Asian Journal of Chemistry; Vol. 29, No. 8 (2017), 1771-1778

ASIAN JOURNAL OF CHEMISTRY

https://doi.org/10.14233/ajchem.2017.20629

Phosphorus Contents of Processed Food in Indonesia

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Received: 7 March 2017; *Accepted*: 10 May 2017; *Published online*: 12 June 2017; AJC-18440

This study aimed to analyze phosphorus contents of processed food in Indonesia and its compliance with the regulations. Processed food with and without phosphorus as food additive on ingredient, listed in the National Agency of Drug and Food Control e-registrration database (2013-2015), were sampled and analyzed by spectrophotometry. The result showed that processed foods without phosphorus as food additives actually contained a certain amount of phosphorus. The difference of total phosphorus level in processed foods without phosphorus compared to that of with phosphorus ranged between 5-9 % with an average increase rate of 39 %. The difference showed the addition of phosphorus in processed food and generally met the regulation, except in seasoning and premix. This finding could be used as the basic for calculating maximum phosphorus permitted as food additive by the differences of phosphorus levels in products with and without phosphorus as food additives.

Keywords: Phosphorus, Phosphate, Food additive, Processed food.

INTRODUCTION

Phosphorus is a micronutrient that can be used as food additives in the form of phosphate compounds. As food additive, phosphorus acts as emulsifying salts, anti-caking agents, emulsifiers, stabilizers and acidity regulator, with maximum level of 10-9000 mg/kg depending on type of the foods [1]. National Agency for Drug and Food Control (NADFC) regulation [2-5] stated that the maximum use level of phosphorus as food additive is calculated according to total phosphorus in final product. Meanwhile, phosphorus as food additive mostly found in processed foods that initially have high phosphorus content such as dairy products, processed meats, cereals, *etc*., thus potentially affecting phosphorus levels in the final product. Based on the regulation of Codex Alimentarius Commission (CAC) [6], the maximum use level of phosphorus in meat and processed meat products has been revised in 2015, which was originally 2200 mg/kg to be 3250 mg/kg, calculated based on total phosphorus added as food additives and phosphorus that naturally existed in the raw material. In the mean time, Indonesia still using the maximum use level according to Codex Alimentarius Commission prior to 2015 [2-5].

Excessive intake of phosphorus can interfere with calcium metabolism [7,8]. Processed foods containing phosphorus additives are the contributors to phosphorus intake which may increase phosporus serum [9]. Research on phosphorus serum levels and its relation to mortality has been widely performed to patients with chronic renal failure undergoing hemodialysis. High phosphorus serum levels may increase death risk for hemodialysis patients, chronic kidney disease patients and cardiovascular patients [10-12]. The prevalence of high phosphorus intake in healthy adults in America and the wide use of inorganic phosphorus additives in processed foods have been linked to the increase of mortality [13].

Hyperphosphatemia is one cause of death in patients with chronic renal failure treated by hemodialysis [14]. Based on research conducted in Yogyakarta to 70 patients with chronic renal failure and hemodialysis, there was 77.14 % of patients with hyperphosphatemia with average phosphorus level of 7936 ± 4277 g/dL [15]. According to the report of Indonesian Renal Registry in 2015, the number of hemodialysis patients in Indonesia was 30,554 people with as much as 89 % chronic renal failure diagnosis, 7 % of acute renal failure and 4 % of chronic renal failure. The overall death number of hemodialysis patients in 2015 was 1243 people [16]. Information of phosphorus content on food products is needed by health professionals or nutritionists for setting the diet and selecting the foods for patients with hyperphosphatemia.

The purpose of this study was to analyze phosphorus content in processed food and its compliance with current regulations. The results were expected as basic information for policies and regulations related to phosphorus level in processed foods in Indonesia.

EXPERIMENTAL

The materials used were ammonium heptamolybdate tetrahydrate [$(NH_4)_6Mo_7O_{24}{\cdot}4H_2O$], ammonium metavanadate (NH_4VO_3), nitric acid, hydrochloric acid, potassium dihydrogen phosphate (KH_2PO_4), processed foods with phosphorus additives and processed foods without phosphorus additives. Laboratory tools for phosphorus assay were Thermo Line furnace, crucible plate, desiccator, plate clamp, hot plate, analytical balance, spectrophotometer (Shimadzu UV-1800), micro pipette, flask, stirring rod, measuring cup and other glassware.

