Animal Feeds and Pet Foods

Recent Developments

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ANIMAL FEEDS AND PET FOODS

Recent Developments

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FOREWORD

The detailed, descriptive information in this book is based on U.S. patents, issued since April 1973, that deal with animal feeds and pet foods.

This book serves a double purpose in that it supplies detailed technical information and can be used as a guide to the U.S. patent literature in this field. By indicating all the information that is significant, and eliminating legal jargon and juristic phraseology, this book presents an advanced, commercially oriented review of animal feeds and pet foods.

The U.S. patent literature is the largest and most comprehensive collection of technical information in the world. There is more practical, commercial, timely process information assembled here than is available from any other source. The technical information obtained from a patent is extremely reliable and comprehensive; sufficient information must be included to avoid rejection for "insufficient disclosure." These patents include practically all of those issued on the subject in the United States during the period under review; there has been no bias in the selection of patents for inclusion.

The patent literature covers a substantial amount of information not available in the journal literature. The patent literature is a prime source of basic commercially useful information. This information is overlooked by those who rely primarily on the periodical journal literature. It is realized that there is a lag between a patent application on a new process development and the granting of a patent, but it is felt that this may roughly parallel or even anticipate the lag in putting that development into commercial practice.

Many of these patents are being utilized commercially. Whether used or not, they offer opportunities for technological transfer. Also, a major purpose of this book is to describe the number of technical possibilities available, which may open up profitable areas of research and development. The information contained in this book will allow you to establish a sound background before launching into research in this field.

Advanced composition and production methods developed by Noyes Data are employed to bring these durably bound books to you in a minimum of time. Special techniques are used to close the gap between "manuscript" and "completed book." Industrial technology is progressing so rapidly that time-honored, conventional typesetting, binding and shipping methods are no longer suitable. We have by-passed the delays in the conventional book publishing cycle and provide the user with an effective and convenient means of reviewing up-to-date information in depth.

The Table of Contents is organized in such a way as to serve as a subject index. Other indexes by company, inventor and patent number help in providing easy access to the information contained in this book.

15 Reasons Why the U.S. Patent Office Literature Is Important to You —

1. The U.S. patent literature is the largest and most comprehensive collection of technical information in the world. There is more practical commercial process information assembled here than is available from any other source.

2. The technical information obtained from the patent literature is extremely comprehensive; sufficient information must be included to avoid rejection for "insufficient disclosure."

3. The patent literature is a prime source of basic commercially utilizable information. This information is overlooked by those who rely primarily on the periodical journal literature.

4. An important feature of the patent literature is that it can serve to avoid duplication of research and development.

5. Patents, unlike periodical literature, are bound by definition to contain new information, data and ideas.

6. It can serve as a source of new ideas in a different but related field, and may be outside the patent protection offered the original invention.

7. Since claims are narrowly defined, much valuable information is included that may be outside the legal protection afforded by the claims.

8. Patents discuss the difficulties associated with previous research, development or production techniques, and offer a specific method of overcoming problems. This gives clues to current process information that has not been published in periodicals or books.

9. Can aid in process design by providing a selection of alternate techniques. A powerful research and engineering tool.

10. Obtain licenses — many U.S. chemical patents have not been developed commercially.

11. Patents provide an excellent starting point for the next investigator.

12. Frequently, innovations derived from research are first disclosed in the patent literature, prior to coverage in the periodical literature.

13. Patents offer a most valuable method of keeping abreast of latest technologies, serving an individual's own "current awareness" program.

14. Copies of U.S. patents are easily obtained from the U.S. Patent Office at 50¢ a copy.

15. It is a creative source of ideas for those with imagination.

CONTENTS AND SUBJECT INDEX

INTRODUCTION

This book contains a wealth of information for animal food technologists and those concerned with animal husbandry. There are nearly 200 processes which deal with animal and pet feeds developed during the past several years.

Preparation of feeds containing nonprotein nitrogen and lipids to increase growth and health of ruminants while improving digestive efficiency and protein utilization are detailed. Included are feeds specifically adapted for postrumen digestion. Also considered are medicinal preparations containing microorganisms such as one specifically cultured for digesting certain diets or for treating adverse conditions like scouring, which results from disruptions in diets caused by shipment of animals to market. A feed supplement containing polyunsaturated lipids in an ammoniated protein-aldehyde complex, which is not hydrogenated in the rumen as much as other lipid-containing feeds, will interest those concerned with the role of fat in arterial and coronary disease.

The chapter "Nutrients" describes feeds containing elements such as Fe, Zn, Cu, Co, Mn, iodine, Mg and Se, so essential to the growth of poultry and domestic animals. Cobalt, for example, is added to ruminant feed so that the animals can synthesize vitamin B_{12} needed for protein conversion. There are also processes to reduce the fluorine content of phosphate supplements fed to domestic animals and fowl, and some pertaining to the addition of the essential amino acid methionine, which demonstrate its effectiveness in improving the wool quality of sheep.

