Phosphate comparative value variations in 16 (Australian) IFP samples

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Contenido

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OBJECTIVE

Make the point on the differences of composition and the relation with a different behaviour on animals.

ANALYZED PRODUCTS

Sixteen different samples of products collected in Australia has been analysed in order to determine the phosphates composition split in Monocalcium phosphate monohydrate, dicalcium phosphate anhydrous and dihydrate, tricalcium phosphate (including apatite), polyphosphoric salts (pyrophosphates) and free phosphoric acid.

The products are declared as calcium phosphates (5), dicalcium phosphates (7), monodicalcium phosphates (2) and monocalcium phosphates (2).

SAMPLE	P_{TOTAL}	$P_{CITR\ 2\%}$	$P_{SOL\ AQ}$	$P_{SOL\ CAA}$	Ca	P_{105}	P_{200}	$CaCO_3$	SO_4^{2-}	As	Cd	Pb	F	pH
Calcium phosphate B sample 1	19,2%	25,1%	0,2%	7,3%	33,9%	0,1%	0,1%	6,5%	0,0%	21,2	0,3	4,4	56,1	12,2
Calcium phosphate A sample 2	18,6%	56,5%	0,0%	7,7%	31,8%	0,1%	0,2%	0,4%	0,1%	8,5	0,4	5,2	0,2	12,1
TIMAB TUNISIA 3	21,7%	99,3%	90,1%	95,5%	16,6%	2,1%	9,2%	2,1%	3,9%	-	7,7	2,0	462,0	3,4
Calcium phosphate S 4	21,2%	99,6%	69,9%	98,6%	18,1%	1,5%	8,4%	2,8%	2,2%	1,9	0,2	4,8	979,0	3,6
Calcium phosphate Sample EF 5	22,9%	98,6%	70,0%	94,8%	17,7%	1,8%	8,4%	0,3%	0,0%	0,5	-	-	1.195,0	3,6
Calcium phosphate Sample EF 6	23,0%	99,6%	67,9%	94,3%	16,8%	1,6%	9,2%	1,0%	0,2%	8,6	0,4	1,2	1.420,0	3,6
DCP PWD 119001 7	18,8%	100,0%	16,4%	75,1%	17,3%	0,5%	0,5%	0,2%	1,1%	13,4	0,5	4,1	219,0	7,2
DCP PWD11900120170401 8	18,3%	96,6%	7,9%	89,7%	16,4%	0,7%	1,0%	0,5%	1,9%	9,7	1,5	4,3	1.048,0	7,0
DCP PWD120051 9	18,2%	99,6%	7,1%	85,4%	23,6%	0,7%	7,3%	1,9%	0,6%	19,2	0,7	1,9	1.277,0	7,1
DCP PWD120051 10	17,9%	44,3%	0,5%	11,1%	38,2%	0,2%	0,2%	0,2%	0,2%	68,6	0,4	4,1	295,0	9,1
DCP PWD12020181129 11	17,5%	48,9%	0,0%	17,6%	30,1%	0,1%	0,1%	0,4%	0,3%	out of range	0,2	7,0	216,0	9,2
DCP PWD120136209020112	18,0%				31,5%	0,0%	0,1%	1,0%		13,8	0,3	5,0		9,4
DCP 120137 13	17,6%	43,0%	6,3%	12,2%	32,6%	0,2%	0,2%	0,6%	0,2%	24,5	1,5	3,6	178,0	
MDCP 119884 14	21,3%		76,3%		15,9%	2,0%	9,3%	5,6%	3,4%	5,4	4,2	1,9	13,3	
MDCP 119869 15	20,8%	99,8%	83,0%	97,0%	13,3%	2,8%	11,4%	4,2%	2,6%	18,2	0,9	4,3	888,0	3,4
MCP 221-837-1 16	22,6%	100,0%	80,1%	99,0%	15,1%	2,5%	5,7%	0,3%	1,3%	8,5	4,0	2,5	23,0	3,5

SAMPLE DESCRIPTION

Sample 1 and 2

Level of phosphorus is like a regular DCP, but it doesn't correspond to this kind of phosphate as solubility in citric 2 % is very low and equivalent to tricalcium phosphate. This nature of composition is confirmed by the very low solubility in alkaline ammonium citrate that doesn't reach to 10 %.

Beside the ratio Ca/P is 1.66 in sample 1 and 1.71 in sample 2 very far than theoretical value for DCP of 1.29. It means that the product is more like TCP than DCP itself.

