the nutritive medium and the time of incubation on the phosphate dissolution by soil bacteria *Azotobacter sp.*

Experimental

Jordan Phosphorite

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

Table 1. The chemical composition of Jordan phosphorite (%)

Al ₂ O ₃	CaO	Fe ₂ O ₃	MnO	SiO ₂	TiO ₂	MgO	P ₂ O ₅
0,26	53,69	0,27	< 0,01	2,60	0,02	0,26	33,72

Planetary mill "Pulverisite 5" has been used for the mechanical activation of the samples. Metal balls of 20 mm diameter and the rotation speed 320 rpm were used. The weight ratio of phosphorite to milling bodies was kept at 1:20. The duration of activation was 4 h.

Microorganisms

The solubilization of TP was realized by using a gram-negative bacteria *Azotobacter sp.* Bacteria were isolated from agricultural soils on glucose-asparagine agar medium with freshly precipitated calcium phosphate.

Experimental methods

The bioconversion of JP was achieved through submerged incubation of the bacteria in a liquid nutritive medium at 25°C. In 250 ml Erlenmeyer flask MAJP or NAJP was added, so that the TP concentration was 0.5, 1 and 2 % w v⁻¹, respectively. After that 2 ml of the bacterial suspension of *Azotobacter sp.* were put to each flask.

On the basis of the results obtained the extent of extraction of P₂O₅ from phosphorite to water-soluble ($\alpha_{w.s.}$) and citrate-soluble ($\alpha_{c.s.}$) as well as the total extent of P₂O₅ extraction (α) were determined.

Table 2 Change in culture pH, glucose concentration, titratable acidity and P₂O₅ at investigations with 1 % JP

Day	pH	Glucose (g/l)	Titratable acidity (µeq/ml)	P ₂ O ₅ (g/l)
1% NAJP				
3	3,9	2,96	23,92	1,29
6	3,9	3,06	23,92	1,37
9	3,9	2,45	26,04	1,72
12	3,9	1,5	21,16	1,65
15	3,9	0,57	21,13	1,58
1% AJP				
1	7,2	9,79	2,16	1,26
3	3,9	1,35	23,55	0,99
4	4,0	1,16	36,31	2,03
5	3,9	1,07	27,72	2,16
6	4,0	1,08	23,53	1,43
7	4,2	0,94	10,71	1,35

