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CDARS 1837

First Edition 2024

Poultry feed premixes — Specification

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Foreword

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This African Standard was prepared by ARSO TC 17 *Animal feeding, feeds and feeding stuffs.*

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DRAFT AFRICAN STANDARD **CDARS 1837: 2024**

Poultry feed premixes — Specification

1 Scope

This Draft African Standard specifies the requirements, sampling and methods of test for poultry feed premixes (vitamins and micro minerals mix). This document applies to poultry species namely; Chicken, Turkey, Duck, Goose, Quail and Ostrich.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

AOAC 101(3):831-842, *Determination of Biotin*

AOAC 932.16, *Determination of Vitamin D3*

AOAC 971.30, *Determination of Vitamin E*

AOAC 999.15, *Determination of Vitamin K*

AOAC 2008.01, *Determination of Vitamin B1*

AOAC 970.65 (6), *Determination of Vitamin B2*

AOAC 945.74, *Determination of Vitamin B6*

AOAC 2011.94 (6), *Determination of Vitamin B12*

AOAC 961.14, *Determination of Niacin*

AOAC 2012.16, *Determination of Pantothenic acid*

AOAC 944.12, *Determination of Folic Acid*

AOAC 967.21, *Determination of Vitamin C*

AOAC 974.30, *Determination of Choline*

FDARS 2139, Code of practice on good animal feeding

FDARS 1828, *Animal feeds — Code of practice for production, processing, storage, transport, and distribution*

ISO 6497, *Animal feeding stuffs — Sampling*

ISO 14565, *Animal feeding stuffs — Determination of vitamin A content — Method using high performance liquid chromatography*

ISO 6869, *Animal Feeding Stuffs — Determination of the contents of Calcium, Copper, Iron, Magnesium, Manganese, Potassium, Sodium and Zinc — Method using Atomic Absorption Spectrometry*

AOAC 2004; 59: 491–494. 8, *Determination of the contents of Iodine*

AOAC 2011.19 - *Determination of the contents of Selenium*

AOAC 952.02 - *Determination of the contents of Cobalt*

ISO 6496, *Animal feeding stuff – Determination of moisture and other volatile matter content*

ISO 6498*, Animal Feeding Stuffs – Guideline for sample preparation*

ISO 27085, Animal feeding stuffs — Determination of calcium, sodium, phosphorus, magnesium, potassium, iron, zinc, copper, manganese, cobalt, molybdenum, arsenic, lead and cadmium by ICP-AES

ISO 15213-2:2023Microbiology of the food chain — Horizontal method for the detection and enumeration of Clostridium spp.Part 2: Enumeration of Clostridium perfringens by colony-count technique

3 Terms and definitions

For the purpose of this standard the following terms and definitions apply.

3.1
premixes
uniform mixture of one or more micro ingredients, (vitamins and / or micro minerals)/feed additives with a diluent and /or carrier and that is not intended for direct feeding to animals

3.2
carrier
edible material to which ingredients are added (absorbed, adsorbed, impregnated, or coated) to facilitate their uniform distribution in feeds

3.3
adulterant
any substance which is not a feed ingredient or an approved additive and it is likely to be harmful to the bird

3.4
anti-caking agent
additive placed in powdered or granulated materials to prevent the formation of lumps and for easy packaging

3.5
antioxidant
substance that inhibits oxidation

3.6
competent authority
person, officer or organization administering a law regulating the use of any Ingredient, drug (including antibiotics), medication, coloring matter or any other additives for making premixes for all classes of poultry feeds

3.7
compounded feed
mixture of at least two feed materials, whether or not containing feed additives for oral animal feeding in the form of complementary feed or complete feed

3.8
contaminants

substances not intentionally added to feed or food that may compromise feed and food safety or suitability

3.9
chicks

young poultry up to 8 weeks of age

3.10
growers

poultry from brooding up to the point of lay

3.11
layers

poultry producing eggs for consumption

3.12
breeders

poultry producing fertile eggs

3.13
broilers

chickens specially produced for meat

3.14
duckling /gosling

young duck / goose up to 8 weeks of age

3.15
poults

young turkeys up to 6 weeks of age

3.16
hazard

biological, chemical or physical agent in, or condition of, feed or food with the potential to cause an adverse health effect. In this standard, it refers to an agent in Premix which has the potential to cause an adverse effect after transfer into an edible product