The research method consisted of six stages. The first stage was data collection and data identification of processed food registered by 2013-2015 e-registrations in Directorate of Food Safety Assessment of BPOM RI (National Agency for Drug and Food Control/NADFC Indonesia). Data of processed food products with phosphate and without phosphate as food additivie (FA) was obtained formally through procedures applicable in NADFC. Identified food products were then grouped into several categories referred to Food Categories of 2015 [17]. After that, data cleaning was done specifically on change submission number, single MD submission number and export specific submission number of food products. The next stage was sampling. Number of samples was determined based on the Slovin method [18] and sampling was done proportionally to represent each category. Next step was identification of class and type of phosphate food additive on the label. According to the result of class and type identification of phosphate food additive, processed food was marked as a, b, c and d with the following conditions: (a) Processed foods label that lists phosphate food additive groups; (b) Processed foods label containing the name of phosphate food additive type; (c) Processed foods label containing phosphate food additive groups and names and (d) Processed foods label that meet labeling requirements.

Total phosphorus content was then analyzed using AOAC 986.24 method 2012 [19]. Results obtained was processed using descriptive quantitative statistic which describing the collected data. The detailed research stage is presented in Fig. 1.

RESULTS AND DISCUSSION

Table-1 presented the average phosphorus levels and maximum limit of phosphorus as additive in each processed food based on Indonesia regulation and Codex STAN 192-1995. Analysis results of phosphorus levels in the food category 08, which is meat and meat products, showed that the products without phosphorus additives were more than products with phosphorus additives with only little difference. Although the raw materials used should be the same for similar types of products, the formula was usually different in each manufacturer. If the raw material naturally contained phosphorus, it would affect the level of total phosphorus content in the final product. For example, in chicken karaage there was bigger difference of phosphorus content (-369 mg/kg); chicken karaage without phosphorus additives (2592 ± 23 mg/kg) was greater than chicken karaage with phosphorus additivess (2223 ± 13 mg/kg). It might occur due to the difference in the amount of the raw chicken meat, or the use of other materials containing phosphorus in product without additional phosphorus. Moreover, there was a possibility of hidden food additive containing phosphorus, meaning that during identification the product did not contain phosphorus additives both in composition or in the carry-over, when it was actually contained phosphorus additives from the materials of ingredient such as seasoning. It occurred also in sausage and nugget products. Research conducted by Lou-Arnal *et al.* [20] showed that the level of total phosphorus was relatively high in 118 processed food products yet there was no information on the label about the existence of phosphorus additives.

Based on the result, the level of total phosphorus in processed foods in the form of a powder was relatively high, but not exceeding the maximum limit of use. Processed foods in the form of powder such as milk powder, beverages and creamers require dilution prior to consumption, thus, the results obtained were converted into fast food/beverage. Phosphorus level analyzed was 221 mg/kg in creamer product, 807 mg/kg in milk powder and 246 mg/kg in powder drink. Maximum limit of use in creamer was 880 mg/kg and in milk and powder drinks were 500 mg/kg thus both products complied with the regulation. The calculation result of potable phosphorus level in milk powder was 807 mg/kg. Compared with the maximum limit (500 mg/kg), the value was not qualified. However, according to the difference in milk without additional phosphorus additives (472 mg/kg), the value met the maximum limit.

Results showed that certain amount of phosphorus was detected in processed foods without additional phosphorus additives, to an extent that even may exceed the maximum limit. For example in snacks, the average of total phosphorus content in snacks without phosphorus additives was 1203 mg/kg, while the maximum limit for these products was 1000 mg/kg. This matter could be taken into consideration in determining the maximum limit of total phosphorus levels on final products.

