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(54) Title: IMPROVED POULTRY MEAT PRODUCTS

(57) Abstract: A modified poultry meat has an increased content of monounsaturated fatty acids and reduced content of saturated fatty acids. A method of modifying poultry products with beneficial fatty acids is also described.

IMPROVED POULTRY MEAT PRODUCTS

Field of the Invention

The present invention relates to poultry meat and meat products which are produced for human consumption. Specifically, it relates to a method for producing poultry, particularly chicken or turkey having improved health and nutritive values.

Background of the Invention

The increasing number of seniors in the general population, along with the general trend of consuming healthier food products led to the demand for the development of foods directed to support a long and healthy life. According to the FDA, healthy foods provide, by virtue of the active ingredients they contain, benefits beyond basic nutrition.

Fatty acids can be saturated and unsaturated, depending on double bonds present between the carbons comprising the fatty acid chain. Saturated fatty acids do not contain any double bonds. The shortest descriptions of fatty acids include only the number of carbon atoms and double bonds in them. C18:0 means that the carbon chain of the fatty acid consists of 18 carbon atoms, and there are no (zero) double bonds in it, whereas C18:1 describes an 18-carbon chain with one double bond in it. If there is one or more double bonds in the fatty acid, it is no longer considered saturated, but rather, mono- or polyunsaturated. Omega poly unsaturated fatty acids are unsaturated fatty acids which have several carbon-carbon double bonds. The omega notation indicates the number of carbons from the terminal methyl carbon, where the first double bond in the chain is present.

The human body cannot synthesize omega-3 and omega-6 polyunsaturated fatty acids (PUFA) de novo, and therefore has to rely on their supply in

the diet. Our body has the capacity to convert the shorter C18 to the longer C20 and C22 carbon fatty acids, while maintaining the same "omega number". Both the omega-3 alpha linolenic acid (ALA) and omega-6 linoleic acid (LA) are essential nutrients which must be obtained from food. The conversion of the shorter omega-6 LA to the longer C20:4 arachidonic acid (ARA) occurs competitively with the parallel conversion of ALA to the omega-3 C20 eicosapentaenoic acid (EPA) and C22 docosahexaenoic acid (DHA) highly-unsaturated fatty acids (abbreviated HUFA). Specifically, the synthesis of EPA from ALA within the body is competitively slowed by the synthesis of ARA from LA. Therefore, entry and accumulation of omega-3 HUFAs in body tissues is more effective when EPA and DHA are obtained directly from food and when the dietary available amounts of omega-6 LA or ARA are not in large excess over those of ALA, and EPA/DHA, respectively.

The nutritionally important fatty acids (termed "essential fatty acids") are: EPA, DHA as well as LA and ARA. It is still uncertain whether ALA is essential by itself when EPA and especially DHA are plentiful in the diet.

It is well accepted that high levels of saturated fatty acids and cholesterol in the human diet increase the risk for cardiovascular/circulatory diseases such as atherosclerosis, myocardial infraction and stroke as well as hypertension and thrombosis. In populations where the level of saturated fat in the diet is low, and the level of omega-3 polyunsaturated fat is high, such as the American Eskimo, the likelihood of coronary heart disease is greatly reduced as compared to a population of mainland United States where the dietary intake of saturated fats is high and that of omega-3 oils and foods is low. Indeed, in recent years the medical community has recommended eating more omega-3 oils as well as monounsaturated fatty acids.

While vegetable or plant polyunsaturated oils containing omega-6 fatty acids such as LA and omega-3 acids such as ALA have some beneficial properties, it has been found that dietary intake of fish and fish (marine) oils, containing substantial omega-3 polyunsaturated fatty acids, such as EPA and DHA, significantly reduce triglycerides level in blood and the likelihood of cardiovascular disease. In the human body, the plant-derived omega-3 fatty acid ALA is only minimally converted to EPA and almost none to DHA. Therefore, supplementation of the human diet with ALA-rich plant oils, or the plant seeds themselves, does not lead to significant increases in the levels of EPA and DHA in blood and tissues.

As part of the attempts to develop healthy foods, research has been recently focused on the "Mediterranean diet" (formulated according to the food consumed by the inhabitants of the island of Crete) as a means to reduce low density lipoproteins (LDL) oxidation and thus coronary heart disease. This diet is characterized by a higher consumption of olive oil, which is rich in the monounsaturated fatty acid oleic acid and low in omega-6 LA, as well as consuming higher levels of fish and other aquatic animals, vegetables and fruits. Indeed, more recent publications have documented in a rabbit model of atherosclerosis, the beneficial effect of high dietary oleic acid in protecting circulating blood LDL against oxidation. These observations led to efforts to develop foods and diets high in oleic acid and in fish-derived EPA and DHA, and at the same time, low in LA.