3.17
preservative

substance or chemical added to premix to prevent decomposition by microbial growth or by undesirable chemical changes

3.18
mineral salts

salt of an inorganic acid or inorganic salts that need to be ingested or absorbed by living organisms for healthy growth and maintenance. they comprise the salts of the trace elements in animals

3.19
organic minerals (chelated minerals)

organic mineral complex formed between an organic molecule and a mineral

3.20
ores

natural rock or sediment that contains one or more valuable minerals concentrated above background levels, typically containing metals, that can be mined, treated

3.21
nano minerals

minerals, crystals, structures etc.in the nano scale i.e. between 1-100 nanometres in size

3.22
coated vitamins

vitamins coated with edible thin layer to protect it from light or oxygen damage and or any chemical reaction

4 Requirements

4.1 General Requirements

4.1.1 Poultry feed premixes shall be in the form of powder, granular or liquid
4.1.2 Poultry feed premixes shall be fine textured, homogenous and free flowing
4.1.3 Poultry feed premixes shall be free from:

a) metallic and glass objects
b) adulterants
c) physical moulds
d) pathogens or insect infestation
e) mustiness,
f) rancidity
g) any objectionable odours.

4.1.4 Nano minerals shall not be used in the poultry feed premixes.
4.1.5 Ores of mineral elements used in poultry feed premixes shall not contain any toxic compound
4.1.6 Annex A and B provides further information on recommended ingredients and mineral compositions that may be used in in preparing poultry premixes.

4.2 Specific requirements

4.2.1 Moisture content in poultry feed premixes shall not be more than 10% when tested in accordance with the requirements of ISO 6496.

4.2.2 The poultry feed premixes shall have minimum requirements for Vitamins and Micro minerals in poultry for growth, maintenance and production as specified in Tables 1-6

4.2.3 The specific nutrient requirements for modern, developed poultry strains should be taken into consideration when formulating compounded poultry feed.

4.3 Vitamins and Micro Mineral requirements for Broiler chicken premixes

Broiler chicken premixes shall have the vitamins and minerals specified in Table 1 when tested with the methods specified therein.

Table 1 — Vitamins and micro mineral requirements of broiler chickens in premix inclusion per kilogram of feeds

S/N	Ingredient	Broilers			Test methods
		0-3 wks	3-6 wks	6-8 wks	
Vitamins					
1.	Vitamin A (IU)	1 500	1 500	1 500	AOAC 2012.003
2.	Vitamin D3 (IU)	200	200	200	AOAC 932.16
3.	Vitamin E (IU)	10	10	10	AOAC 971.30
4.	Vitamin K (mg)	0.5	0.5	0.5	AOAC 999.15
5.	Vitamin B1 (mg)	1.8	1.8	1.8	AOAC 2008.01
6.	Vitamin B2 (mg)	3.6	3.6	3.6	AOAC 970.65
7.	Vitamin B6 (mg)	3.5	3.5	3.0	AOAC 945.74
8.	Vitamin B12 (mg)	0.01	0.01	0.007	AOAC 2011.94
9.	Vitamin B3 (mg)	35	30	25	AOAC 961.14
10.	Vitamin B5 (mg)	10	10	10	AOAC 2012.16
11.	Vitamin B9 (mg)	0.55	0.55	0.50	AOAC 944.12
12.	Vitamin B7 (mg)	0.15	0.15	0.12	AOAC 2016.02
14.	Choline (mg)	1300	1000	750	AOAC 974.30
Micro-minerals (insert for vitamins)					
15	Copper (mg)	8	8	8	ISO 6869
16	Iodine, (mg)	0.35	0.35	0.35	AOAC 2004;59: 491–494. 8.
17	Iron (mg)	80	80	80	ISO 6869
18	Manganese (mg)	60	60	60	ISO 6869
19	Selenium (mg)	0.15	0.15	0,15	AOAC 2011.19
20	Zinc (mg)	40	40	40	ISO 6869
Note The Premix producer shall indicate the inclusion rates					

4.4 Vitamins and Micro Mineral requirements for Layer chicken premixes

Layer chicken premixes shall have the vitamins and minerals specified in Table 2 when tested with the methods specified therein.

