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METABOLISM OF ^{32}P IN POULTRY

By

E.R.M. Abou-Hussein, M.A. Raafat, I.M. El-Gindi and M.S.M. Samy*

Experiments were conducted to determine the rate of uptake and distribution of intramuscularly and intraperitoneally administered 32p by cocks that had previously received phosphorus deficient and adequate diets. These studies indicated that the inorganic phosphorus in plasma was highly significant affected by its level in the diet. It was found that phosphorus level in the diet had very slight effect on its level in the soft tissues and organs tending to be the highest in the supplemented group and the least in the deficient one. The level of dietary phosphorus affacted its content in bones. Bones in the supplemented group contained the highest level of phosphorus while that of the deficient one contained the least. The results of these experiments showed that the order of distribution of ^{32}P among tissues and organs of each group was not affected by the dietary phosphorus level. The mode of injection viz., intramuscularly and intraperitoneally had no effect on the distribution of ^{32}P among tissues and organs. Of the soft tissues tested, the liver contained the greatest amount of ^{32}P followed by the kidneys heart muscles and others, with the brain containing only very small amounts. These data indicated that the tissues and bones of the deficient group retained generally more --P than those of the other two groups, and those of the supplemented one retained the least. The standard specific activities of most tissues and organs tended to be high at times soon after tracer administration and then declined gradually thereafter, while that of bones increased at later times after injection.

Recently, the production of artificially radiocative phosphorus (^{32}P) has furnished a new expermintal approach of phosphorus metabolism. Inoue *et al.* (1950) observed that ^{32}P was most aboundantly by mice in bones, liver and blood, while the small intestines, spleen, kidney, testes and muscles contained minute amounts. Smith *et al.* (1951) found that the rate of ^{32}P uptake by swine tissues decreased in the following order : bile, liver, kidneys, thymus, lymphnode, heart, spleen tongue muscle, lung, stomach (smooth) muscle, gastro-cnemius and biceps (skeletal) muscle and brain. Rosenfeld and Inoue (1950 Beath 1952) furnished a new expermintal approach of phosphorus metablishm. Pointed out that the rate of ^{32}P uptake by adult rabits tissues was bility of the cells to phosphate ion. Freeksen and Meissner (1953) found that the activity of ^{32}P in rabgits, blood decreased exponentially with the lapse that the activity of ^{32}P in rabbits, blood decreased expontially with the lapse of time up to 10 days after injection. After intravenous, intrapleural or subcutaneous injections, the curves were similar in the shape, but after oral administration the activity in the blood reached its maximum only after the lapse of 2—3 days and then decreased. Their results showed little effect due to the route but a definite effect due to the lapse of time. Smith *et al.* (1951) observed that the rate of ^{32}P uptake by turkey tissues was greater in the liver than in the kidneys, heart, spleen, lungs, gastrocnemius and brain.

* Animal Production Department, Faculty of Agriculture, Cairo University.

Material and Methods

Thirty six Rhode Island Red coks of about one year old were experimented on. They were dividen into equal three groups. The first group received a ration containing the normal level phosphorus (0.6 gm phosphorus per cock daily) recommended by Morrison (15). The second group (supplemented one) was given the previous ration plus phosphate salt (to cover three times phosphorus requirements of cocks. The third group (deficient one) was fed on yellow corn alone which covered only half of phosphorus requirement of cocks. Water was supplied ad libitum. The composition of the diet of the three groups are given in the following :

Criteria	Group I	Group II	Group III
Corn grains %	20	20	100
Barley %	20	20	—
Wheat bran %	20	20	—
Rice bran %	20	20	—
Undecorticated cottonseed cake %	20	20	—
Quantity of the ration/cock daily gm.	100	100	100
Phosphorus per cock daily gm.	0.621	1.821	0.301

Two months before administrating radioactive isotope, the cocks were individually caged. On the sixty first day, immediatyl after the first feed intake, each cock in the three groups was injected with 20 Mc ^{32}P labeled sodium phosphate. Six cocks in each group were injected intramuscularly and the others intraperitoneally. Two cocks from each group but differing in the site of injection were killed and bled to death at 6, 12, 24, 48, 72 and 96 hours after injection. Blood was collected and some tissues were taken for radioactive assaw and chemical determination. The injectoin, precautions, and techniques involving the radioactive material were carried out according to Comar (1955), and Hansard *et al.* (1951).