The goal of modifying poultry meat to obtain healthier meat may be achieved by introducing supplementary food ingredients into the chickens feed.

US 4,918,104 describes a method of increasing the concentration of omega-3 PUFA in poultry administering to the poultry a feed comprising

preformed omega-3 PUFA or a metabolic precursor thereof. The preferred source of omega-3 according US 4,918,104 is Menhaden fish oil. This type of fish oil has a strong fishy odor and taste. Additionally, high levels of Menhaden oil in the chickens' diet most probably impart a strong fishy taste and smell to the eggs and meat obtained. Furthermore, although US 4,918,104 does not provide hedonic sensory data for the poultry feed comprising 10% Menhaden oil, it discloses such analysis for a feed comprising 10% fish meal, reporting that the chicken has a fishy taste which some defined as awful.

US 5,133,963 relates to a poultry feed comprising Menhaden oil and enriched water which contain additional ingredients.

US 6,054,147 describes a feeding regimen for feeding chicken (broilers), wherein the content of omega-3 highly unsaturated fatty acids (HUFA) in the feed is higher in the late phase of the growth than in the early phase, with the strict limitation that the maximal concentration of any low quality omega-3 HUFA source oil is less than 2% by weight of the feed. The feed of the present invention comprises a fish oil-rich oil blend at the minimal concentration of 2.3%. Furthermore, US 6,054,147 provides examples in which the chicken are fed only algal DHA as the sole source of omega-3 PUFA, with no detailed example of a feed comprising fish oil and no analysis of the fatty acids content (especially DHA and EPA) in the meat obtained .

US 6,103,276 provides a method for obtaining chicken meat with increased levels of LA and ALA, by feeding chicken with whole flaxseed, soybean oil and grit. This publication does not relate to increased levels of long-chain omega-3 fatty acids EPA and DHA in the meat.

In summary, the prior art does not provide a commercially feasible, low-cost method for producing modified poultry meat which are rich in DHA and EPA as well as in oleic acid, and at the same time also low in ARA and LA.

It is therefore an object of the present invention to provide a method for producing poultry meat with beneficial health and nutritive values, which reside in their unique fatty acids composition.

It is another object of the invention to provide poultry meat with reduced content of saturated fatty acids and omega-6 PUFA together with increased content of omega-3 HUFA and oleic acid.

It is another object of this invention to provide a method for producing poultry meat rich in DHA, EPA and oleic acid, and low in LA and ARA.

It is another object of the present invention to provide poultry feeds for the production of chicken and turkey meat that are rich in DHA, EPA and oleic acid, and low in LA and ARA.

Another object of the present invention is to provide modified poultry meat with no fishy smell or taste.

Summary of the Invention

In one aspect, the present invention relates to a method for modifying poultry meat products with beneficial fatty acids, comprising feeding a fowl with a acceptable poultry feed in which the animal or vegetable oil blend component of the feed is replaced by, or supplemented with, an oil blend consisting of fish oil (50-90%), canola oil (0-30%), soy oil and/or soap stock (0-50%) and linseed oil (0-30%) at oil levels added to the feed from

about 3.5% up to about 7.0%, calculated based on the final feed composition.

According to one embodiment of the invention the fowl is a broiler and the oil level added to the feed is from 3.5% up to about 5.3%, calculated based on the final feed composition.

According to another embodiment of the invention the fowl is a turkey and the oil levels added to the feed is from 5.3% up to about 7.0%, calculated based on the final feed composition.

According to a further embodiment of the invention the poultry product is poultry meat.

In another aspect, the invention relates to a chicken meat containing per 100 g of boneless meat (a) at least 12 mg DHA; and (b) at least 16 mg of combined DHA + EPA.

The invention further relates to a turkey meat containing per 100 g of boneless meat (a) at least 22 mg DHA; and (b) at least 33 mg of combined DHA + EPA.

