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PATENT SPECIFICATION

NO DRAWINGS

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COMPLETE SPECIFICATION

Poultry Feed Compositions

We, AMERICAN CYANAMID COMPANY, a corporation organized under the laws of the State of Maine, United States of America, of the Township of Wayne, State of New Jersey, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to novel poultry feed compositions containing a tetracycline antibiotic and a potentiating agent therefor which are highly useful in controlling infectious diseases and in accelerating the growth of poultry. More particularly, the present invention concerns a poultry feed containing the normally-added, inorganic calcium and phosphate supplements, a tetracycline antibiotic, and a potentiating agent i.e. an adjuvant which promotes increased absorption of the antibiotic by the blood and tissue of poultry consuming the treated feed.

Although the broad-spectrum antibiotics chlorotetracycline, tetracycline, oxytetracycline, and demethylchlorotetracycline have been found to be extremely effective for controlling infectious diseases and for stimulating growth in poultry, nevertheless, due to incomplete absorption thereof by the poultry, believed to be due at least in part to the presence of calcium and other metallic cations in the diet, full utilization of such antibiotics has never been achieved.

The standard sources for calcium and phosphorus in animal diets, particularly poultry diets, are calcium carbonate, calcium hydrogen phosphate and bone meal. These materials, while generally considered necessary for normal poultry growth, have been found to markedly lower the blood levels of the tetracycline antibiotics. Since improvement in health is normally related to blood levels of antibiotic, efforts have been made to overcome the deleterious effects of calcium on the blood-levels of the antibiotic without eliminating calcium from the diet.

[Price 4s. 6d.]

It is generally believed that the calcium ion forms a complex with the tetracycline antibiotics which prevents absorption thereof by the blood. Since such antibiotics are rather expensive, it is most desirable to provide a means by which maximum absorption of the antibiotic is achieved. Various means, such as a low-calcium diet, have been proposed to accomplish this end, but no entirely satisfactory method of solving this problem has hitherto been available. While the low-calcium diet may be used for short periods of time, as, for example, when treating diseased poultry with therapeutic quantities of antibiotic, continued feeding of the low-calcium diet for extended periods of time can result in malformed bone structure and improper poultry growth.

In poultry of large size, such as turkeys, the problem is even more acute than it is with smaller fowl, such as chickens, since the larger birds require substantially more phosphorus and calcium for normal growth than do the smaller ones. According to the National Research Council, turkeys require at least about 1.0% phosphorus and 2.0% calcium whereas chickens require about 0.6% phosphorus and only 1.0% calcium for normal growth. While somewhat lower levels of calcium and phosphorus have been used effectively by poultry growers, the levels cannot be reduced below about 70% of the given values without seriously affecting the growth of the poultry. If these requirements are not met, the larger birds, turkeys especially, are plagued with serious leg defects which ultimately lead to their loss as marketable birds.

While the calcium requirement for poultry feed could be satisfied by the addition thereto of a selected calcium salt which is free of phosphorus, e.g., calcium sulfate, and which from the standpoint of complexing with the tetracycline antibiotic is less objectionable than other calcium salts, as, for example, calcium carbonate, such addition will in no way satisfy the phosphorus requirement. Phosphorus is essential for normal growth and bone develop-

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ment and it must be supplied in some form. Conventionally, feed supplements such as fish meal, bone meal, meat scraps and dicalcium phosphate have been added to feeds to provide the required phosphorus. These materials are relatively inexpensive and, in addition, furnish other necessary constituents such as minerals, protein and vitamins. However, they contain substantial proportions of calcium in a form which readily complexes with the tetracycline antibiotics, i.e., tricalcium phosphate or dicalcium phosphate.