Radioactivity was counted using Geiger muller counter. Preparation of samples of plasma for counting was carried out as reported by Kamal and Cragle (1962). Organs and tissues were prepared using the method of Smith *et al.* (1951). The samples used for radioassay were used also for phosphorus determination. The method of Fiske and Sabbarow (1925) was used for phosphorus estimation. The calculations of radioactivity were carried out according to Hevesy (1948), Sacks (1953), Comar (1955), and Overman and Clark (1960). Snedecor's book (1959) was consulted for statistical analysis.

Results and Discussion

1. *Radioactive and inorganic phosphorus in plasma :*

The results indicated that there was no effect for the route of injection on the course of the standard speccific activity (S.A.) of plasma during the different intervals after injection. This is in agreement with that abtained by Freerksen and Meissner (1953) with rabbits. It can be noticed from table (1, 2) that the dietary phosphorus level had a significant effect on phosphorus concentration in the different parts of the body, being the lowest in the deficient group and the highest in the supplemented one. The average plasma phosphorus was 5.37, 6.87 and 3.89 mg/ 100 ml plasma for the cocks fed on the normal, supplemented and deficient ration respectively. Three were highly significant differences between the normal group and either the supplemented or the deficient one. These results are in good agreement with those obtained by Abou-Hussein *et al.* (1968) with rams, Beeson *et al.* (1944) with lambs, Gibson *et al.* (1950), and Tillman *et al.* (1959) with cattle.

2. *Phosphorus distribution :*

It can be seen from Table (3) that phosphorus level in the diet had a very slightly effect on its level in the soft tissues and organs, tending to be the highest in the supplemented group and the least in the dificient one. These findings are in good agreement with those of Schneider and Steengock (1939) with rats, and Tillman *et al.* (1959) with cattle. In this connection Hansard and Plumlese (1954) reported that soft tissues are apparently maintained when necessary at the expense of bone minerals. The equilibrium existing between bone and soft tissues would probably require complete bone depletion before these tissues would materially be affected. It can be observed that there was a marked effect of dietary phosphorus on its content in bones. The supplemented group contained the highest level of phosphorus while the deficient one contained the least. The results indicate that the phosphorus content, in the diaphysis, is always higher than that of the epiphysis in the different groups. These results are in agreement with those found by Rosenfeld and Beath (1952) with rates, Smith *et al.* (1951) with swine, Smith *et al.* (1955) with sheep and Smith *et al.* (1956) with turkeys.

3. *Radioactive phosphorus retention :*

It was observed that the deficient group generally retained more ^{32}P than the other two groups while the supplemented one retained the least. These results are similar to those found by Allam (1966), Hansard and Plumlese (1954) with ^{45}Ca on rats and Abou-Hussein *et al.* (1964) with ^{52}Mn on rams. The retention of ^{32}P by bones was affected by the level of phosphorus in the diet. The phosphorus deficient group retained more ^{32}P in tissues organs, and bones than the normal one, while the supplemented group retained the least. This adaptation may be mediated through the postulated active transport system.

TABLE 1.—RADIOACTIVE AND INORGANIC PHOSPHORUS IN PLASMA OF COCKS FED ON NORMAL AND SUPPLEMENTED RATIONS

Hours after injection	Normal group				supplemented group			
	Inorganic P mg/100 ml.	^{32}P Uc/ml.	Specific activity	Standard S.A.	Inorganic P mg/100 ml.	^{32}P Uc/ml.	Specific activity	Standard S.A.
6	5.33	0.00748	0.1403	9.296	7.03	0.00206	0.0293	2.080
12	5.68	0.00368	0.0648	4.130	7.01	0.00793	0.1131	8.486
24	5.04	0.00362	0.0647	3.660	6.75	0.00249	0.0369	3.137
48	4.93	0.00304	0.0616	3.836	6.28	0.00246	0.0361	3.194
72	5.00	0.00320	0.0640	3.348	6.88	0.00162	0.0235	1.924
96	6.10	0.00176	0.0288	2.040	6.86	0.00099	0.0144	1.428