In a further aspect, the invention relates to a poultry feed comprising an oil blend consisting of fish oil (50-90%), canola oil (0-30%), soy oil and/or soup stock (0-50%) and linseed oil (0-30%), in admixture with acceptable poultry feed at oil levels from about 3.5% up to about 7.0%, in the final feed composition. Specifically, the acceptable poultry feed comprises corn meal (30-40%), soybean meal (30-40%) and wheat-sorghum (18-25%) alone, or in admixture with additional acceptable poultry feed ingredients. According to one embodiment of the invention the poultry are broilers. According to another embodiment of the invention the poultry are turkeys.

The term "acceptable poultry feed", as used herein indicates any conventional poultry feed employed in the art. Such feed conventionally comprises one or more of corn meal, soybean meal and wheat-sorghum as major components of the feed and smaller quantities of additional ingredients such as vitamins and minerals.

In another aspect the invention relates to a process for the manufacture of the poultry feed of the invention, comprising the steps of: (a) admixing corn meal, soybean meal, wheat-sorghum and any additional ingredient with an oil blend comprising fish oil (50-90%), canola oil (0-30%), soy oil and/or soup stock (0-50%) and linseed oil (0-30%); and (b) wetting the mixture and compressing the mixture into nuggets.

According to another aspect the invention relates to a process for the manufacture of a poultry feed, comprising the steps of: (a) admixing corn meal, soybean meal, wheat-sorghum and any additional ingredient with a fraction of an oil blend comprising fish oil (50-90%), canola oil (0-30%), soy oil and/or soup stock (0-50%) and linseed oil (0-30%); (b) wetting the mixture and compressing the mixture into nuggets; and (c) spraying the reminder of the oil blend onto the nuggets.

In another aspect the invention relates to a process for the manufacture of a poultry feed, comprising the steps of: (a) admixing corn meal, soybean meal, wheat-sorghum and any additional ingredient with a fraction of one or more of the components of an oil blend comprising fish oil (50-90%), canola oil (0-30%), soy oil and/or soup stock (0-50%) and linseed oil (0-30%); (b) wetting the mixture and compressing the mixture into nuggets; and (c) spraying the reminder of the oil blend components onto the nuggets.

According to one embodiment, the process of the invention further comprises granulating the nuggets to finer mini-nuggets.

The above and other characteristics and advantages of the invention will be more readily apparent through the following examples.

Detailed Description of the Invention

The present invention provides modified poultry meat having an increased content of monounsaturated fatty acids and reduced content of saturated fatty acids, and a method of producing the same. The invention further provides poultry feed and a process for its manufacture.

The term "poultry" as employed herein refers particularly to chickens grown for meat (broilers or other types) and to turkey grown for meat, and in general to any avian species including goose and ostrich.

The term "chicken meat" as employed herein refers particularly to meat obtained from a chicken or turkey, and in general to any avian species including goose and ostrich.

Reference will be often made herein to "chicken" for the sake of brevity, it being understood that the description applies, mutatis mutandis, to other poultry as well and to fowls in general.

Whenever reference is made herein to "canola oil" the same applies to other high oleic acid oils, such as high oleic sunflower oil, high oleic soybean oil or high oleic corn oil. Canola oil is referred to herein specifically, for the sake of brevity.

The fatty acids composition of the chicken meat according to the present invention comprises no less than 2.2% DHA and no less than 3.1% of EPA

+ DHA. Calculated per 100 g meat, the broilers' meat (boneless) obtained using the preferred embodiment, contains no less than 12 mg DHA and no less than 16 mg of combined EPA + DHA.

The fatty acids composition of the turkey meat according to the present invention comprises no less than 3.3% DHA and no less than 4.5% of combined EPA+DHA. Calculated per 100 g meat weight, the turkey meat (boneless) obtained using the preferred embodiment, contains no less than 22 mg DHA and no less than 33 mg EPA+DHA.

The present invention provides a method for obtaining modified chicken and turkey meat, by feeding chickens or turkeys grown for meat with supplementary ingredients. The feed according to the present invention includes a feed for growing chickens or turkeys, as listed in tables 1 and 4 respectively, and having the ingredients analysis as given in tables 2 and 5 respectively, and in which the regular animal or vegetable fat (oil) blend in the feed, generally termed "soap stock", is replaced by an oil blend consisting of fish oil (50-90%), canola oil (0-30%), soy oil and/or soap stock (0-50%) and linseed oil (0-30%) at levels of 3.5%-5.3% (in chicken feed) or 5.3%-7.0% (in the turkey feed).

According to a specific embodiment of the invention, the regular animal or vegetable fat (oil) blend in the feed is not removed from the feed, but rather supplemented with the oil blend of the invention.