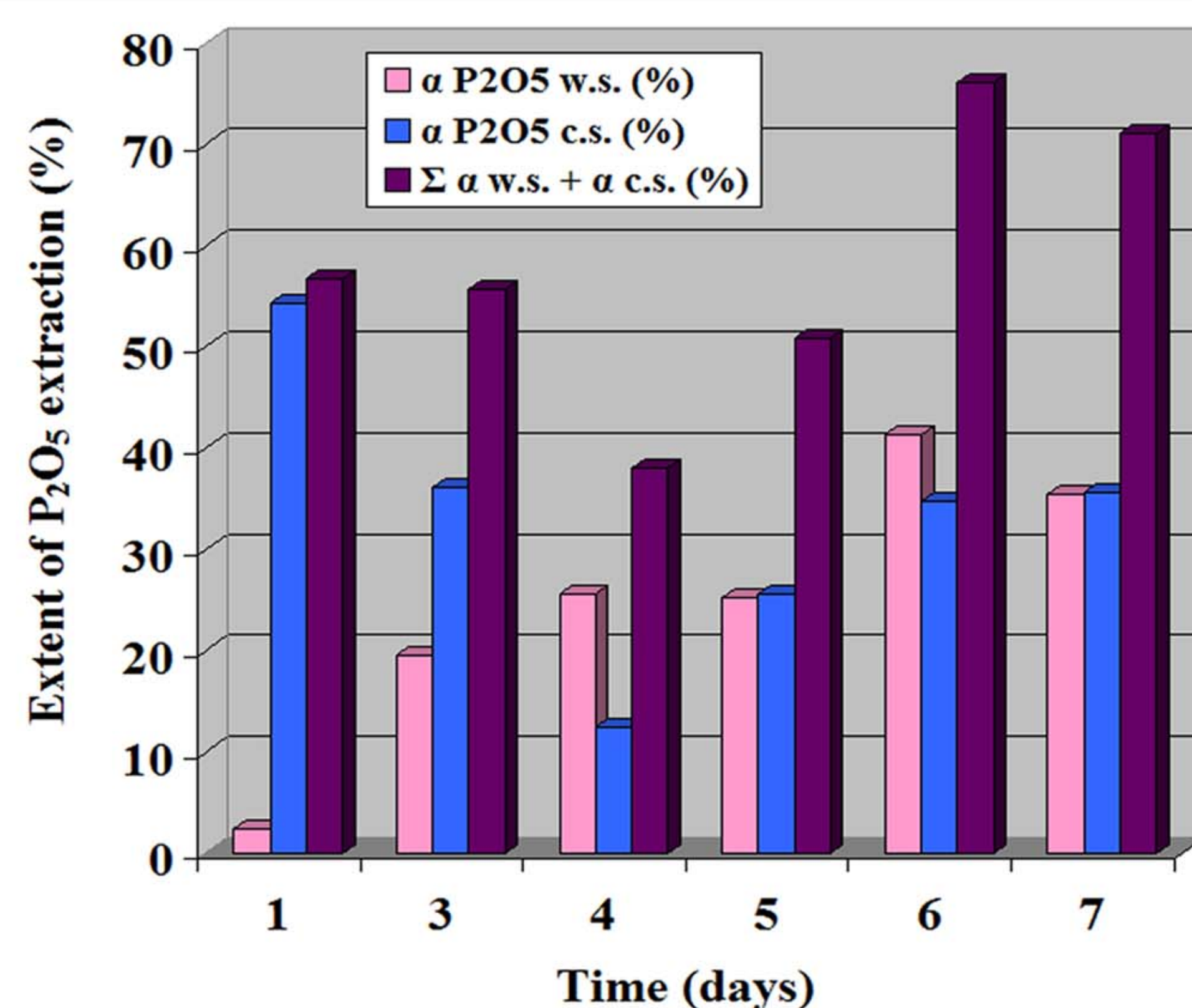


Fig.1 Change in the extents of P₂O₅ extraction ($\alpha_{w.s.}$, $\alpha_{c.s.}$, and $\Sigma\alpha_{w.s.} + \alpha_{c.s.}$) in nutritive medium containing 0.5% MAJP