Due to the high cost of antibiotics it is desirable to obtain maximum efficacy for a given amount of antibiotic. Therefore, losses of antibiotic by any means must be minimised if the use thereof is to be practical. To accomplish this end it has been proposed that calcium-free phosphates might be added to the feed. However, it has been found that feeds prepared with such additives are not entirely satisfactory since they are generally too alkaline or acidic, depending upon the additive used, and are not palatable to poultry when the phosphorus requirement is satisfied by the sole addition of such non-conventional phosphates. Some non-conventional phosphates react with the feed, rendering it useless; others are too costly to be practical and do not furnish essential minerals, proteins or vitamins required for normal growth.

It would be most desirable commercially to obtain compositions which would permit the effectiveness of the tetracycline antibiotics to be appreciably enhanced. It has been found that potentiation of tetracycline antibiotics can be achieved with the novel compositions of the present invention which comprise a poultry feedstuff, a source of calcium, a source of phosphorus, a tetracycline antibiotic, that is, any antimicrobially active form of the antibiotics tetracycline, chlortetracycline, oxytetracycline, demethylchlortetracycline and structurally related substances, and as a potentiating agent for the antibiotic an effective amount of a sulfate of a cation carrying a single positive charge.

Thus the invention provides a method of treating poultry feeds containing a tetracycline antibiotic and the recommended amounts of calcium and phosphorus supplied from conventional sources whereby the absorption of the antibiotic by the blood and tissue of the poultry consuming the feeds is significantly increased. Preferably the calcium requirements are supplied by tricalcium phosphate, dicalcium phosphate or a mixture of both. It has been found that such compositions produce substantially higher-antibiotic blood levels in poultry from a given amount of antibiotic than has heretofore been possible with feeds containing like concentrations of the above-mentioned ingredients.

The invention includes concentrates suitable for addition to poultry feeds and also

poultry feeds which are nutritionally adequate *per se*. The latter preferably contain between 0-24% and 2-4% by weight of the feed of a sulfate ion provided by a sulfate salt which has a cation carrying a single positive charge. Preferably the sulfate is sodium sulfate, sodium bisulfate, potassium sulfate, potassium bisulfate, ammonium sulfate, ammonium bisulfate or sulfuric acid, or mixtures thereof, and preferably is used in an amount sufficient to provide about 0.96% of sulfate ions. Organic sulfates of a cation carrying a single positive charge, such as trimethyl ammonium sulfate, dimethyl ammonium sulfate and the like, may also be employed but with less advantage. As previously stated, it has been found that the total concentration of sulfate ion is preferably in the range of 0.24 to 2.4% of the feed to be consumed by poultry. This is equivalent to from 4.8 to 48 pounds of sulfate ion per ton of feed or from 7 to 70 pounds of sodium sulfate per ton of feed.

While sulfates of cations carrying a single positive charge have been found to be effective potentiators for tetracycline antibiotics orally administered, sulfates and bisulfates of cations carrying more than one positive charge generally have been found to produce substantially less desirable results. Some multivalent metallic sulfates actually inhibit absorption of tetracycline antibiotics while others require reduction in the amount of conventional calcium and phosphorus additives in the diet to be effective.

At sulfate ion levels below about 0.24% in the diet, little if any potentiation of the tetracycline antibiotic is obtained and at levels exceeding about 2.4% in the diet, it has been found that wet litter is sometimes produced. Since wet litter is a breeding ground for infectious diseases such conditions are obviously undesirable.

Surprisingly, in accordance with the present invention, it has been discovered that the addition of sodium sulfate or potassium sulfate at a concentration of 0.96% sulfate ions in a poultry diet containing calcium and a tetracycline antibiotic will produce a significant increase in antibiotic blood levels for a given concentration of antibiotic in the feed without causing undesirable effects.

Also, the addition of sodium sulfate to poultry feed pre-mixes of concentrates, used for the preparation of potentiated antibiotic feeds, has the surprising advantage that it noticeably reduces dusting and improves flowability of the pre-mix materials. In a concentrate comprising a conventional feedstuff, dried chlortetracycline fermentation harvest mash solids (i.e. tetracycline together with the nutrient media in which the tetracycline is produced), an edible oil and a major portion of anhydrous sodium sulfate, no dusting or separation of fines could be observed. In con-

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trast thereto, a similar pre-mix minus the sodium sulfate additive showed noticeable separation or stratification of fines in the lower portions of the mix and considerable dusting.