One aspect of the present invention provides modified poultry meat having increased content of omega-3 HUFA and reduced content of omega-6 PUFA and HUFA. The invention further provides modified poultry meat with increased content of monounsaturated fatty acids and reduced content of saturated fatty acids and a method of producing the same.

Poultry supplementary feed compositions known in the art that contain Menhaden oil or fish meal have been shown to impart a strong fishy odor and taste on the chicken meat obtained. In contrast, the fish oil blend utilized in the poultry feed according to the present invention posses very mild fishy qualities and can be added in low concentrations of at up to 4.8% for broilers or up to 4.9% for turkey, by weight of the poultry feed, with no fishy smell or taste imparted on the meat and fat obtained.

The present invention further provides processes for the manufacture of the poultry feed. In general, the oil blend according to the present invention, comprising fish oil (50-90%), canola oil (0-30%), soy oil and/or soup stock (0-50%) and linseed oil (0-30%) is admixed with an acceptable poultry feed, comprising corn meal, soybean meal, wheat-sorghum and any additional ingredient. Next, the mixture is wetted, optionally with steam and compressed into nuggets. Optionally, the nuggets are further granulated to finer mini-nuggets.

According to one embodiment, the oil blend is added to the other feed ingredients in one stage. According to another embodiment, the oil blend is added in two or more stages of the feed preparation. According to a further embodiment, the various components of the oil blend are added at different stages of the feed preparation, e.g. the fish oil is added at one stage, and the other oil components are added at another stage in the feed preparation process.

The relative amounts of the three major solid ingredients of fowl feed (corm meal, soybean meal and wheat-sorghum, see examples below) may vary according to the availability and cost of each component, and the level of the oil blend added to the feed and its composition is adjusted accordingly.

Additional supplementary ingredients can be added to the feeds of the present invention, for obtaining poultry meat enriched with additives such as vitamins, minerals, proteins, antibiotics etc.

Examples

Example 1

Feed for chickens grown for meat and the fatty acid content of the meat obtained

This example illustrates the production of modified chicken meat according to the present invention.

30 young chicks, age 22 days, previously fed a commercial young chicks diet, were assigned to three experimental dietary groups. The first group of 10 chickens continued to receive the standard feed listed in Tables 1 and 2, with soap stock as the oil component, mostly composed of soybean oil and animal fat. The second experimental group, also consisting of 10 chickens, received a feed in which the soap stock was replaced by 4.4% oil blend (calculated from the final feed composition), composed of 65% fish oil, 30% canola oil and 5% soy oil, designated as feed 1. The third group received a feed containing an oil blend composed of 45% fish oil, 35% soap stock and 20% canola oil, designated as feed 2. The diets were fed for 3 weeks after which the chickens were sacrificed and meat samples (dark and white portions) were subjected to total lipid extraction, followed by lipids and fatty acid analysis.

There were no significant differences between the three experimental groups in food consumption, final body weight or percent of depot body fat. Furthermore, no differences between the experimental groups were observed in taste, smell and overall appearance of the meat.

Table 1: *Broilers' diet ingredients*

Ingredient	Weight %
Corn Meal	33.00
Soybean Meal	30.60
Wheat (11.5% protein) – Sorghum (9.1% protein)	28.30
Oil Blend	4.43
Dicalcium Phosphate	1.24
Limestone ($CaCO_3$)	1.20
Vitamin Mix	0.50
Alimet (85)	0.28
Sodium Bi-Carbonate	0.20
L-Lysine Sulphate	0.12
Calperona P	0.10

Table 2: *Broilers' diet-nutritional information*

Nutrient	Content
Metabolized Energy	3150 Kcal/Kg
Protein	19.8%
Calcium	0.96%
Phosphorus	0.59%
Sodium	0.17%
Salt	0.33%
Fat	6.2%

Fatty acids analyses of the broilers meat key fatty acids revealed highly significant differences among the experimental groups in the fatty acids profile and overall content of EPA +DHA vs. ARA, as well in the oleic acid content. The chicken meat obtained from the group supplemented in their diet with the fish oil- canola oil- soy oil blend (feed 1) was highly enriched in EPA and DHA, as well as in oleic acid and had a reduced level of ARA. The meat fatty acid composition consisted of 5.9-8.0% DHA, combined EPA+DHA of 8.5-11.1%, and only 3.0-4.2% ARA.