TABLE 2.—RADIOACTIVE AND INORGANIC PHOSPHORUS IN PLASMA COCKS FED ON NORMAL AND DEFICIENT RATIONS

Hours after injection	Normal group				Deficient group			
	Inorganic P mg/100 ml.	^{32}P Uc/ml.	sepecific activity	Standard S.A.	Inorganic P mg/100 ml.	^{32}P Uc/ml.	sepecific activity	Standard S.A.
6	5.33	0.00748	0.1403	9.296	3.92	0.00567	0.1446	14.865
12	5.68	0.00368	0.0648	4.130	4.02	0.00704	0.1751	14.009
24	5.04	0.00326	0.0647	3.660	3.95	0.00311	0.0787	7.209
48	4.93	0.00304	0.0616	3.836	3.91	0.00189	0.0483	4.871
72	5.00	0.00320	0.0640	3.348	3.82	0.00228	0.0597	7.016
96	6.10	0.00176	0.0288	2.040	3.87	0.00270	0.0698	7.312

TABLE 3.—PHOSPHORUS CONTENT IN TISSUES AND ORGANS OF COCKS FED ON RATIONS CONTAINING DIFFERENT HOSHORUS LEVELS

ITEM	mg. phosphorus/ gm. fresh weight		
	Normal	Supplemented	Deficient
Pectoral muscle	2.19	2.31	2.11
Gastrocnemius muscle	1.85	1.90	1.72
Kidneys	2.40	2.58	2.34
Liver	2.78	2.87	2.63
Testes	1.57	1.64	1.38
Heart	2.06	2.16	1.95
Spleen	2.69	2.90	2.53
Bile	1.75	1.89	1.55
Femur :			
Epiphysis	38.14	50.75	21.34
Diaphysis	75.22	80.34	68.75

4. *Radioactive phosphorus distribution :*

The results indicated that the level of dietary phosphorus did not ifluence the distribution of ^{32}P among tissues and organs. Moreover, the mode of injection viz. intramuscularly and intraperitoneally had no effect on the radioactive distribution. In this connection, Havesy (1948), Rosenfeld and Beath (1952) reported that the uptake of phosphorus by a particular tissue may depend upon the permeability of the cells to phosphate ion. Some tissues, notably the liver, Kidneys, heart, spleen; showed a rapid uptake rate; while others particularly the testes, and gastrocnemius and pectoral muscle showed much slower rate (Figures 1—3). Within the three groups, the tissues can be arranged generally in the following order of decerasing radioactive phosphorus uptake rate : bile, liver, kidneys, heart, spleen; testes; gastrscnemius muscle and pectoral muscle. It can be noticed also that ^{32}P uptake by these tissues was the highest in the deficient group and the lowest in the normal one. These results are in harmony with those found by Cohn and Greenberg (1938) with rats, Smith *et al.* (1951) with swine, Smith *et al.* (1955), and Abou-Hussein *et al.* (1968) with sheep.