5 Pre-mixes or concentrates included within the scope of the instant invention and useful in supplementing one ton of feed, may contain from about 4.8 to 48 pounds of sulfate ions provided by a sulfate salt which has a cation carrying a single positive charge such as sodium sulfate, potassium sulfate, sodium bisulfate, potassium bisulfate, sulfuric acid, ammonium sulfate, ammonium acid sulfate or mixtures thereof; from 10 to 1000 grams of a tetracycline antibiotic, such as tetracycline, oxytetracycline, chlortetracycline, and demethylchlortetracycline; mixtures of tetracycline antibiotics; from 0.5 to 3% of edible oil by weight of concentrate and an edible feedstuff. Other edible diluents may be added if desired.

20 Pre-mixes which are particularly desirable for supplementing one ton of poultry feed contain, in addition to feedstuff or other inert edible carrier, from about 100 to 500 grams of tetracycline antibiotic, 14 to 28 pounds of sulfate ions provided by a sulfate salt which has a cation carrying a single positive charge and from about 0.5 to 1.5% of edible oil by weight of concentrate.

30 Any of the commercially available and commonly used tetracycline antibiotics such

as tetracycline, chlortetracycline, oxytetracycline, and demethylchlortetracycline, may be used. Chlortetracycline, however, is preferred because of its already wide acceptance as an animal feed additive of choice and because it is more effective than the other tetracycline antibiotics.

40 Preferably, the tetracycline antibiotic is present to the extent of between 50 and 2000 parts per million based on the weight of the feed with the optimum amount being 200—400 parts per million.

45 The invention will be described in greater detail in conjunction with the following specific examples.

EXAMPLE 1

50 Turkeys, 31 days old and of substantially equal size and weight, were randomly divided into 19 groups of ten turkeys each. These birds were placed in cages and fasted overnight. The following morning a diet of ground yellow corn supplemented with either 200 or 400 ppm of chlortetracycline and selected amounts of calcium, phosphorus, and the potentiating agent sodium sulfate, as described in Table I below, was fed to the turkeys *ad libitum* for three hours. Immediately following the three hour feeding period, the turkeys were bled by cardiac puncture. 1.5 ml. of blood was taken from each bird and assayed microbiologically. An average of the results obtained with each group of turkeys is reported in Table I below.

TABLE I

Chlortetracycline blood levels obtained from additions to ground yellow corn fed to turkeys

% Ca++	% inorganic phosphorus	Supplement		% Na ₂ SO ₄	Avg. blood levels with 200 ppm CTC in feed	Avg. blood levels with 400 ppm CTC in feed
		Ca++	source + Phosphorus			
0.01	0.00		None	0.0	0.42	0.81
0.01	0.00		None	4.93	0.51	0.99
1.44	0.75		dicalcium phosphate	0.0	0.05	0.11
1.44	0.75		dicalcium phosphate	4.93	0.22	0.52
1.44	0.75		CaCO ₃ +H ₃ PO ₄	0.0	0.05	0.13
1.44	0.75		CaCO ₃ +H ₃ PO ₄	4.93	0.27	0.43
1.44	0.75		CaCO ₃ +NaH ₂ PO ₄ ·H ₂ O	0.0	0.04	0.11
1.44	0.75		CaCO ₃ +NaH ₂ PO ₄ ·H ₂ O	4.93	0.25	0.64

From Table I above, it can be readily seen that: (1) the addition of calcium and phosphorus to a poultry diet containing a given amount of chlortetracycline causes severe depression of blood levels in poultry consuming the same. (2) The addition of sodium sulfate to a poultry diet containing given amounts of

chlortetracycline, calcium and phosphorus causes a significant increase in the antibiotic blood levels of poultry consuming such diet. That is, the addition of sodium sulfate to the above diets produces as much as a six-fold increase in the antibiotic blood levels for a given amount of antibiotic in the diet.