As demonstrated in Table 3, calculated per 100 g meat weight, the chicken meat (boneless) obtained from the group supplemented with feed 1 contained 25-30 mg DHA, 35-46 mg of combined EPA + DHA, 170-220 mg oleic acid, and only 11-13 mg ARA. Significantly, the meat obtained is highly enriched in oleic acid (oleic to LA ratio of approx. 3). This is in sharp contrast to the fatty acids content of meat from the control group which had, per 100 g weight, 4.4-4.6 mg DHA, 5.2-5.5 mg EPA+DHA, 28.0-30.2 mg ARA and 100-105.2 mg of oleic acid, with the resulting ratio of oleic acid to LA of only 0.9-1.0. A smaller increase in DHA, EPA +DHA and oleic acid values, accompanied by a milder reduction in ARA, were seen in the meat of chickens supplemented with feed 2, compared to the results of the group on feed 1.

A smaller content of DHA was also found in another experiment, in which the broilers were fed a diet similar to feed 1, but with only 3.5% oil blend added to the feed instead of 4.43%.

Table 3: *Key Fatty Acid Content of control chicken meat vs. modified chicken meat*

Fatty Acid	Fatty Acid Content (mg/100 g meat)		
	Control	**Feed 1**	**Feed 2**
ARA	28.0 – 30.2	11 – 13	19 – 21
DHA	4.2 – 4.6	25 – 30	12 – 15
EPA + DHA	5.0 – 5.5	35 – 46	16 – 20
Oleic Acid	100 – 107.7	170 – 220	130 – 145

Example 2

Feed for turkeys grown for meat and the fatty acid content of the meat obtained

This example illustrates the production of modified turkey meat according to the present invention.

30 young turkey females, age 40-42 days, previously fed a commercial young turkey diet, were assigned to three experimental dietary groups. The first group of 10 turkeys continued to receive the standard diet for growing turkey listed in Tables 4 and 5, with the oil blend being mostly soybean oil and animal fat. The second experimental group, also consisting of 10 turkeys, received a diet in which the standard fat and oil blend was replaced by 7.0% oil blend, calculated from the final feed composition, composed of 70% fish oil and 30% canola oil, designated as feed 3. The third group receiving a feed containing an oil blend composed of 35% fish oil, 35% soap stock and 30% canola oil, designated as feed 4. The diets were fed for 6 weeks after which the turkeys were sacrificed and meat samples were subjected to total lipid extraction, followed by lipids and fatty acid analysis.

There were no significant differences between the two experimental groups in food consumption, final body weight or percent of depot body fat. Furthermore, no differences between the experimental groups were observed in taste, smell and overall appearance of the fresh meat as well as the cooked meat.

Table 4: *Turkeys' diet- ingredients*

Ingredient	Weight %
Soya Meal – 46.5% protein	37.7
Corn – 7.5% protein	34.7
Sorghum – 9.5% protein	10
Sunflower Meal – 36% protein	4.8
Oil Blend	7.0
Dicalcium Phosphate	3.0
Limestone (CaCO3)	1.2
Vitamin Mix (starter + growth)	0.8
Alimet (85)	0.25
L-Lysine Sulphate	0.33
Calperona P	0.2
L-Threonine	0.03

Table 5: *Turkeys' diet- nutritional information*

Nutrient	Content
Metabolized Energy	3125 Kcal/Kg
Protein	23
Ash	7.7
Cellulose	2.9
Calcium	1.3
Phosphorus	0.95
Sodium	0.15
Salt	0.39
Fat	8.4

Fatty acids analyses of the turkeys' meat revealed highly significant differences among the experimental groups in the fatty acids profile and overall content of EPA +DHA vs. ARA as well in the oleic acid content. The meat obtained from group of feed 3 was highly enriched in EPA and DHA, as well as in oleic acid and had a reduced level of ARA. The meat fatty acids composition consisted of 12.77-15.19% DHA, combined

EPA+DHA of 16.58-21.08%, only 4.87-6.34% ARA, and an oleic acid to LA ratio of about 1.5. The corresponding values for feed 4 were 7.29-9.87% DHA, 8.88-11.92% EPA+DHA and 10.04-12.89% ARA and an oleic-LA ratio of about 1.