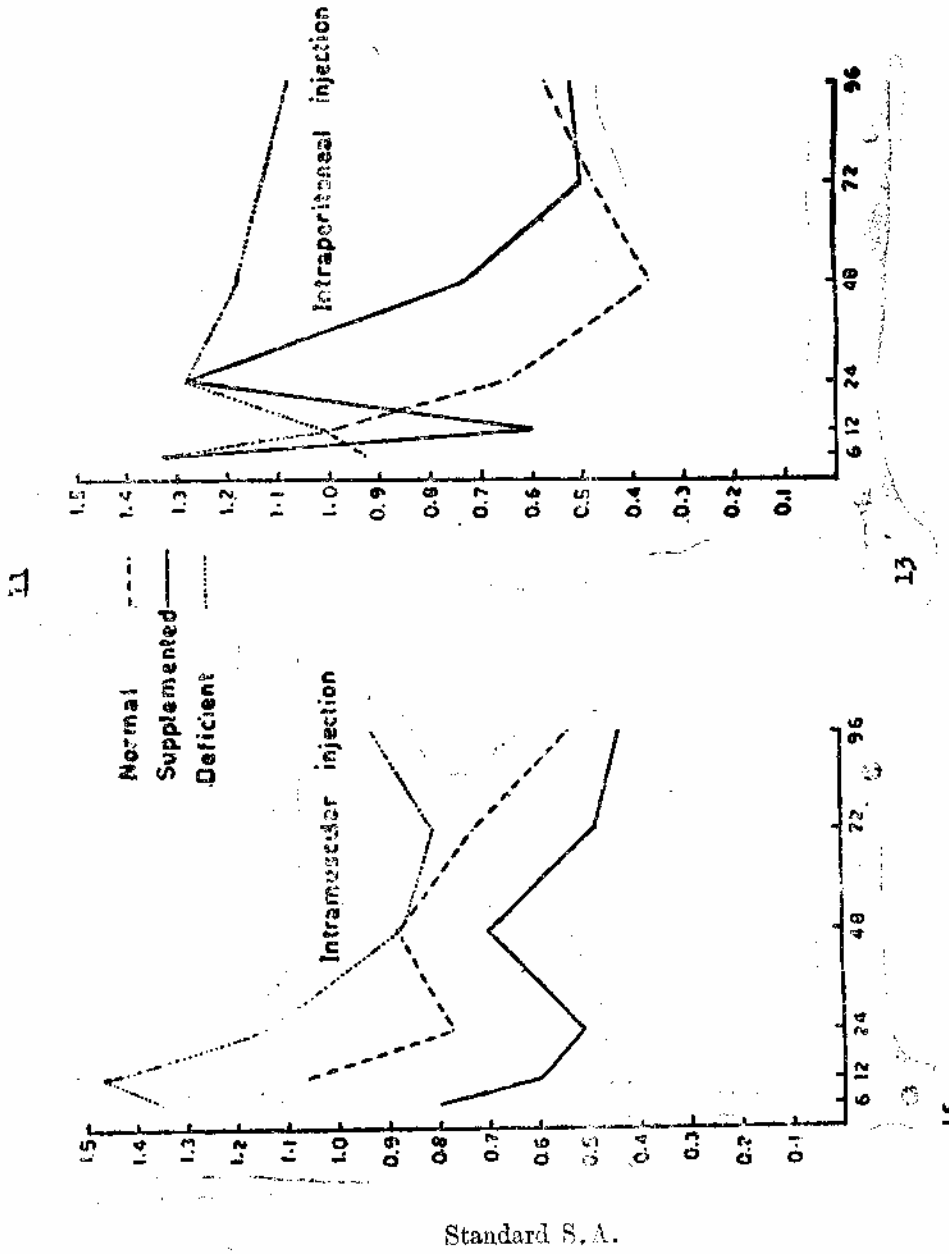

FIG. 1.—Standard S.A. for the liver of cocks at different intervals after injection.