Table 2 — Vitamins and micro minerals requirements of layer chicken in premix inclusion per kilogram of feeds

S/N	Ingredient	Layers						Test method
		0-6 wks	6-12 wks	12-18 wks	18 wks – first egg	Breeders	Layers	
Vitamins								
1.	Vitamin A (IU)	1 420	1 420	1 420	1 420	3 000	2 500	AOAC2 012.003
2.	Vitamin D3 (IU)	190	190	190	280	300	250	AOAC 932.16
3.	Vitamin E(IU)	9.5	4.7	4.7	4.7	5.0	4.0	AOAC 971.30

4.	Vitamin K(mg)	0.470	0.470	0.470	0.470	0.500	0.400	AOAC 999.15
5.	Vitamin B1(mg)	1.0	1.0	0.800	0.800	0.700	0.060	AOAC2008.01
6.	Vitamin B2 (mg)	3 400	1 700	1 700	1 700	2 500	2 100	AOAC 970.65
7.	Vitamin B6(mg)	2 800	2 800	2 800	2 800	2 500	2 100	AOAC 945.74
8.	Vitamin B12 (mg)	0.009	0.003	0.003	0.003	0.004	0.004	AOAC 2011.94
9.	Vitamin B3 (mg)	26.00	10 300	10 300	10 300	10 000	8 300	AOAC 961.14
10.	Vitamin B5 (mg)	9 400	9 440	9 400	9 400	2,000	1 700	AOAC2012.16
11.	Vitamin B9(mg)	0.520	0.230	0.230	0.230	0.250	0.210	AOAC 944.12
12.	Vitamin B7 (mg)	0.140	0.090	0.090	0.090	0.100	0080	AOAC 2016.02
13.	Choline (mg)	1 255	850	470	470	1 050	875	AOAC 974.30
Microminerals								
14.	Copper (mg)	5 000	4 000	4 000	4 000	-	-	ISO 6869
15.	Iodine (mg)	0.330	0.330	0.330	0.330	0.035	0.029	AOAC 2004;59
16.	Iron (mg)	75	56	56	56	45	38	ISO 6869
17.	Manganese(mg)	56	28	28	28	20	17	ISO 6869
18.	Selenium, (mg)	0.140	0.100	0.100	0.100	0.060	0.050	AOAC 2011.19
19.	Zinc (mg)	38 000	33 000	33 000	33 000	35 000	29 000	ISO 6869
Note The Premix Producer shall indicate the inclusion rates.								

4.5 Vitamins and Micro Mineral requirements for Turkey premixes

Turkey premixes shall have the vitamins and minerals specified in Table 3 when tested with the methods specified therein.

Table 3 — Vitamins and microminerals requirement of turkeys in premix inclusion per kilogram of feed

S/N	Ingredients	Turkey							Test methods
		0-4 wk	4-8 wk	8-12 wk	12-16 wk	16-24 wk	Breeder holding	Breeder Laying Hen	
Vitamins									
1.	Vitamin A(IU)	5 000	5 000	5 000	5 000	5 000	5 000	5 000	AOAC 2012.003
2.	Vitamin D3 (IU)	1 100	1 100	1 100	1 100	1 100	1 100	1 100	AOAC 932.16
3.	Vitamin E(IU)	14	12	12	10	10	10	25	AOAC 971.3
4.	Vitamin K (mg)	1.75	1.5	1.0	0.75	0.75	0.5	1.0	AOAC 999.15
5.	Vitamin B1 (mg)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	AOAC 2008.01
6.	Vitamin B2 (mg)	4.0	3.6	3.0	3.0	2.5	2.5	4.0	AOAC 970.65
7.	Vitamin B6 (mg)	4.5	4.5	3.5	3.5	3.0	3.0	4.0	AOAC 945.74
8.	Vitamin B12 (mg)	0.003	0.003	0.003	0.003	0.003	0.003	0.003	AOAC2011.94
9.	Vitamin B3 (mg)	60	60	50	50	40	40	40	AOAC961.14