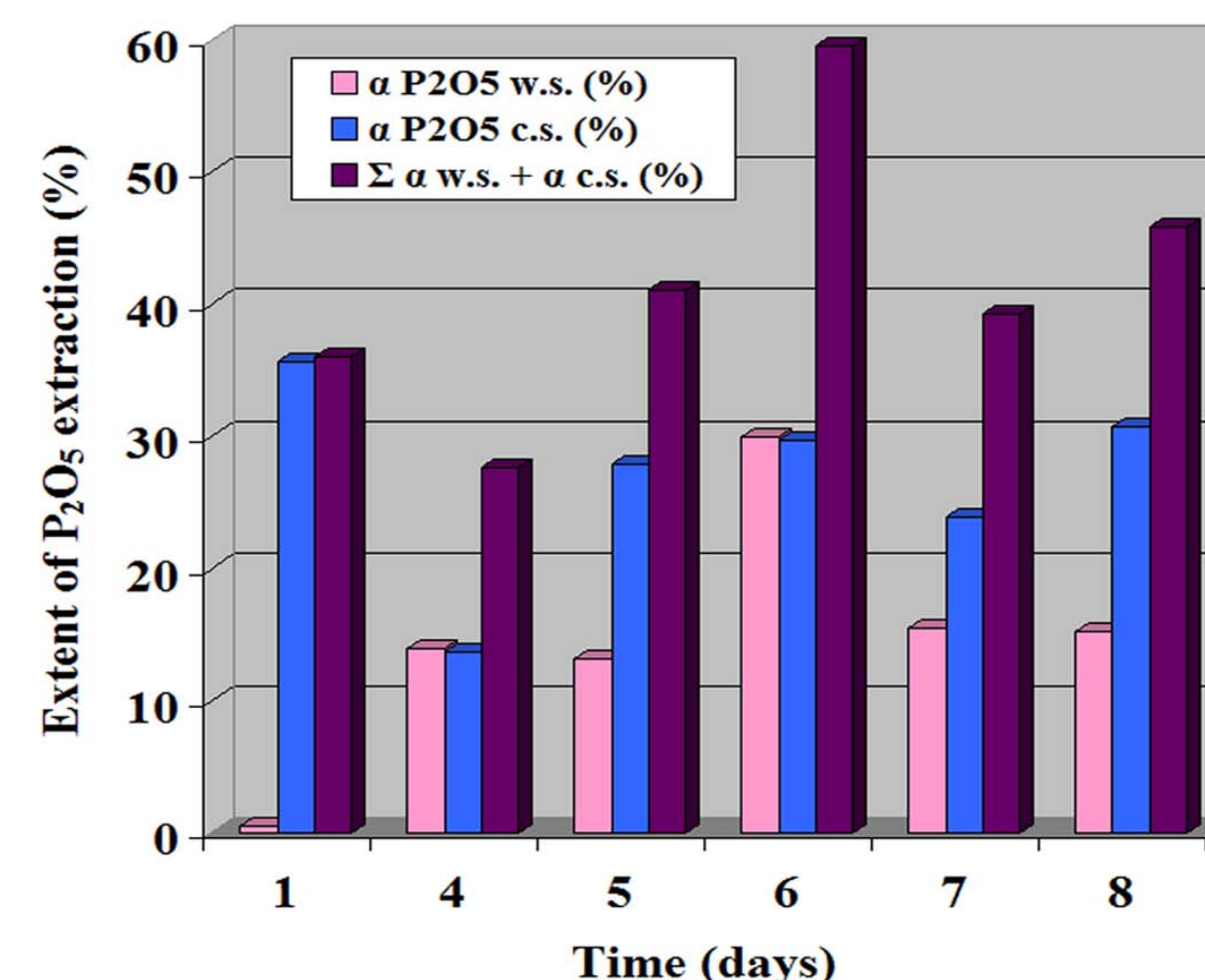


Fig.2 Change in the extents of P₂O₅ extraction ($\alpha_{w.s.}$, $\alpha_{c.s.}$, and $\Sigma\alpha_{w.s.} + \alpha_{c.s.}$) in nutritive medium containing 1% MAJP

