Studies on the chemistry of phosphorus compounds in the calcareous soils treated with organic materials

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previous studies showed fairlysometimes contradictory informationsinvolving phosphorus compounds thatcalcareous soils.little and perhapsamout the reactionsmay take place inTo elucidate the nature of such reactions, CaC03(chemical compound), fractionated oleitic limestone and atypical calcareous soil were investigated for their reactivitywith P either from phytic acid or hydroxyapatite in presenceof humic acids derived from three organic-raw materials.The recovery and characterizations of humic acidsincluding elementary analysis, infra-red and ultra-violetspectroscopy were carried out. The ability of humic acids for Psolubilization was compared using H20, NaHC03 and NaOH as Psolvents. Langmuir, Freundlich And Van-Huay equations weretested for their reliability to assess P adsorption relationsin the systems including; different limestone fractions, threedifferent humic acids and (calcareous soil + humic acid).The results obtained are summarized as follows:a) Recovery and characterization of hnmic acids.Recovery of humic acids dominated than fulvic acid andthat seems to be dependent on/the total organic carbon contentof organic materials and their rate of decomposition.The highest and lowest values of total N content of humicacids were obtained from humic acids derived from peanut andbarley straw, respectively.The aromatization of humic acid prepared from barleystraw exceeded those originated from other sources.The infra-red test showed that, the greatest intensity ofhumic acids at 3400 cm-1 was obtained in humic acid derivedfrom barley straw, compared with other sources.The highest humic acid O/H ratios were the greatest O-Hstretch absorption at 3400 em-I, at 1400 em-I, at 1200 cm-1 andat 1128 cm-1 when they were treated with KH2P04.As the surface area of the CaC03 present in the system of H.Asand hydroxyapatite increased, the intensity of infra-red at3400 cm-1 also, increased.There were no serious variations between the absorptionat 3400 cm-1 of H.As treated with either hydroxyapatite orphytic acid.---------- ---- ._-- -- As the C/H ratios of H.As increased, the absorptionintensity at 2920-2860 cm-1 also, increased either in presenceor absence of KH2P04.The absorption of H.As at 1700-1725 cm-1 in the presenceof KH2P04 greatly depends on their oxygen content and their C/Oratios.Application of humic acids with phytic acid, mostlyincreased their absorption at 1700-1725 cm-1, compared withthose treated with hydroxyapatite. This is probably attributedto the lower adsorption of phytic acid on both H.A. and CaC03than hydroxyapatite due to the greater molecule of the formercompared with the later.The absorption of H.As mixed with hydroxyapatiteincreased by increasing the surface area of CaC03 fractionspresent in the same system, that may suggest that the amountsof hydroxyapatite adsorbed on H.As mixed with fine limestonewould be smaller than those mixed with coarse limestone.The values of H.As intensity at 1300 cm-1 agree withtheir total C/N ratios content.147The ultra violet spectra indicated that the higher carboncontent humic acid was the greater aromatic condensation andthe more humified humic acid.b I The ability of acids ou the P solubility uuder the equilibrated systems.Half normal sodium hydroxide dissolved P, mostly morethan ten times those dissolved by both H20 and O.5N NaHC03 dueto the greater pH of the former, compared with the laters.Humic acid dissplved in O.5N NaOH extracted mostly morethan ten times and more than one hundred times those extracted•by both O.5N NaOH and H20 or O.5N NaHC03, respectively. Calciumchelation by humic acids !~m calcareous soil and limestonefractions

stimulate P solubilization and decreases itsprecipitation as calcium phosphate.The solubilization of P by different solutes from systemscontaining phytic acid and CaC03 greatly exceeded thatsolubilized from hydroxyapatite. These results are due to thehigher solubility of phytic acid in the different solutes,compared with the very low solubility of hydroxyapatite.Phosphorus solubilization from systems containing thefinest limestone yielded the lowest P values as compared withall the other systems.Humic acid in the gel form has a greater capability tosolubilize P, compared with the dried form of humic acid.C) Phosphorus adsorption isotherms:Data of P adsorption by different CaC03 sources, showedcomplete fitness to Langmuir adsorption isotherm in case ofcalcareous soil and oleitic limestone fractions. The previousequation was of fairly low efficiency in the case of thechemical compound, CaC03 (c.c.), that may be due to dominancyof other mechanisms responsible for P sorption rather than tothe one layer adsorption mechanism.According to Langmuir isotherm, there was no significantfitness for assessing P sorption in the systems containinghumic acid, meanwhile this reliability was highly significantin case of either Van-Huay or Freundlich equation, that was themost reliable isotherm for such systems. The failure ofLangmuir isotherm to describe the relation of P sorption inpresence of humic acid may indicate the dominance of otherreactions requiring higher bonding energy such as chemicalreactions involving replacement of enolic or phenolic O-Hgroups.A close positive relationship between the maximum Padsorption (b) of Langmuir isotherm adsorbed on active surfaceand clay content, whereas a negative relationship with theaffinity constant (K) was also, obtained. It seems that Van-Huay equation is more efficient for describing P sorption insuch systems.Finally, it may be concluded that:humic acids are proved to be effective materials inducing Psolubility in systems involving CaC03 which may suggest acontrolling effect on P solubility due to these acids in suchsystems. The tested H.As can be arranged according to theirsolubilizing effect on P in the following order: Peanut H.A >farmyard manure H.A > Barley straw H.A.As the surface area of limestone fractions increased, theP solubility of the system decreased and paralley increased theabsorption of l.R at the wave length, characterizing the OHstretch which represent the main seat of P sorption. Thisphenomenon could be explained a basis of increasing theactivity or potentials of Ca ions and hence the H2P04potentials decreased and/or precipitation reaction ofCa3 (P04) 2 that may take place at relatively higher Pconcentrations.