10.	Vitamin B5 (mg)	10	9	9	9	9	9	16	AOAC 2012.16
11.	Vitamin B9 (mg)	1.0	1.0	0.8	0.8	0.7	0.7	1.0	AOAC 944.12
12.	Vitamin B7 (mg)	0.25	0.20	0.125	0.125	0.1	0.1	0.2	AOAC 2016.02
13.	Choline(mg)	1 600	1400	1 100	1 100	950	800	1 000	AOAC 974.30
Microminerals									
14.	Copper (mg)	8	8	6	6	6	6	8	ISO 6869
15.	Iodine (mg)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	AOAC. 59:491-494.8
16.	Iron (mg)	80	60	60	60	50	50	60	ISO 6869
17.	Manganese (mg)	60	60	60	60	60	60	60	ISO 6869
18.	Selenium (mg)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	AOAC 2011.19
19.	Zinc (mg)	70	65	50	40	40	40	65	ISO 6869
NOTE The Premix Producer shall indicate the inclusion rate per ton of feed									

4.6 Vitamins requirements for Duck premixes

Duck premixes shall have the vitamins specified in Table 4 when tested with the methods specified therein.

Table 4 — Vitamins requirement of ducks in the premix inclusion per kilogram of feeds

S/N	Ingredient	DUCKS			Test Methods
		0-2 wks	2-7 wks	Breeding	
1.	Vitamin A(IU)	2 500	2 500	4 000	AOAC 2012.003
2.	Vitamin D3(IU)	400	400	900	AOAC 932,16
3.	Vitamin E(IU)	10	10	10	AOAC 971.30
4.	Vitamin K(mg)	0.5	0.5	0.5	AOAC 999.15
5.	Vitamin B3 (mg)	55	55	55	AOAC961.14
6.	Vitamin B5 (mg)	11	11	11	AOAC 2012.16
7.	Vitamin B6(mg)	2.5	2.5	2.5	AOAC 945.74
8.	Riboflavin (mg)	4.0	4.0	4.0	A0AC970.65

4.7 Vitamins requirements for Goose premixes

Goose premixes shall have the vitamins specified in Table 5 when tested with the methods specified therein.

Table 5 — Vitamins requirement of goose in the premix inclusion per kilogram of feed

S/N	Ingredient	Goose			Test method
		0-4 wks.	After 4 wks. to market weight	Breeders	
1.	Vitamin A(IU)	1 500	1 500	4 000	AOAC 2012.003
2.	Vitamin D3(IU)	200	200	200	AOAC 932.16
3.	Vitamin B3 (mg)	65	35	20	AOAC 961.14
4.	Vitamin B5(mg)	15	10	10	AOAC2012.16
5	Vitamin B6(mg)	3.8	2.5	4.0	AOAC 945.74
6	Choline (mg)	1 500	1 000		AOAC 974.3
Note The Premix Producer shall indicate the inclusion rates					

4.8 Vitamins and micro mineral requirements for Japanese quails premixes

Japanese quail premixes shall have the vitamins and micro mineral requirements specified in Table 6 when tested with the methods specified therein.

Table 6 — Vitamins and micro mineral requirement of japanese quails in the premix inclusion per one kilogram of feed

S/No	Ingredient	Quail		Test method
		Starting/Growing	Breeding	
1	Vitamin A (IU)	1 650	3 300	AOAC 2012.003
2	Vitamin D3 (IU)	750	900	AOAC 9316
3	Vitamin E (IU)	12	25	AOAC 971.30
4	Vitamin k (mg)	1	1	AOAC 999.15
5	Vitamin B1(mg)	2	2	AOAC2008.01
6	Vitamin B6(mg)	3	3	AOAC945.74
7	Vitamin B12 (mg)	0.003	0.003	AOAC 2011.94
8	Vitamin B3 (mg)	40	40	AOAC 961.14
9	Vitamin B5 (mg)	10	15	AOAC2012.16
10	Vitamin B9 (mg)	1	1	AOAC944.12
11	Vitamin B7 (mg)	0.3	0.5	AOAC 2016.02
12	Choline(mg)	2 000	1 500	AOAC 974.3
Microminerals				
13	Copper (mg)	5	5	ISO6869
14	Iodine (mg)	0.3	0.3	AOAC 2004;59:491-494.8
15	Iron (mg)	120	60	ISO6869
16	Manganese (mg)	60	60	ISO 6869
17	Selenium(mg)	0.2	0.2	AOAC2011.19
18	Zinc (mg)	25	50	ISO6869
NOTE The Premix Producer shall indicate the inclusion rates.				

4.9 Vitamins requirements for Ostrich premixes

Ostrich premixes shall have the vitamin requirements specified in Table 7 when tested with the methods specified therein.