Total phosphorus detected in processed foods using from meat, flour, milk powder or skim milk, cocoa powder, egg yolk, as well as cereals, such as processed meats, bakery products and snacks, were more than 1000 mg/kg. Naturally, phosphorus content in flour is 150 mg/100 g, chocolate powder was 715 mg/100 g, egg yolk was 586 mg/100 g, chicken meat was 200 mg/100 g and beef was 170 mg/100 g [21]. Most processed foods are analyzed using those raw materials as standard. Phosphorus in food from both animal and plant was naturally contained in the form of organic phosphorus. Phosphorus in plant-based food can only be absorbed approximately 10 to 30 % as the majority of phosphorus in plant-based foods are available in the form of phytate [22].

Fig. 2 exhibited that the highest average of phosphorus content was seasoning, which was 10603 ± 320 mg/kg. Furthermore, the difference in average phosphorus level on seasoning

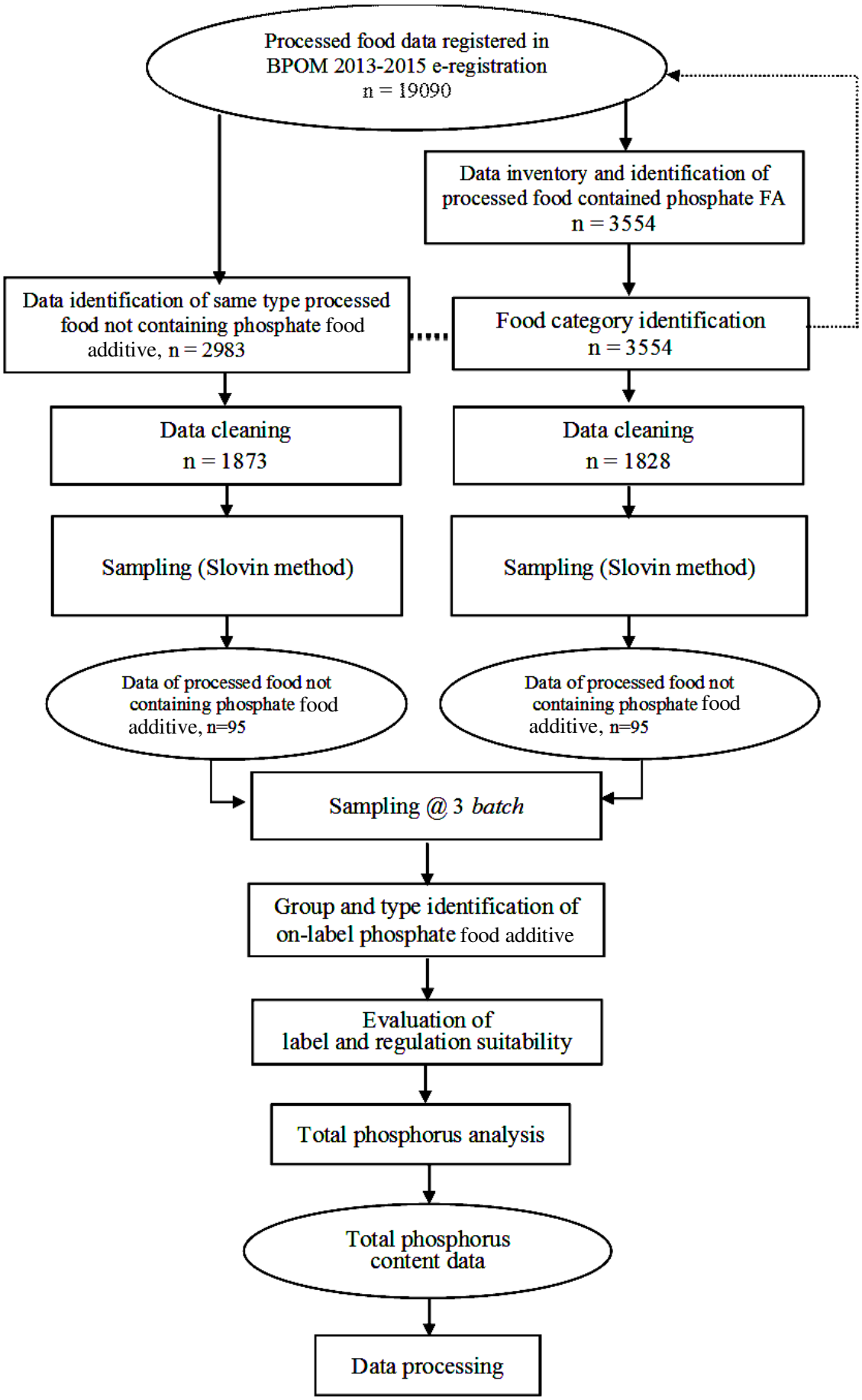

Fig. 1. Stages of sampling and analysis of total phosphorus content in processed food