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EXAMPLE 2

5 Following the procedure set forth in Example I, 31-day old turkeys were divided into 19 groups of ten each, placed in cages and fasted overnight. The following morning they were fed *ad libitum* a ground corn diet containing 1.4% calcium ion and 0.75% inorganic phosphorus supplied by 5% fish meal and 3.3% dicalcium phosphate and supplemented

with 400 ppm of chlortetracycline hydrochloride. 10

In addition, the diets of ten groups of turkeys were potentiated with various amounts of sodium sulfate. After three hours feeding, the birds were bled by cardiac puncture and the chlortetracycline blood levels obtained by microbiological assay. The results obtained are shown below. 15

TABLE II

Supplements			Blood CTC mcg. per ml.
Fish Meal %	Dicalcium Phosphate %	Na ₂ SO ₄ %	
5.0	3.30	—	0.268
5.0	3.30	0.355	0.230
5.0	3.30	0.71	0.334
5.0	3.30	1.065	0.439
5.0	3.30	1.42	0.425
5.0	3.30	1.775	0.608
5.0	3.30	2.13	0.648
5.0	3.30	2.485	0.684
5.0	3.30	2.84	0.804
5.0	3.30	3.195	0.828

20 The additional nine groups of birds were treated in the same manner as those described above but the diet was altered to determine the effect substitution of calcium sulfate and sodium acid phosphate for equivalent amounts of dicalcium phosphate in the diet would have on the blood levels of the antibiotic. In this series the calcium ion concentration and inorganic phosphorus level were maintained at

1.4% and 0.75%, respectively. However, dicalcium phosphate was removed in increments from the diet and equivalent quantities of calcium sulfate and sodium acid phosphate were substituted therefor. After feeding for three hours, the birds were bled by cardiac puncture and the chlortetracycline blood level assayed microbiologically. The results obtained are given below. 30
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TABLE III

Supplements					Blood CTC mcg. per ml.
Fish meal %	Dicalcium phosphate %	Na ₂ SO ₄ %	CaSO ₄ ·2H ₂ O %	NaH ₂ PO ₄ ·H ₂ O %	
5.0	3.04	—	0.43	0.232	0.266
5.0	2.75	—	0.86	0.464	0.306
5.0	2.46	—	1.29	0.696	0.349
5.0	2.17	—	1.72	0.928	0.437
5.0	1.88	—	2.15	1.160	0.340
5.0	1.59	—	2.58	1.392	0.388
5.0	1.30	—	3.01	1.624	0.630
5.0	1.01	—	3.44	1.856	0.496
5.0	0.72	—	3.87	2.088	0.638

On examination of Table III it can be seen that (1) the addition of from 0.355% to about 3.2% of sodium sulfate by weight of diet, significantly increased the blood levels of chlortetracycline obtainable from diets containing such antibiotic and recommended levels of calcium and phosphorus supplied from conventional sources. (2) The use of sodium sulfate as a potentiator for chlortetracycline produced substantially higher blood levels for a given amount of chlortetracycline than can be obtained by substitution of calcium and phosphorus in less objectionable forms than the forms present in conventional additives.

EXAMPLE 3

Twenty-eight day-old chicks were randomly divided into 10 groups of 10 chicks each.

These chicks were fasted overnight and the following morning fed *ad libitum* a diet of ground corn supplemented with 0.8% calcium and 200 ppm of chlortetracycline. In some tests sodium sulfate was also added to the diet and in others calcium sulfate was substituted for an equivalent amount of calcium carbonate. Three hours after feeding was begun all birds were bled by cardiac puncture. One and one-half milliliters of blood were taken and blood levels of chlortetracycline were determined by microbiological assay.