Table 7 — Vitamins requirement of ostrich in the premix inclusion per one kilogram of fee

S/N	Ingredient	Limits	Test methods
1.	Vitamin A (IU)	12 000 – 16 000	AOAC 2012.003
2.	Vitamin D3 (IU)	3 000 – 4 000	AOAC 932.16
3.	Vitamin E (IU)	40 - 60	AOAC 971.30
4.	Vitamin K (mg)	2 - 4	AOAC 999.15
5.	Vitamin B1 (mg)	3 - 5	AOAC 2008.01
6.	Vitamin B2 (mg)	10 -20	AOAC 970.65
7.	Vitamin B6 (mg)	6 - 8	AOAC 945.74
8.	Vitamin B12 (mg)	0.05 – 0.1	AOAC 2011.94
9.	Vitamin B3 (mg)	80 - 100	AOAC 961.14
10.	Vitamin B5 (mg)	12 - 20	AOAC 2012.16
11.	Vitamin B9	2 - 4	AOAC 944.12
12.	Vitamin B7	0.02 – 0.035	AOAC 2016.02
13.	Vitamin C	200 - 225	AOAC 967.21
14.	Choline	600 - 800	AOAC 974.30

5 Hygiene, storage, receiving and transportation

Poultry feed premixes shall be handled and prepared in accordance with provision specified in FDARS 2139 and FDARS 1828.

6. Contaminants

6.1 Heavy metals

Poultry feed premixes shall comply with the limits of heavy metals as specified in Table 8 when tested in accordance with the methods specified therein

Table 8 — Maximum metals limits for poultry feed premixes

S/N	Heavy metal	limit mg/kg	Test method
i.	Arsenic	2.0	ISO 27085
ii.	Lead	5.0	
iii.	Cadmium	1.0	
iv.	Mercury	0.1	

6.2 Microbiological limits

Poultry feed premixes shall comply with the microbiological limits specified in Table 7 when tested with the methods specified therein.

Table 7 — Microbial Limits for poultry feed premixes

S/N	Parameters	Limits	Test method
i	*Salmonella spp cfu*	absent	ISO 6579-1
ii	*Escherichia coli*	absent	ISO 16654
ii.	*Clostridium*	absent	ISO 15213-2

7 Packaging and labelling

7.1 Packaging

7.1.1Poultry feed premixes shall be packaged in clean food grade containers which are of sufficient strength and sufficiently sealed so as to withstand reasonable handling without tearing, bursting or falling open during normal handling and transportation.

7.1.2The containers shall be free from parasites and any disease-causing agents.

7.1.3Containers for poultry feed premixes shall be clean and free from visible indications of contamination.

7.2Labelling

Each package for poultry feed premixes shall be legibly and indelibly marked with the following information:

a) Type of Premix;
b) Name and physical address of the manufacturer;
c) Country of origin;
d) The manufacturer's trademark if any;
e) Batch or code number;
f) Net weight in SI units;
g) Date of manufacture;
h) Expiry date;
i) Inclusion rates;
j) Nutrient composition;
k) Storage conditions;
l) Indication for poultry use only;
m) Indication of medication (if any);
n) Indication of additives (if any);
o) Instructions for use; and
p) List of ingredients.

8 Sampling

Sampling shall be done in accordance with the requirements of ISO 6497.

Annex A
(informative)

Recommended Ingredients Available for Making Premixes

A1 List of vitamins

1. Vitamin A 500
2. Vitamin AD3 500/100
3. Vitamin AD3 1000/200
4. Vitamin D3
5. Vitamin E50
6. Vitamin K3
7. Vitamin B2 Riboflavin
8. Vitamin B12
9. Vitamin b6
10. Nicotinic Acid
11. Nicotinamide
12. Folic acid (45%, 95%)
13. Calcium Pantothenate (80%, 98%)
14. Biotin (2%, 5%, 10%)
15. Thiamine
16. Vitamin C
17. Choline chloride (50%, 60%, 70% and 80%)

A.2 List of micro minerals compounds (Appendix C)

1. Potassium Iodates
2. Copper Sulphate (Feed grade)
3. Manganese oxide
4. Manganese Sulphate
5. Zinc oxide
6. Zinc Sulphate
7. Ferrous Carbonate
8. Ferrous Sulphate
9. Sodium Selenite
10. Cobalt
11. Organic copper
12. Organic manganese
13. Organic zinc
14. Organic selenium

A.3 ANTIOXIDANTS

15. Butylated Hydroxy Toluene (BHT)
16. Butylated Hydroxyl Anasole (BHA)

A.4 Dust control agents

a) Mineral oil
b) Vegetable oil

A.5 Carriers

a) Wheat offal
b) Ground Rice Husk
c) Limestone
d) Water for liquid Premixes

Annex B
(informative)

Source, empirical formulas, mineral concentrations and relative bio availabilities of common mineral sources.