TABLE-1
LEVELS OF TOTAL PHOSPHORUS (mg/kg) IN PROCESSED FOOD LISTED *via* e-REGISTRATION OF NADFC IN THE YEAR 2013-2015

Food categories	Type of processed food	Pocessed food with phosphorus additives		Processed food without phosphorus additives		Difference average between processed food with and without phosphorus additives	Maximum limit of total phosphorus	
		$\bar{X}$ ± SD	Min-Max	$\bar{X}$ ± SD	Min-Max		NADFC (Perka BPOM)	Codex STAN 192-1995
01	Non dairy creamer	5532** ± 19 (221)***	5519-5549	-*	-*	-	880[6]	13000
	Milk powder	5416** ± 25 (807)***	5399-5434	2249** ± 56 (335)***	2209-2289	3167(472)***	500[6]	4400
	Milk drink	1057 ± 39	1029-1085	752 ± 19	731-777	305	1320[6]	1320
	Flavoured milk drink	-*	-*	745 ± 11	737-753	-	1320[6]	1320
	Cheese	8365 ± 1856	6255-10763	4496 ± 107	4420-4571	4448	9000[5]	9000
06	Cereal	-*	-*	1444 ± 9	1437-1450	-	900[6]	2200
	Seasoned flour	1713 ± 25	1695-1731	795 ± 23	778-811	918	2500[5]	2500
	Instant noodle	1421 ± 355	1049-2226	1107 ± 302	705-1466	314	2000[6]	2500
	Dry noodle	1604 ± 256	1358-1838	1274 ± 23	1237-1276	329	2000[6]	2500
07	Crackers	1835 ± 1	1834-1835	1104 ± 147	935-1311	731		
	Malkist	2107 ± 7	2102-2112	-*	-*	-		
	Biscuit	1510 ± 367	1063-1856	1116 ± 336	660-1814	394		
	Cookies	1167 ± 0	1167-1167	1668 ± 788	817-2819	(22)	2200[6]	9300
	Wafer	1430 ± 27	1407-1461	1362 ± 359	582-1953	68		
	Premix	5211 ± 2000	2546-6572	1264 ± 209	1061-1447	3947		
	Cake	1282 ± 759	622-2040	-*	-*	1282		
08	Meatballs	1588 ± 492	1002-2318	971 ± 3	969-973	617	2200[5,6]	3520
	Corned beef	1823 ± 32	1800-1846	-*	-*	-	2200[5,6]	2200
	Sausage	1843 ± 492	1186-2997	1854 ± 67	1742-1944	(11)	2200[5,6]	3520
	Nugget	1547 ± 158	1396-1876	1582 ± 3	1580-1584	(35)	2200[5,6]	3520
	Chicken karaage	2223 ± 13	2214-2232	2592 ± 23	2576-2608	(369)	1650[6]	2200
09	Processed fish	1265 ± 411	756-1807	1073 ± 623	416-1819	192	2000[6]	2200
12	Seasoning	10603 ± 320	10377-10829	814 ± 499	316-1910	9789	880[6]	2200
14	Flavoured drink	-*	-*	97 ± 124	0-308	-	1300[6]	1000
	Carbonated drink	-*	-*	66 ± 62	0-177	-	800[6]	1000
	Powder drink	2464** ± 776 (246)***	2280-3904	1653** ± 236 (165)***	1343-1831	1214 (80.7)***	500[3]	300
15	snack	1847 ± 985	1031-3741	1203 ± 348	708-1825	644	1000[6]	2200

*There are no samples analyzed (based on the calculation of sampling); **Calculated on the product ready for consumption; ***P content is ready for consumption; NADFC = National Agency of Drug and Food Control.