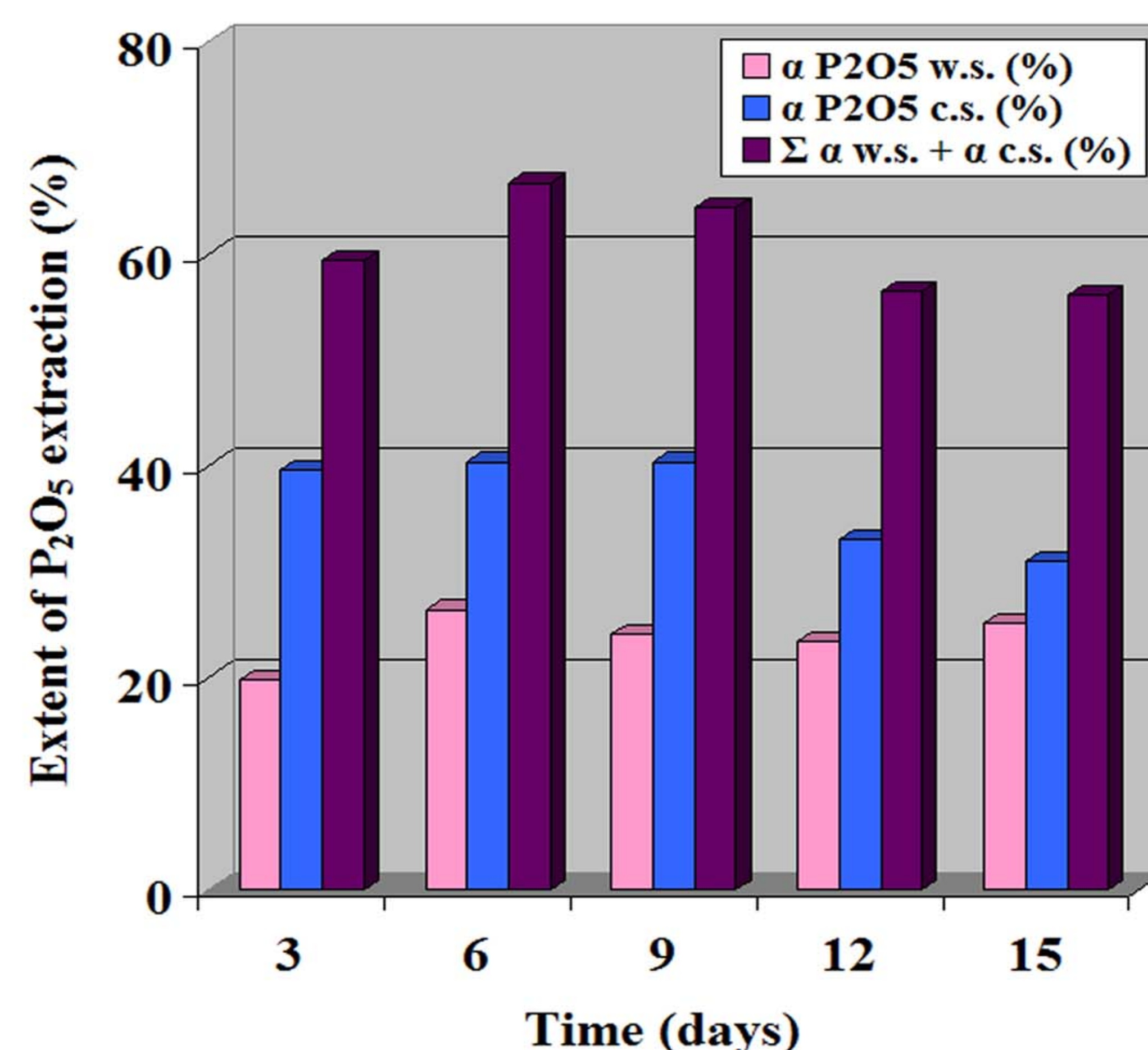


Fig. 3 Change in the extents of P₂O₅ extraction ($\alpha_{w.c.}$, $\alpha_{c.s.}$, and $\Sigma\alpha_{w.s.} + \alpha_{c.s.}$) in nutritive medium containing 0.5 % NAJP