Supplement	Empirical formula	Mineral concentration(%)	Relative bioavailability(RV)	Mineral availability (% of content)
Calcium				
Calcium carbonate	$CaCO_3$	38	100.00	38.00
Bone meal	variable	24	110.00	26.40
Calcium chloride (dihydrate)	$CaCl_2(H_2O)$	31	125.00	38.75
Dicalcium phosphate	$Ca_2(PO_4)$	20	110.00	22.00
Limestone		36	90.00	32.40
Monocalcium phosphate	$Ca(PO_4)$	17	130.00	22.10
Cobalt				
Cobaltous sulfate	$CoSO_4(H_2O)_7$	21	100.00	21.00
Cobaltic oxide	Co_3O_4	73	20.00	14.60
Cobaltous carbonate	$CoCO_3$	47	110.00	51.70
Cobaltous oxide	CoO	70	55.00	38.50
Copper				
Cupric sulfate	$CuSO_4(H_2O)_5$	25	100.00	25.00
Copper EDTA	variable	variable	95.00	variable
Copper lysine	variable	variable	100.00	variable
Cupric chloride (tribasic)	$Cu_2(OH)_3Cl$	58	115.00	66.70
Cupric oxide	CuO	75	15.00	11.25
Cupric sulfide	CuS	66	25.00	16.50
Cuprous acetate	$CuC_2O_2H_3$	51	100.00	51.00
Iodine				
Potassium iodide	KI	69	100.00	69.00
Sodium iodide	NaI	84	100.00	84.00
Calcium iodate	$Ca(IO)_3$	64	95.00	60.80
Diiodosalicyclic acid	$C_7H_4I_2O_3$	65	15.00	9.75
Ethylenediamine dihydriodine	$C_2H_8N_2(HI)_2$	80	105.00	84.00
Pentacalcium orthoperiodate	$Ca_5(IO_6)_2$	39	100.00	39.00

Iron				
Ferrous sulfate heptahydrate	$FeSO_4(H_2O)_7$	20	100.00	20.00
Ferric citrate	variable	variable	110.00	variable
Ferric EDTA	variable	variable	95.00	variable
Ferric phytate	variable	variable	45.00	variable
Ferrous carbonate	$FeCO_3$	38	10.00	3.80
Magnesium				
Magnesium sulfate	$MgSO_4$	20	100.00	20.00
Magnesium acetate	$MgC_2O_2H_4$	29	110.00	31.90
Magnesium basic carbonate	$MgCO_3$	31	100.00	31.00
Magnesium oxide	MgO	55	100.00	55.00
Manganese				
Manganese sulfate	$MnSO_4(H_2O)$	30	100.00	30.00
Manganese carbonate	$MnCO_3$	46	30.00	13.80
Manganese dioxide	MnO_2	63	35.00	22.05
Manganese methionine	variable	variable	125.00	variable
Manganese monoxide	MnO	60	60.00	36.00
Phosphorus				
Sodium phosphate	$NaPO_4$	variable		
Bone meal	variable	21	100.00	21.00
Defluorinated phosphate	variable	12	80.00	9.60
Dicalcium phosphate	$CaHPO_4$	18	85.00	15.30
Selenium				
Sodium selenite	Na_2SeO_3	45	100.00	45.00
Cobalt selenite	variable	variable	105.00	0.00
Selenomethionine	variable	variable	245.00	0.00
Selenoyeast	variable	variable	290.00	0.00
Sodium				
Sodium chloride	NaCl	40	100.00	40.00
Sodium bicarbonate	$Na(CO_3)_2$	27	95.00	25.65

Zinc				
Zinc sulfate	$ZnSO_4(H_2O)$	36	100.00	36.00
Zinc carbonate	$ZnCO_3$	56	60.00	33.60
Zinc oxide	ZnO	72	100.00	72.00

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