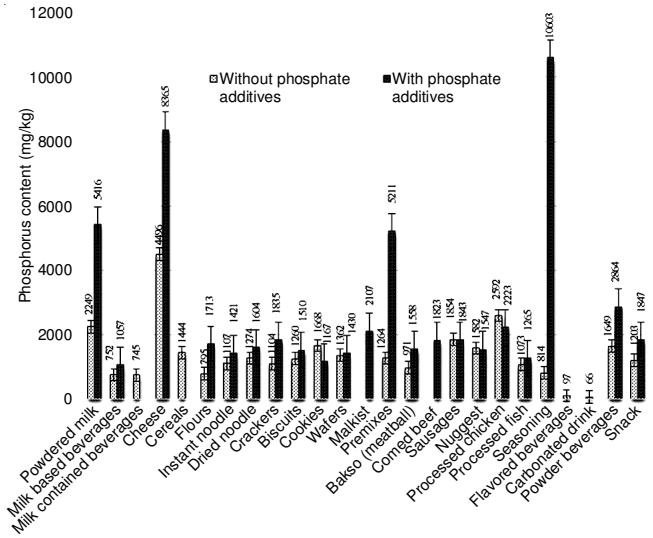

Fig. 2. Average of total phosphorus content in processed food without phosphate additives and processed foods with phosphate additives based on the type of food

without phosphorus additives was 9789 mg/kg with the increase of 92 %. Average phosphorus content in cheese products with phosphorus additives ranged between 8365 ± 1856 mg/kg and the difference from products without phosphorus additives was 4448 mg/kg with the increase of 46 %. The cheese is made from milk which naturally has high phosphorus content. Data of phosphorus content on a variety of milk; in cow's (whole) milk is 60 mg/100 g, skim milk is 97 mg/100 g, powdered milk is 694 mg/100 g and powdered skim milk is 1030 mg/100 g [21]. Among the products analyzed was processed cheddar cheese, which made not directly from raw milk but from pure cheddar cheese which already contained phosphorus additives, hence the relatively high phosphorus content in the final product.

Table-2 showed the differences of average phosphorus between processed food with phosphorus additives and processed foods without phosphorus additives. From these data, it could be calculated the increase in the average phosphorus level in processed food with phosphorus additives compared to processed food without phosphorus additives and can be

TABLE-2
INCLUSION OF PHOSPHATE ADDITIVES ON PROCESSED FOOD LABEL REGISTERED E-REGISTRATION YEAR 2013-2015 AND REGULATION OF THE MINISTER OF HEALTH NUMBER 033 ON FOOD ADDITIVES IN 2012

Food category	Number of samples	Product with phosphate food additive, n (%)	Product with phosphate food additive group, n (%) (a)	Product with phosphate food additive type name, n (%) (b)	Product with phosphate food additive group and type name, n (%) (c)	Products met labeling requirement n (%) (d)
Milk and milk products	11	6 (55)	4 (67)	4 (67)	4 (67)	5 (83)
Cereals and cereal products	30	23 (77)	22 (96)	7 (30)	8 (35)	11 (48)
Bakery	51	12 (24)	7 (58)	6 (50)	6 (50)	7 (58)
Meat and meat products	45	38 (84)	19 (50)	20 (53)	19 (50)	25 (66)
Fish and fish products	9	6 (67)	0 (0)	0 (0)	0 (0)	3 (50)
Salt, spices, soup, sauce, salad (seasoning)	11	1 (9)	0 (0)	0 (0)	0 (0)	1 (100)
Beverages (not milk based)	17	3 (43)	1 (33)	1 (33)	1 (33)	3 (100)
Snack	16	6 (38)	3 (50)	2 (33)	2 (33)	3 (50)
Total	190	95	56 (59 %)	40 (42 %)	40(42 %)	63 (66 %)

seen in Fig. 3. The average difference was 1337 mg/kg and the percentage of increase in total phosphorus content ranged between 5-92 % with an average increase of 39 %. This amount was higher than the research conducted by Leon *et al.* [23] on 13 categories of processed food, which was amounted to 670 mg/kg.