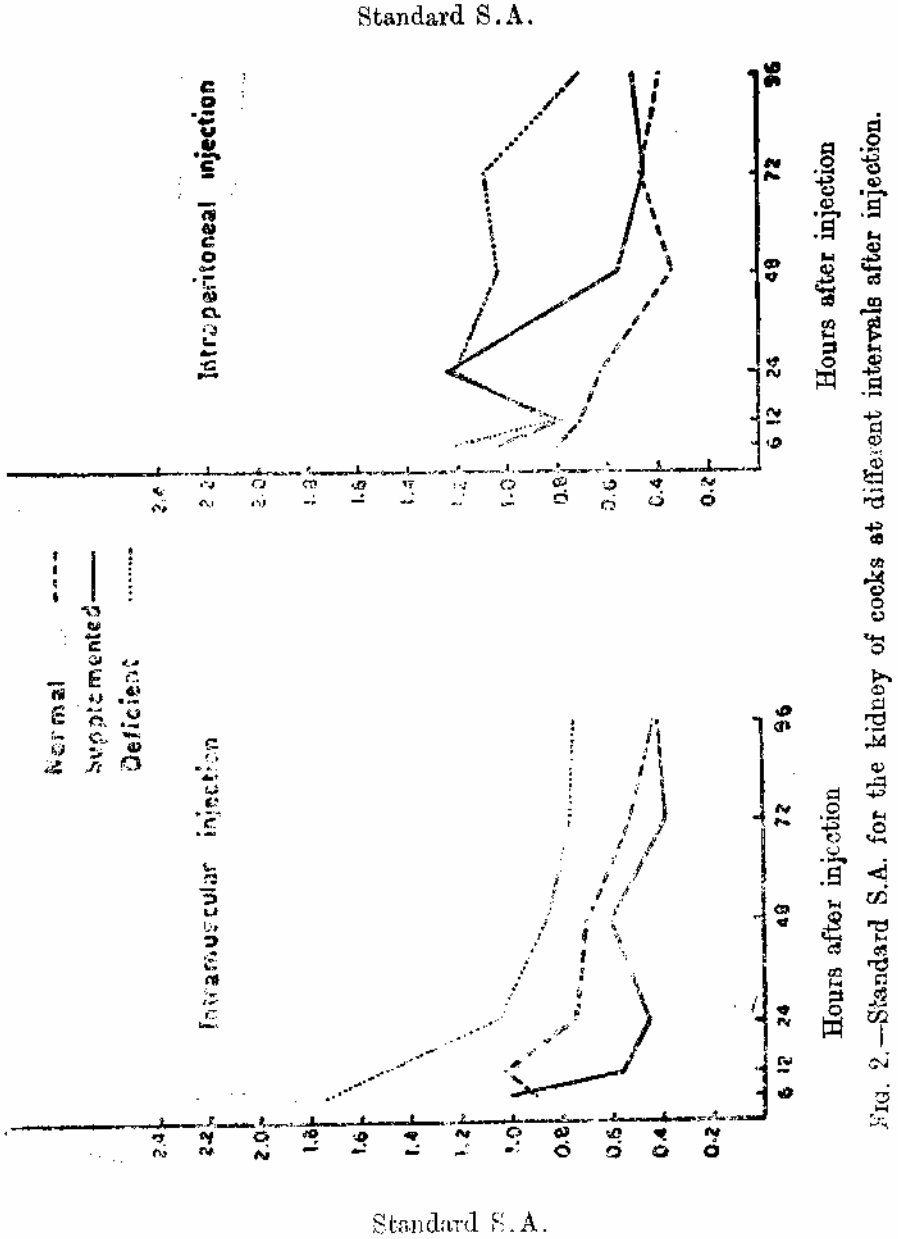

Fig. 2.—Standard S.A. for the kidney of cocks at different intervals after injection.

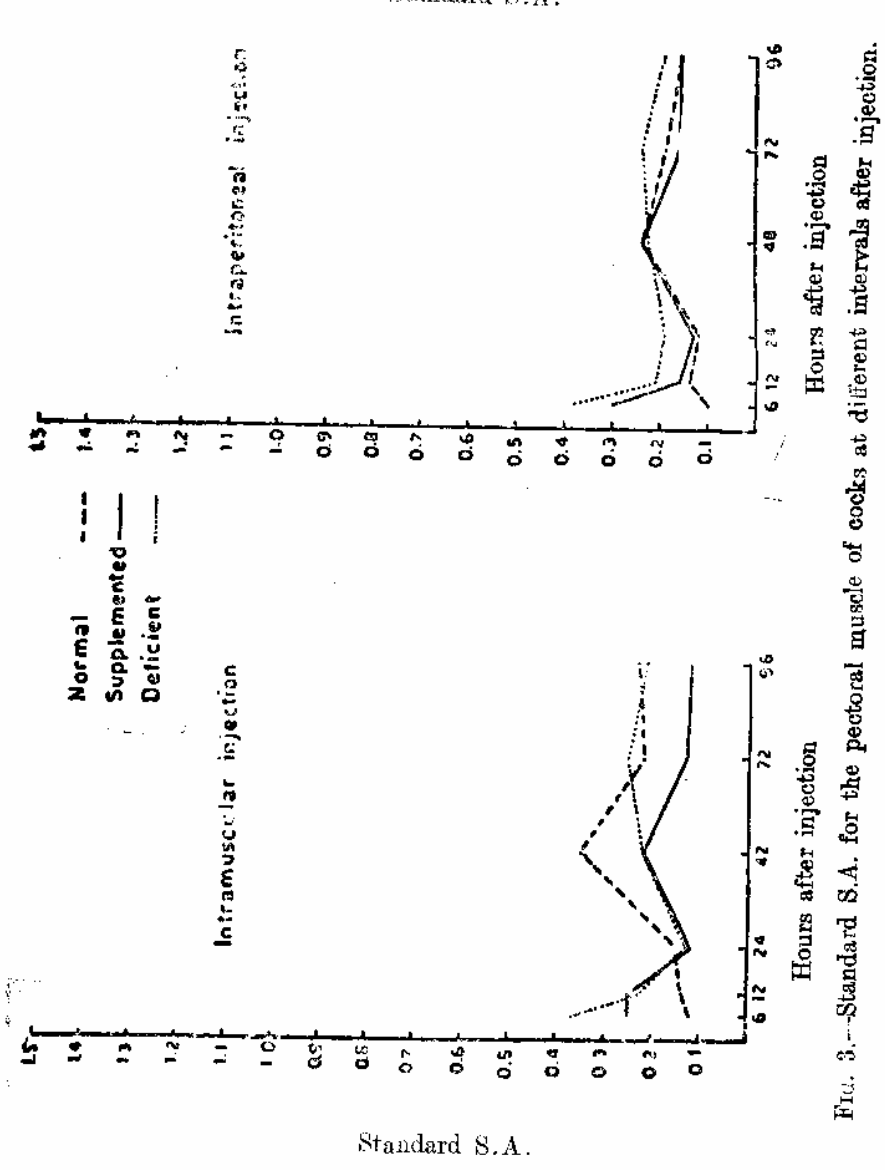

FIG. 3.—Standard S.A. for the pectoral muscle of cocks at different intervals after injection.