Table 6 presents the fatty acid content of the meat obtained from the three experimental groups, calculated per 100 g meat weight. The turkey meat from the group fed with feed 3 contained 43-51 mg DHA, 61-78 mg of combined EPA + DHA, 73-82 mg oleic acid, and only 23-27 mg ARA. This is in sharp contrast to the fatty acids content of meat from the control turkey group which had, per 100 g weight, 3.7-4.2 mg DHA, 4.2-4.9 mg EPA + DHA, 51-62 mg oleic acid and 33.5-39.8 mg ARA. Furthermore, the turkey meat from the experimental group of feed 3 contained 23% less saturated fat (i.e. the sum of palmitic and stearic acids) as compared to the meat from the control group. Also, as seen in Table 6, the fatty acids values in the meat of turkeys supplemented with feed 4 changed more moderately from the control group values, as compared to the results of the group of feed 3.

Finally, as expected a smaller content of DHA was also found in another experiment, in which the turkeys were fed a diet similar to that described in feed 3, but with only 5.3% oil blend added to the feed instead of 7.0%.

Table 6: *Key fatty acids content of control turkey meat vs. modified turkey meat*

Fatty Acid	Fatty Acid Content (mg/100 g meat)		
	Control	Feed 3	Feed 4
ARA	33.5 - 39.8	23 – 27	29-32
DHA	3.7 - 4.2	43 – 51	22-29
EPA + DHA	4.2 - 4.9	61 – 78	33-40
Oleic Acid	51 - 62	73 – 82	65-71

While this invention has been described in terms of some specific examples, many modifications and variations are possible. It is therefore understood that within the scope of the appended claims, the invention may be realized otherwise than as specifically described.

CLAIMS:

1. A method for modifying poultry products with beneficial fatty acids, comprising feeding a fowl with acceptable poultry feed in which the animal or vegetable oil blend component of the feed is replaced by, or supplemented with, an oil blend consisting of fish oil (50-90%), canola oil (0-30%), soy oil and/or soup stock (0-50%) and linseed oil (0-30%) at oil levels added to the feed from about 3.5% up to about 7.0%, calculated based on the final feed composition.

2. A method according to claim 1, wherein the fowl is a broiler and the oil level added to the feed is from 3.5 up to about 5.3%, calculated based on the final feed composition.

3. A method according to claim 1, wherein the fowl is a turkey and the oil levels added to the feed is from 5.3% up to about 7.0%, calculated based on the final feed composition.

4. A method according to claim 1, wherein the poultry product is poultry meat.

5. A chicken meat containing per 100 g of boneless meat:
   a. at least 12 mg DHA;
   b. at least 16 mg of combined DHA + EPA.

6. A turkey meat containing per 100 g of boneless meat:
   a. at least 22 mg DHA;
   b. at least 33 mg of combined DHA + EPA.

7. Poultry feed comprising an oil blend consisting of fish oil (50-90%), canola oil (0-30%), soy oil and/or soup stock (0-50%) and linseed oil (0-30%), in admixture with acceptable poultry feed at oil levels from about 3.5% up to about 7.0%, in the final feed composition.

8. A feed according to claim 7, wherein the acceptable poultry feed comprises corn meal (30-40%), soybean meal (30-40%) and wheat-sorghum (18-25%) alone, or in admixture with other acceptable poultry feed ingredients.

9. A feed according to claim 8, wherein the poultry are broilers.

10. A feed according to claim 8, wherein the poultry are turkeys.

11. A process for the manufacture of a poultry feed according to claim 8, comprising the steps of:
    a. admixing corn meal, soybean meal, wheat-sorghum and any additional ingredient with an oil blend comprising fish oil (50-90%), canola oil (0-30%), soy oil and/or soup stock (0-50%) and linseed oil (0-30%); and
    b. wetting the mixture and compressing said mixture into nuggets.

12. A process for the manufacture of a poultry feed according to claim 8, comprising the steps of:
    a. admixing corn meal, soybean meal, wheat-sorghum and any additional ingredient with a fraction of an oil blend comprising fish oil (50-90%), canola oil (0-30%), soy oil and/or soup stock (0-50%) and linseed oil (0-30%);
    b. wetting the mixture and compressing said mixture into nuggets; and
    c. spraying the reminder of said oil blend onto said nuggets.

13. A process for the manufacture of a poultry feed according to claim 8, comprising the steps of:
    a. admixing corn meal, soybean meal, wheat-sorghum and any additional ingredient with a fraction of one or more of the components of an oil blend comprising fish oil (50-90%), canola oil (0-30%), soy oil and/or soup stock (0-50%) and linseed oil (0-30%);

b. wetting the mixture and compressing said mixture into nuggets; and

c. spraying the reminder of said oil blend components onto said nuggets.

14. A process according to any one of claims 11-13 further comprising granulating said nuggets to finer mini-nuggets.