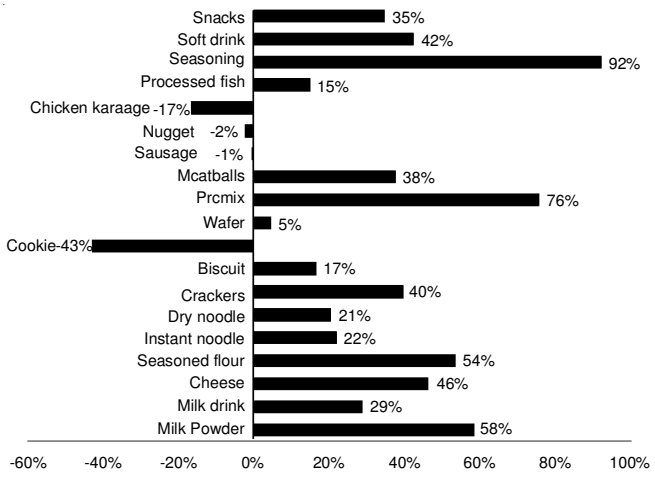

Fig. 3. Percentage of increase in phosphorus levels in processed food with phosphate additives

Type of phosphate allowed as food additive in Indonesia consisted of 23 types [1]. According to identification result on food label of processed food samples, phosphate additives used consisted of 12 types: sodium polyphosphate, dipotassium phosphate, disodium phosphate, sodium tripolyphosphate, tricalcium phosphate, disodium diphosphate, monosodium phosphate, tetrasodium diphosphate, trisodium phosphate, monocalcium phosphate, potassium polyphosphate and potassium tripolyphosphate with function as stabilizers, emulsifiers and anti-caking. Results of a study conducted by Sullivan *et al.* [24] on chicken products in the Cleveland Ohio, phosphate additive used in the samples consisted of sodium phosphate, sodium aluminum phosphate, sodium acid pyrophosphate, monocalcium phosphate and sodium tripolyphosphate. The type of phosphorus compound which was most widely used in products from this study was sodium tripolyphosphate (34 samples), which was used in instant noodles, dried noodles, meat balls, sausage, nugget, processed fish, seasoning and snacks. Phosphate additive used in the samples of this study was single or in mixed form, with phosphorus additives mixture consisting of 2 to 5 types of phosphorus compounds.

The inclusion of phosphorus additives on food label has been set on Ministry of Health Regulation of Indonesia (Permenkes No 033/2012) about food additives. Article 13 paragraph 1 states that "For food containing food additives, on the label must be included food additives groups" and paragraph 9 states: "On the label of processed foods containing carry-over food additives, it shall be included the carry-over food additives after the food additives-containing material" [1]. However, in the products identified containing phosphorus additives as carry-over, the information was not included on the label, thus it is difficult to know that the product actually contains phosphorus additives or not. As the study of phosphorus levels in some types of processed food by Arnal *et al.* [20], phosphorus content in processed foods containing phosphorus additives was relatively high, but there was mismatch on the label inscription.

Most of the phosphates food additive used in the samples served as stabilizer and emulsifier, also as anti-caking agent in one sample, which was powder beverage, according to the identification of processed food label. Beside phosphate-based, emulsifiers and stabilizers may be derived from vegetable or animal materials so it is mandatory to include the origin of the material on food label [25]. Phosphate food additive inclusion data on processed food labels is presented in Table-2, with identification as follows; 56 samples (59 %) only listed food additive group, whereas phosphate food additive type name was listed in 40 samples (42 %). The number of samples which listed both food additive group and type or class name was 40 (42 %). From all samples, there were 63 (66 %) who had fulfilled labeling requirement. From 63 samples meeting labeling requirement, 7 samples were processed foods containing phosphate food additive derived from carry over with unknown type of phosphate used, this was known not from labels but from preliminary data. The inclusion of carry over phosphate food additive on the label is not mandatory, hence the 7 samples meeting labeling requirements. Based on internal policy of NADFC, the inclusion of carry over of food additives on the label was only for colorant, preservatives, antioxidant,

TABLE-3
TYPE OF PHOSPHATE COMPOUNDS USED IN PROCESSED FOOD SAMPLES AND BASED ON PERMENKES RI No. 033 OF 2012 [Ref. 1]