The product is a very fine white powder produced by precipitation of dilute phosphoric acid probably coming from some recycled phosphorus with a calcium source. In sample 1 it seems that source may be calcium carbonate while in second sample could be calcium oxide or hydroxide. The excess of this calcium source may be the explanation of the very high pH.

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The fluorine content is well controlled but sample 1 has a very high level of arsenic out of EU legislation.

Sample 3

Though the level of Phosphorus is below 22 %, It's declared as monocalcium phosphate with a Ca/P ratio of 0.76 below the maximum level of 0.9 required by EU legislation to be included in this group.

The analysis of phosphorus soluble in different media and the low pH confirm that most of the phosphate is in the monocalcium phosphate form.

Production process is a reaction between phosphoric acid and calcium carbonate. It looks a dusty small granular with a gray colour probably due to an excess of heat during drying process. Therefore, the dicalcium content of the product seems to be in the anhydrous form.

Metal content is within EU legislation

Sample 4

This product has a Ca/P relation of 0.85. Considering that EU legislation consider than MDCP must be >0.8 and MCP <0.9, this production could be included in both definitions. A rich MDCP or poor MCP.

From the chemical point of view, it should be clearly included as MDCP as the phosphorus soluble in water is low for MCP. Compared with sample 3 or Global Feed MCP is 21 points lower.

The production process is like the one above. Phosphoric acid reacted with calcium carbonate as it appears traces of it.

The particle size is not homogeneous. There are lot of coarse granules bigger than 1.8 mm and beside there are 6 % of fines too.

Heavy metals fulfil EU requirements

Sample 5 and 6

Quite similar samples of MCP with a very high total phosphorus content due mainly to a very low sulphate and carbonate content. Oppositely the value of phosphorus soluble in water is low for an MCP due to the high level of DCP anhydrous that decrease the solubility in water without decreasing total phosphorus. In the case of sample 6 there are presence of polyphosphoric salts. This composition indicates that the drying process is quite aggressive.

Particles size of sample 5 it's coarser than sample 5. May be this is the reason of the highest reactivity of sample 6 to become polyphosphate.

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Samples 7,8 and 9

Declared as DCP. It seems to be a real DCP, but calcium level detected in samples 7 and 8 doesn't fit with a standard DCP value as they are very low. pH is the standard value for an DCP. There may be some cation missed in the analysis.

Strange sample to be studied in a deeper way as it doesn't fit with regular DCP.

Samples 10,11,12 and 13

They look like a good 'phosphate rock' or a rock slightly reacted with phosphoric acid. In samples 10,11 and 12 there is no phosphorus soluble in water at all and small amount of phosphorus soluble in alkaline ammonium citrate. In sample 13 it appears some solubility in water. That's why it may be a slight attack with phosphoric acid, but not hundred per cent sure. The colour and bulk density seem to confirm that they are phosphate rock.

None of this product are accepted in Europe for feed due to the high level of arsenic.

Particle size is finer in samples 10 and 11 than 12 and 13.

Sample 14

Though it is marked with MDCP, in terms of EU regulation is an MCP with a low level of total phosphorus as ratio Ca/P is 0.74 not reaching to the 0.8 minimum to be called MDCP. The phosphorus soluble in water is low and indicates a low presence of monocalcium phosphate compared with good quality MCP.

There is something strange in this sample as it can be noticed some coarse orange granules that doesn't fit with the hypothetic production process that may be the reaction between phosphoric acid and calcium carbonate.

The low level of phosphorus may be due to this filler that appears to be in the product. The analysis of carbonates and sulphates are higher than the rest of products probably linked with the presence of these spots.

Sample 15

Like former sample. The ratio Ca/P indicates that legally in Europe is considered as MCP, but the level of phosphorus corresponds to MDCP. The very low level of calcium makes impossible to consider it as MDCP. Again, it looks like an MCP with some kind of filler. The level of carbonates and sulphates are not normal with the composition of MCP. It seems again some cation missed.

The phosphorus soluble in water corresponds with a poor quality MCP more than to a MDCP.

The level of arsenic is higher than required per EU regulation.

Sample 16

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The phosphorus level and the Ca/P ratio indicates that it is an MCP but with a low level of phosphorus soluble in water.

In terms of particle size, it looks like very well with homogeneous size and dustless.

COMPARATIVE OF CHEMICAL COMPOSITION

Once all the products are analysed the data are used to make a chemical balance in which a composition is assigned.