In the series of tests in which sodium sulfate was added to the diet the calcium content was maintained at 0.8% with calcium carbonate. Sodium sulfate was added to the diet at increments of 0.355%. The results obtained are shown below.

TABLE IV

Supplements			Blood CTC mcg. per ml.
CaCO ₃ %	CaSO ₄ ·2H ₂ O %	Na ₂ SO ₄ %	
2.00	—	—	0.154
2.00	—	0.355	0.186
2.00	—	0.71	0.213
2.00	—	1.065	0.224
2.00	—	1.42	0.256
1.75	0.43	—	0.159
1.50	0.86	—	0.175
1.25	1.29	—	0.195
1.00	1.72	—	0.234

5 The calcium ion concentration in the feed containing 200 ppm chlortetracycline was maintained at 0.8%. However, in these tests initially 0.8% or all of the calcium in the diet was provided as CaCO₃ and then increments of CaSO₄ equivalent to 0.1% Ca++ were substituted for the CaCO₃ in the diet.

10 The results of these tests show that the addition of from 0.355% to 1.42% of calcium sulfate to a chick diet produced a significant potentiation of chlortetracycline in the blood levels. Substitution of calcium sulfate for dicalcium phosphate produced much less desirable results.

EXAMPLE 4

15 In these tests five groups of day-old turkey poults, ten turkeys per group, were weighed

and placed in cages where they were permitted to feed and drink *ad libitum* for 21 days. The diet supplied was a standard-laboratory turkey diet supplemented with up to 3.2% by weight of sodium sulfate. The feed provided for each group was weighed and total feed consumption was calculated for the 21-day test period. A sixth group was fed with the same diet but without the sodium sulfate supplement for comparison purposes. At the end of the test period the groups of birds were weighed and their average weight and the average grams of feed per gram gain was determined. The results of the test were recorded and appear in Table V below. The diet employed is also provided below.

TABLE V
Weight Gain and Safety Factor for Na₂SO₄ Supplemented Diet

Sodium sulfate in diet percent	Av Wt. 21 Days (grams)	Grams feed per gram gain
None	408	1.57
0.2	390	1.57
0.4	403	1.54
0.8	407	1.57
1.6	423	1.53
3.2	404	1.61

Diet	%
Ground yellow corn	40.7
Soybean oil meal	45.5
Menhaden fish meal	7.5
CaCO ₃	2.4
Dicalcium phosphate	2.0
Brewers dried yeast	1.25
Iodized salt	0.250
Magnesium sulfate	0.025
Vitamin A (10,000 IU/g.)	0.110
Vitamin D-3 (15,000 ICU/g.)	0.009
Choline chloride — 25%	0.125
Vitamin supplement 92	0.100
Proferm—20 (Vitamin B ₁₂)	0.025
Niacin	0.0044
D-alpha tocopherol acetate	0.00055
Parvo 3% (folic acid supplement)	0.0030

(Vitamin supplement 92 is a mixture of riboflavin, calcium pantothenate, niacin, choline chloride, wheat middlings, sodium carbonate, and soybean oil.)

From Table V, it can be seen that all birds consuming a sodium sulfate supplemented diet gained normally and showed good feed to weight conversion.

EXAMPLE 5

Following the procedure set forth in Example 4 day-old chicks were divided into groups of ten. The groups of chicks were weighed, placed in standard poultry cages where they were permitted to feed and drink *ad libitum* for 28 days. The diet employed was a standard commercial chick diet, as described below, supplemented with various

concentrations of sodium sulfate. The feed provided each group of chicks was carefully weighed and the total weight employed for the 28-day test period determined. On termination of the tests, the groups of chicks were weighed and the average weight per bird, per group calculated. The average grams of feed per gram gain for each chick group was also calculated and the results are recorded in Table VI below. The diet used is likewise set forth below. For comparison purposes a group of chicks were fed with the same diet but without the sodium sulfate supplement for the same 28-day test period.