No.	Type of phosphate additives in Permenkes 033	INS	Group of food additives	Food categories	Type of processed food (n)	Head of NA-DFC Regulation No. 10, 20, 24 of 2013	Function
1.	Asam fosfat (Orthophosphoric acid)	338	Acidity regulator		-		
2.	Mononatrium fosfat (Monosodium orthophosphate)	339(i)	Emulsifying salts, Emulsifier, stabilizer	01.6.4 06.4.3 15.1	Processed cheese (1) Instant noodle (3) Snack (1)	✓ ✓ ✓	Emulsifier Stabilizer Stabilizer
3.	Dinatrium fosfat (Disodium orthophosphate)	339(ii)	Emulsifying salts, Emulsifier, stabilizer	01.1.2 01.6.4 06.4.3	Milk drink (1) Processed cheese (2) Instant noodle (2)	✓ ✓ ✓	Emulsifier Stabilizer stabilizer
4.	Trinatrium fosfat (Trisodium orthophosphate)	339(iii)	Emulsifying salts, Emulsifier, stabilizer	01.6.3	Instant noodle (1)	✓	Stabilizer
5.	Monokalium fosfat (Monopotassium orthophosphate)	340(i)	Emulsifying salts, Emulsifier, stabilizer		-		
6.	Dikalium fosfat (Dipotassium orthophosphate)	340(ii)	Emulsifying salts, Emulsifier, stabilizer	01.3.2 08.3.2 09.2.4	Non dairy creamer (1) Meatballs (1) Processed fish (1)	✓ ✓ ✓	Stabilizer Emulsifier Stabilizer
7.	Trikalium fosfat (Tripotassium orthophosphate)	340(iii)	Emulsifying salts, Emulsifier, stabilizer		-		
8.	Kalsium fosfat (Calcium phosphate)	341	Stabilizer		-		
9.	Monokalsium fosfat (Monocalcium orthophosphate)	341 (i)	Stabilizer	07.2.1 07.2.1	biscuit (1) cake (2)	✓ ✓	Stabilizer Stabilizer
10.	Dikalsium fosfat (Dicalcium orthophosphate)	341 (ii)	Stabilizer		-		
11.	Trikalsium fosfat (Tricalcium orthophosphate)	341 (iii)	Stabilizer, anti-caking	14.1.5	Powder drink (1)	✓	Anti-caking
12.	Dinatrium difosfat (Disodium diphosphate)	450(i)	Emulsifying salts, Emulsifier, stabilizer	01.6.4 06.6 06.4.2 07.1.2 07.2.1 07.2.3 07.2.1 08.3.2 08.3.1 08.3.3 09.2.4 15.1	Processed cheese (1) Seasoned flour (1) Instant noodle (1) Crackers (1) Cookie (1) Premix (3) Cake (1) Meatballs (3) Sausage (7) Nugget (2) Processed fish (3) snack (1)	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	Emulsifier Emulsifier Stabilizer Emulsifier Emulsifier Stabilizer Emulsifier Emulsifier, stabilizer Emulsifier, stabilizer Stabilizer Stabilizer Stabilizer
13.	Trinatrium difosfat (Trisodium diphosphate)	450 (ii)	Emulsifier, stabilizer		-		
14.	Tetranatrium difosfat (Tetrasodium diphosphate)	450(iii)	Emulsifying salts, Emulsifier, stabilizer	01.6.4 06.4.2 08.3.1 08.2.3	Processed cheese (1) Instant noodle (1) Sausage (1) Chicken karaage (1)	 ✓ ✓ ✓	Emulsifier Stabilizer Stabilizer
15.	Tetrakalium difosfat (Tetrapotassium diphosphate)	450(v)	Emulsifying salts, Emulsifier, stabilizer		-		
16.	Dikalsium difosfat (Dicalcium diphosphate)	450(vi)	Emulsifying salts, Emulsifier, stabilizer Emulsifier		-		
17.	Kalsium difosfat (Calcium dihydrogen diphosphate)	450(vii)	Emulsifying salts, stabilizer		-		