There are some products in which some difficulties have been found. The more problematics balances have been for samples number 7,8, 9 and 15 dues to the low level of calcium detected.

While new tests for this samples are developed in order to assure the real composition, a hypothetical composition have been assigned always choosing the option with a higher digestibility.

In the table below appears the composition of each product sorted by EPCAR (Spanish acronym for Total absorption coefficient predictive equation). It also appears the EPCD for poultry (Digestibility predictive equation)

SAMPLE	MCP	DCPd	DCPa	PYRO	FREE ACID	TCP	EPCD	EPCAR
MCP GLOBAL FEED	80,2%	6,9%	5,7%	0,9%	0,7%		89,3	85,4%
3 TIMAB TUNISIA	77,0%		6,0%				90,0	85,0%
15 MDCP 119869	56,7%	5,2%		3,7%	9,0%		87,8	84,6%
4 Calcium phosphate S	58,2%	12,7%	13,7%				87,1	82,5%
5 Calcium phosphate Sample EF	63,6%	6,6%	22,0%				85,4	81,3%
16 MCP 221-837-1	71,6%	2,2%	1,8%	14,6%			86,7	80,1%
9 DCP PWD120051	3,6%	79,4%	9,4%			5,8%	79,4	79,3%
6 Calcium phosphate Sample EF	61,3%	3,0%	19,9%	7,2%			83,0	79,0%
14 MDCP 119884	57,4%			19,7%	5,0%		84,2	78,1%
8 DCP PWD11900120170401	4,2%	51,9%	10,2%	22,1%		2,1%	72,4	72,1%
7 DCP PWD 119001	10,8%	11,6%	0,0%	11,6%		15,2%	61,0	68,6%
2 Calcium phosphate A sample		13,3%				73,3%	56,5	63,4%
1 Calcium phosphate B sample			27,0%			61,0%	53,7	61,8%
13 DCP 120137	2,9%	10,3%				71,2%	56,3	29,9%
11 DCP PWD12020181129			13,2%			69,8%	52,3	27,3%
10 DCP PWD120051			8,0%			84,5%	51,7	24,0%
12 DCP PWD1201362090201			7,4%			79,4%	51,6	23,9%

The EPCAR is a new index produced from bibliographic data table. On that table it appears a TAC value for commercial product. Supposing it corresponds to mean values and knowing the mean composition of the commercial products, it has been assigned a TAC to each pure phosphate using this coefficient for ponderation the TAC for each commercial phosphate.

Looking at the order in the table it should be noticed that all the top phosphates are MCP or MDCP. In the seventh position it appears the first DCP that is even better than MDCP #14. This is due that the level of dihyrdrate in the DCP is very very high (79%) making it as digestible as MCP.

The four latest in the classification are the phosphoric rock with a very low value of absorption.

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COMPARATIVE OF DIGESTIBLE PHOSPHORUS

If mixed the digestibility results, as EPCAR, with the total phosphorus in each product there is a new classification in terms of kg P_{dig}/t phosphate. This is the real comparative among the product. The third column is the factor

SAMPLE	kg Pdig/t	price index	EU lex
MCP GLOBAL FEED	193,9	100,0%	MCP
5 Calcium phosphate Sample EF	186,0	95,9%	MCP
3 TIMAB TUNISIA	184,8	95,3%	MCP
6 Calcium phosphate Sample EF	181,3	93,5%	MCP
16 MCP 221-837-1	181,3	93,5%	MCP
15 MDCP 119869	175,5	90,5%	MCP
4 Calcium phosphate S	174,7	90,1%	MDCP
14 MDCP 119884	166,4	85,8%	MCP
7 DCP PWD 119001	157,5	81,3%	DCP
9 DCP PWD120051	144,1	74,3%	DCP
8 DCP PWD11900120170401	132,0	68,1%	DCP
1 Calcium phosphate B sample	119,0	61,4%	TCP
2 Calcium phosphate A sample	117,8	60,7%	TCP
13 DCP 120137	52,4	27,0%	Phosphate rock
11 DCP PWD12020181129	47,9	24,7%	Phosphate rock
12 DCP PWD1201362090201	43,9	22,6%	Phosphate rock
10 DCP PWD120051	42,8	22,1%	Phosphate rock

In the third column it appears the comparative price a customer could pay for one ton of phosphate to yield the same phosphorus efficiency.

In the last one it's written the European category of each product analysed. It's clearly noted that the first values correspond to MCP, then MDCP/poor MCP appears, later DCP, TCP and in the last one the phosphate rock.

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