TABLE VI
Weight Gain and Safety Factor for Sodium Sulfate Supplemented Diet

Supplement	Grams feed per gram gain	Average weight after 28 Days (gram)
None	1.693	536
0.2% Na ₂ SO ₄	1.698	527
0.4% Na ₂ SO ₄	1.680	535
0.8% Na ₂ SO ₄	1.644	542
1.6% Na ₂ SO ₄	1.692	536
3.2% Na ₂ SO ₄	1.703	553

Diet	g./kg.
Ground yellow corn	514
Soybean oil meal (containing 44% crude protein)	300
Menhaden fish meal (60%)	50
Corn gluten meal (41%)	50
Dehydrated alfalfa meal (17%)	20
Stabilized fat	40
Ground limestone	5
Dicalcium phosphate	12
Sodium chloride	3
Delamix + 2% zinc	1
Vitamin pre-mix	5

(Corn gluten meal is that part of commercial shelled corn that remains after extraction of the larger part of the starch and germ, and the separation of the bran by the processes employed in the web milling manufacture of corn starch or syrup. Dehydrated alfalfa meal is the product obtained by grinding alfalfa hay which is reasonably free of other crop plants, weeds, and mold, and dehydrating the same. Delamix contains manganese, iodine, iron, copper, cobalt and calcium. Vitamin pre-mix is essentially a mixture of vitamins.)

From Table VI, it can be seen that chicks have a good feed to weight gain conversion rate. 5
fed a normal diet supplemented with sodium sulfate gained normally and were found to

EXAMPLE 6

Following the procedure set forth in Example 3, twenty-seven day old chicks were divided into groups of twelve chicks each. These groups were fasted overnight. The following morning they were fed *ad libitum* a ground corn diet containing 200 ppm CTC.HCl and 0.8% calcium ion as calcium carbonate. Additionally, diets other than the control were supplemented with 1.03% dietary sulfate ion furnished by various sulfate or bisulfate salts. Three hours after feeding

was commenced the chicks were bled by cardiac puncture and the blood was assayed microbiologically for CTC. The results obtained are shown in Table VII below where it can be readily seen that the CTC blood levels in chicks consuming diets containing sulfates and bisulfates of cations carrying a single positive charge were significantly enhanced, whereas the CTC blood levels in those consuming diets containing sulfates of cations carrying two positive charges were no better than the unpotentiated control.

TABLE VII

Chlortetracycline blood levels obtained from additions to ground yellow corn fed to chicks

Supplement	3 Hours After Feeding
	Blood CTC microgram/ml.
None	0.11
H ₂ SO ₄	0.26
Na ₂ SO ₄	0.17
K ₂ SO ₄	0.24
NaHSO ₄ ·H ₂ O	0.24
KHSO ₄	0.20
(NH ₄) ₂ SO ₄	0.21
MgSO ₄	0.11
MnSO ₄ ·H ₂ O	0.08

WHAT WE CLAIM IS:—

1). A poultry feed composition comprising poultry feedstuff, a source of calcium, a source of phosphorus, a tetracycline antibiotic, and as a potentiating agent for the antibiotic an effective amount of a sulphate of a cation carrying a single positive charge.

2). A composition according to Claim 1 in which the sulphate is sodium sulphate, sodium bisulphate, potassium sulphate, potassium bisulphate, ammonium sulphate, ammonium acid sulphate, sulphuric acid, trimethyl ammonium sulphate, or dimethyl ammonium sulphate, or a mixture of any two or more of these sulphates.

3). A composition according to Claim 1 or Claim 2 containing between 0.24% and 2.4% by weight of sulphate ion.

4). A composition according to any preceding Claim in which the antibiotic is chlortetracycline.

5). A composition according to any preceding Claim in which the source of calcium is calcium carbonate, dicalcium phosphate or tricalcium phosphate.

6). A composition according to any preceding Claim containing at least 0.4% by weight phosphorus and at least 0.7% by weight calcium.