18.	Natrium tripolifosfat (Sodium Tripolyphosphate)	451(i)	Emulsifying salts, stabilizer	06.4.2	instant noodle (7)	✓	Stabilizer
				06.4.3	dry noodle (3)	✓	Stabilizer
				08.3.2	meat ball (6)	✓	Emulsifier, stabilizer
				08.3.2	corned beef (1)	✓	Stabilizer
				08.3.2	sausage (11)	✓	Emulsifier, stabilizer
				08.3.3	nugget (4)	✓	Emulsifier, stabilizer
				09.2.4	processed fish (2)	✓	Stabilizer
				12.2.2	seasoning (1)	✓	Stabilizer
				15.1	snack (2)	✓	Stabilizer
19.	Kalium tripolifosfat (Potassium tripolyphosphate)	451(ii)	Emulsifying salts, stabilizer	08.3.2	meat ball (1)	✓	Stabilizer
				08.3.2	sausage (1)	✓	Stabilizer
20.	Natrium polifosfat (Sodium polyphosphate)	452(i)	Emulsifying salts, Emulsifier, stabilizer	01.3.2	non dairy creamer (1)	✓	Stabilizer
				01.6.4	cheese (2)	✓	Emulsifier
				06.4.2	Instant noodle (13)	✓	Stabilizer
				08.3.2	Meatballs (1)	✓	Stabilizer
				08.3.2	Nugget (1)	✓	Stabilizer
				08.2.3	Chicken karaage (1)	✓	Stabilizer
21.	Kalium polifosfat (Potassium polyphosphate)	452(ii)	Emulsifying salts, Emulsifier, stabilizer	08.3.2	Meatballs (2)	✓	Emulsifier
				08.3.2	Sausage (4)	✓	Emulsifier, stabilizer
22.	Natrium kalsium polifosfat (Sodium calcium polyphosphate)	452 (iii)	Emulsifier, stabilizer		-		
23.	Kalsium polifosfat (Calcium polyphosphate)	452(iv)	Emulsifying salt, emulsifier, stabilizer		-		

–No sample containing phosphate additives; ✓permitted on the Head of NA-DFC Regulation.

sweeteners, and flavor enhancers. Eight samples only listed the phosphate food additive group without the type name of food additive, 15 samples listed the phosphate type name albeit not in accordance with the applicable regulation, 17 samples listed food additive groups that do not comply with the regulations; consisting of 16 samples listed sequestrant and 1 sample listed stabilizer. Data of phosphate food additive usage on samples completed with phosphate food additive type can be seen in Table-3.

One type of phosphorus additives can have a single or several functions; for example, sodium tripolyphosphate is most widely used because it has three functions as salt emulsifiers, stabilizers and emulsifiers with wide application of processed food. In addition, a study by Yuanita *et al.* [26] showed that soaking chicken with sodium tripolyphosphate at certain concentrations and time could increase shelf life. Therefore, sodium tripolyphosphate is not only acts as a food additive group but can also extend the shelf life of chicken meat as permitted in the Regulation of National Agency of Drug and Food Control. This suggests that if phosphorus is used in the soaking process of raw materials, it could also be potential as phosphorus carrier in the final product.

Conclusion

Average phosphorus content in processed food containing phosphate food additive were varied from 622 mg/kg to 10829 mg/kg with overall average of 2867 mg/kg. Processed food without phosphate food additive also contained phopshorus detected in total amount ranged from 0-4571 mg/kg with average of 1530 mg/kg. The mean difference of phosphorus content of processed food that not contained phosphate food additive with processed food containing phosphate food additive was 1337 mg/kg or with increase rate 39 %. In general, the phosphorus content of processed food met the maximum limit of phosphate food additive usage except on spice and premix products. There was 12 type of phosphate food additivie identified in the samples with sodium tripolyphosphate as the most widely used. Phosphate food additive serves as a stabilizer, emulsifier and anti caking agent.

For registration requirement, total phosphorus analysis on the final product could not be relied as the maximum content of phosphate food additive in processed food because the detected phosphorus is not only identified from the food additive but also from phosphorus naturally contained in the raw material.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge to NADFC for the funding of this research, Center of Food Laboratory of NADFC for the facilities of phosphorus analysis, as well as SEAFAST Center for publication funding.

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