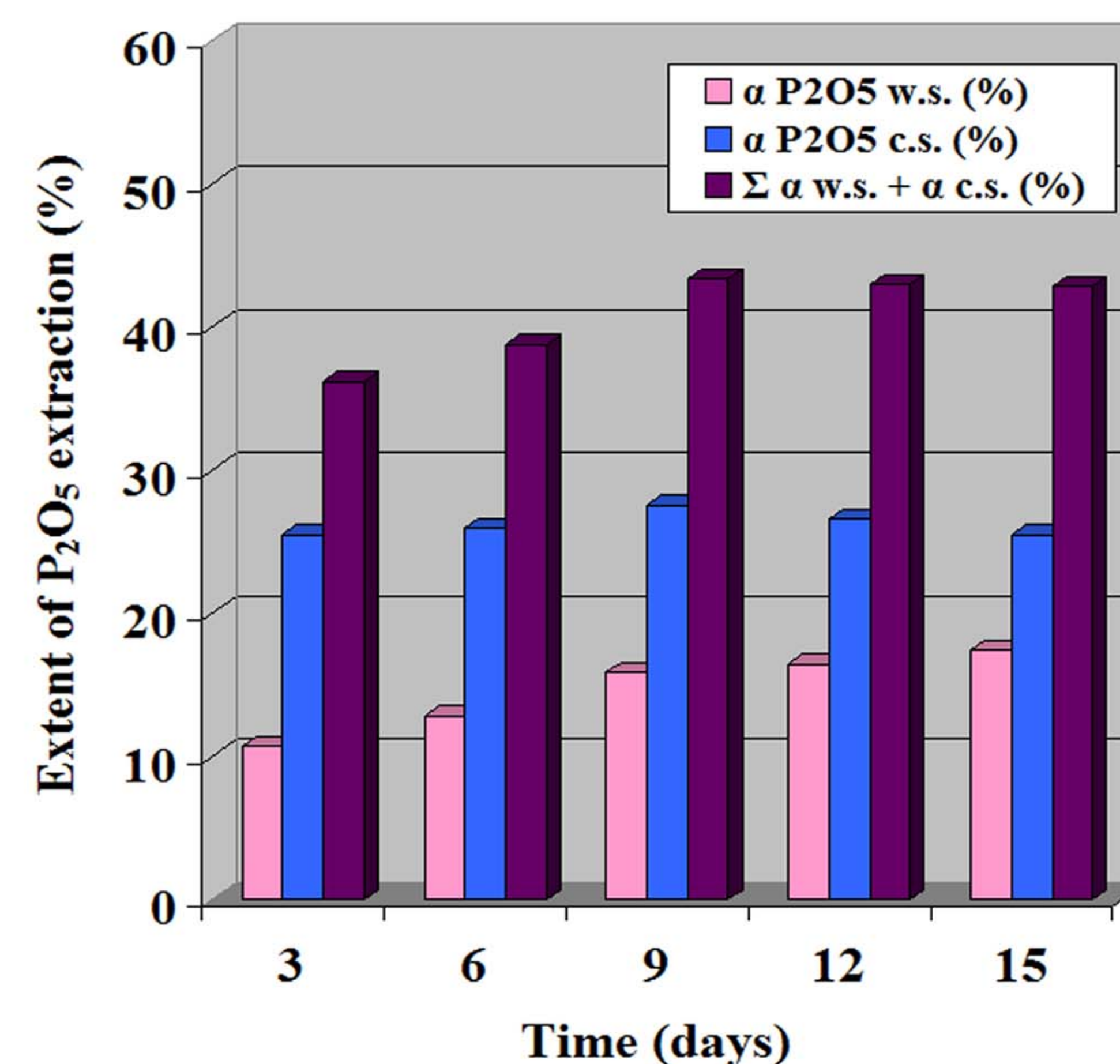


Fig. 4 Change in the extents of P₂O₅ extraction ($\alpha_{w.c.}$, $\alpha_{c.s.}$, and $\Sigma\alpha_{w.s.} + \alpha_{c.s.}$) in nutritive medium containing 1% NAJP