7). A composition according to any preceding Claim containing from 50 to 2,000 parts by weight of tetracycline antibiotic per million parts of the feedstuff.

8). A poultry feed composition according to Claim 1 substantially as hereinbefore described.

9). A poultry feed composition comprising a poultry feedstuff, from 50 to 2,000 parts per million parts by weight of the feedstuff of chlortetracycline, at least 1% by weight of calcium provided by calcium carbonate, dicalcium phosphate or tricalcium phosphate,



EXAMPLE 6

Following the procedure set forth in Example 3, twenty-seven day old chicks were divided into groups of twelve chicks each. These groups were fasted overnight. The following morning they were fed *ad libitum* a ground corn diet containing 200 ppm CTC.HCl and 0.8% calcium ion as calcium carbonate. Additionally, diets other than the control were supplemented with 1.03% dietary sulfate ion furnished by various sulfate or bisulfate salts. Three hours after feeding

was commenced the chicks were bled by cardiac puncture and the blood was assayed microbiologically for CTC. The results obtained are shown in Table VII below where it can be readily seen that the CTC blood levels in chicks consuming diets containing sulfates and bisulfates of cations carrying a single positive charge were significantly enhanced, whereas the CTC blood levels in those consuming diets containing sulfates of cations carrying two positive charges were no better than the unpotentiated control.

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MnSO ₄ ·H ₂ O	0.08

WHAT WE CLAIM IS:—

1). A poultry feed composition comprising poultry feedstuff, a source of calcium, a source of phosphorus, a tetracycline antibiotic, and as a potentiating agent for the antibiotic an effective amount of a sulphate of a cation carrying a single positive charge.

2). A composition according to Claim 1 in which the sulphate is sodium sulphate, sodium bisulphate, potassium sulphate, potassium bisulphate, ammonium sulphate, ammonium acid sulphate, sulphuric acid, trimethyl ammonium sulphate, or dimethyl ammonium sulphate, or a mixture of any two or more of these sulphates.

3). A composition according to Claim 1 or Claim 2 containing between 0.24% and 2.4% by weight of sulphate ion.

4). A composition according to any preceding Claim in which the antibiotic is chlortetracycline.

5). A composition according to any preceding Claim in which the source of calcium is calcium carbonate, dicalcium phosphate or tricalcium phosphate.

6). A composition according to any preceding Claim containing at least 0.4% by weight phosphorus and at least 0.7% by weight calcium.

7). A composition according to any preceding Claim containing from 50 to 2,000 parts by weight of tetracycline antibiotic per million parts of the feedstuff.

8). A poultry feed composition according to Claim 1 substantially as hereinbefore described.

9). A poultry feed composition comprising a poultry feedstuff, from 50 to 2,000 parts per million parts by weight of the feedstuff of chlortetracycline, at least 1% by weight of calcium provided by calcium carbonate, dicalcium phosphate or tricalcium phosphate,



5 a source of phosphorus when the calcium source is calcium carbonate, and, as a potentiating agent for the antibiotic, sodium sulphate or potassium sulphate in an amount sufficient to provide about 0.96% by weight of sulfate ions.

10 10). A concentrate suitable for addition to poultry feedstuff comprising a minor proportion of feedstuff, a tetracycline antibiotic, and as a potentiating agent therefor, a major proportion of a sulphate of a cation carrying a single positive charge.

15 11). A concentrate according to Claim 10 in which the antibiotic is provided by dried chlortetracycline fermentation harvest mash solids.

12). A concentrate according to Claim 10

or Claim 11 in which the sulphate is sodium sulphate, sodium bisulphate, potassium sulphate, potassium bisulphate, ammonium sulphate, ammonium acid sulphate, sulphuric acid, trimethyl ammonium sulphate, or dimethyl ammonium sulphate, or a mixture of any two or more of these sulphates.

25 13). A method of accelerating the growth rate of poultry comprising feeding the poultry with a composition according to any one of Claims 1—9.

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