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تمثيل الفوسفور المشـــع فى الدجاج

رفعت أبو حسـين ، محمد على رافت ، ابراهيم الجندى ، محمد سـامى

الملخص

استخدم فى هذا البحث ستة وثلاثون ديكا رود ايلاند أحمر وقسمت هذه الديوك الى ثلاث مجاميع متســاوية وغذيت ديوك المجموعات الأولى والثانية والثالثة طوال مدة الدور التمهيدى الذى استمر لمدة شهرين على علائق عادية وعنية وفقيرة بالنسبة لعنصر الفسفور . وفى نهاية مدة الشهرين حقن كل ديك فى الثلاث مجموعات بمقدار ٢٠ ميكروكورى فسفور مشـع فو٣٢ . وقد حقن فى كل مجموعة ستة ديوك فى العضل والسـتة الباقية حقنت فى التجويف البطنى . ثم ذبح ديكان فى كل مجموعة تختلفان فى موضع الحقن على الفترات التالية ٦ ، ١٢ ، ٢٤ ، ٤٨ ، ٧٢ ، ٩٦ ساعة بعد الحقن . جمع الدم من كل ديك عند الذبح وقدر الفسفور الغير عضوى والمشـع فى البلازما . وكذلك أخذت عينات من بعض الأعضاء وانسجة معينة من كل ديك وذلك لتقدير الفسفور المشع . أما بالنسبة للفسفور الكلى فقد قدر فى اعضاء وانسجة ثلاث ديوك مختلفة لكل مجموعة من المجموعات الثلاث .

وقد أوضحت النتائج أن الفسفور الغير عضوى فى بلازما الدم يتأثر تأثرا معنويا بمستوى الفسفور فى الغذاء فكان متوسطه ٦ر٨٧ ، ٣٧ر٥ ، ـ ٣ر٨٩ جم/١٠٠ سم ٣ بلازما فى كل من المجموعات التى غذيت على علائق عتية وعادية وفقيرة فى الفســفور على التوالى . كان لمسـتوى الفسـفور فى الغذاء تأثير طفيف جدا على مســتواه فى الأعضــاء والأنســجة المختلفة بالجسم . وان كان يميــل للزيادة فى المجموعة التى غذيت على عليقة غنيبة به وللقلة فى المجموعة التى غذيت على عليقة فقيرة به وكان لمستواه فى الغذاء تأثير واضح على مستوى الفسفور فى العظم اذ احتوى عظم المجموعة التى غذيت على عليقة غنية بالفسفور على أعلى مقدار منه واحتوى عظم المجموعة التى غذيت على عليقة فقيرة فى الفسفور على أقل مقدار منه .

ووجد أن موضع الحقن سواء فى العضل أو التجويف البطنى ليس له تأثير على توزيع الفسفور المشع بين الانسجة المختلفة وبعضها فى المجاميع الثلاث . وقد أمكن ترتيب الأنسجة والأعضاء المختلفة فى المجاميع الثــلاثة تبعا للنشـاط النوعى المعرض للفسفور المشع فى ترتيب تنازلى كالآتى :

« مرارة ـ كبد ـ كلية ـ طحال ـ خصيتين ـ عضلة الفخذ ـ عضلة الصــدر » .

قسم الانتاج الحيوان (فرع التغذية) كلية الزراعة . جامعة القاهرة .

ولقد وجد أن المجموعة التى غذيت على عليقة فقيرة فى الفسفور قد احتجزت أعلى كميات من الفسفور المشع (نشاط نوعى موحد) فى أعضائها وأنسجتها المختلفة واحتجزت المجموعة التى غذيت على عليقة غنية فى الفسفور أقل مقادير منه . وكان النشاط النوعى الموحد للأنسجة والأعضاء المختلفة فى المجاميع الثلاث عاليا فى الأوقات القريبة من الحقن بينما وجد أنه ازداد فى العظام فى الفترات البعيدة من وقت الحقن .