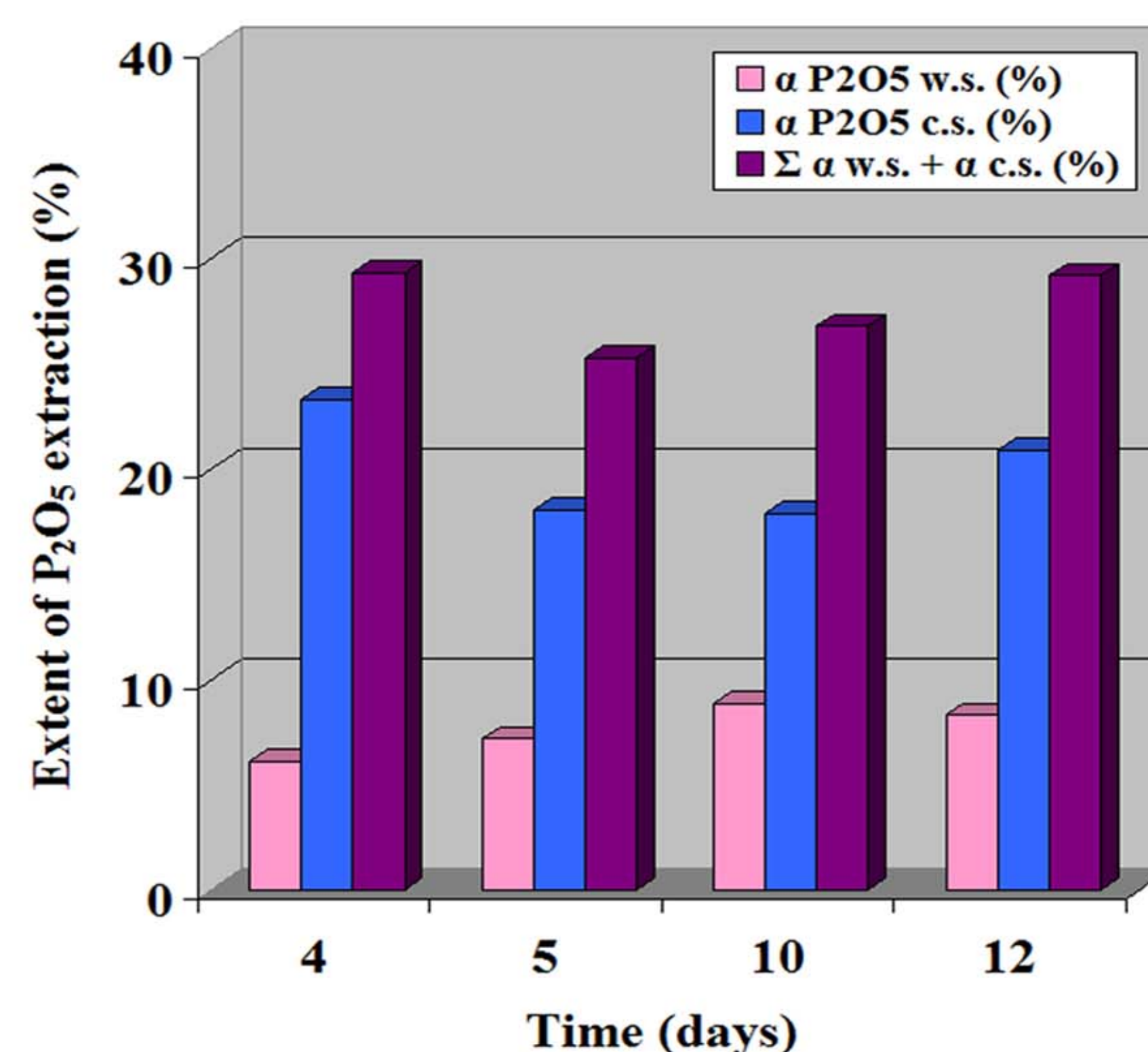


Fig.5 Change in the extents of P₂O₅ extraction ($\alpha_{w.s.}$, $\alpha_{c.s.}$, and $\Sigma\alpha_{w.s.} + \alpha_{c.s.}$) in nutritive medium containing 2% MAJP

Conclusions

The results indicated the positive affect of preliminary mechanical activation on the bioconversion process. A correlation has been observed between soluble phosphate and titratable acidity.

A maximum degree 54.3 % of P₂O₅ extraction has been reached immediately on the 1st day of incubation when in the medium was added 0.5 % MAJP. The investigations with NAJP showed that the extraction of P₂O₅ was two times lower than with phosphate (26.4 %) in the same conditions.