Fifty-six processes for promoting the growth of ruminants and nonruminants are presented under "Growth Promoters." Those skilled in the art of animal husbandry realize that by shortening the growing period for an animal the sooner it will be moved to market, resulting in higher profit. Inducing polyphagia or eating beyond satiety in the animal helps achieve this goal and can be accomplished by compounds described in this chapter, such as 2,3-dibromopropanol, which effects a greater weight gain on the same or even less ingested food.

Growth promoters which curb bacterial infection are used in veterinary medicine. By preventing diseases such as coccidiosis growth is fostered. The sections on streptomycetes and other antibiotics furnish considerable data on this topic.

By proper treatment of silage, bacteria can be killed while fermentation of the green fodder to the desirable lactic acid is still attained. Salts, enzymes, and other ensiling agents used to prepare and preserve silage and fodder are presented. Apparatus and treatment methods developed for the various processes necessarily performed to produce satisfactory, specialized feeds are also treated in depth.

Not to be ignored are the methods for enriching fish foods and presenting them in a manner that will prompt consumption, a much desired goal in view of the insufficent supply of feed for satisfactory multiplication of fish and fowl. Both natural and synthetic baits are also described.

There are three categories of pet foods--dry, semimoist and high-moisture--each of which is treated at length in a separate chapter. Foods containing between 15 and 50% moisture fall into the intermediate category of semimoist.

"Dry Pet Foods" encompasses bone substitutes, products of cereal and meat simultaneously extruded to give the marbleized appearance characteristic of fresh meat, and dry foods of varied textures prepared so as to be appetizing to pets.

Because semimoist pet foods may present a problem of bacterial growth, the processes to achieve bacteriostasis contained in this book are noteworthy. Other topics covered under the semimoist category are simulated egg and meat products, filled and extruded foodstuffs, special flavors and binder systems.

Among the subjects dealing with high-moisture foods are gel inhibition in gravy products and a procedure for texturizing lung to give it the appearance of beef muscle.

As fine as a pet food may be from a nutritional standpoint, it is useless if it is not consumed. To encourage consumption the pet food industry is constantly developing palatability enhancers described in the last chapter. An example is the coating of dog and cat food with yeast or the coating of a cat food with a synergistically effective coating of phosphoric and citric acids to make it more acceptable.

RUMINANT FEEDS AND FEED SUPPLEMENTS

NONPROTEIN NITROGEN

Urea Chemically Bound to Cellulose

K.L. Berger, J.J. Nassar and W.B. Benken; U.S. Patent 4,089,980; May 16, 1978; assigned to Syntex (U.S.A.) Inc. described a process for the preparation of NPN (nonprotein nitrogen) ruminant feed supplements containing a high percentage of chemically bound urea, relative to free urea, which are prepared in a simple, commercially feasible, process from readily available cellulose commodities.

As starting cellulose commodities that may be used there may be mentioned a variety of readily available, inexpensive industrial and agricultural waste products such as, for example, soy hulls, rice hulls, peanut hulls, oat hulls, cottonseed hulls, wheat straw, oat straw, cornstalks, soybean hay, corncobs, cottonseed trash, bagasse, molasses and fiber residue from starch, cane and beet sources, cow and horse manure, wood by-products such as chips, pine shavings, dust and paper, sewage, and the like. Preferred commodities are soy hulls, rice hulls, peanut hulls and oat straw.

The mineral acids that may be employed include, for example, sulfuric acid, phosphoric acid, hydrochloric acid and mixtures thereof. A dilute mineral acid in sufficient quantity to provide the reaction mixture with a pH less than 1 must be used, for example, sulfuric acid (2 N to 8 N), phosphoric acid (2 N to 8 N), and hydrochloric acid (2 N to 6 N). The choice of acid will be dictated to a certain extent by the desired content of, for example, sulfur, phosphorus or chloride in the final product. The use of hydrochloric acid is preferred, especially hydrochloric acid between about 3.5 and 5.5 N, most preferably between about 4.0 and 5.0 N.

The cellulose commodity is mixed with urea and the dilute mineral acid. The order of addition is not narrowly critical although normally it is preferred to first combine the urea and the acid and then to add the cellulose commodity, preferably portionwise. During admixture the temperature is maintained between

about 20° and 40°C. An equimolar amount of urea, relative to the monosaccharide potential from hydrolysis of the cellulose commodity, will normally be employed. The total quantity of urea employed will, of course, be reflected in the free urea content of the final product. In general, the weight ratio of urea to 100% acid is in the range of from about 0.5 to about 3.0 and the weight ratio of cellulose commodity to 100% acid is in the range of from about 2.0 to about 9.0. Surprisingly, it has been found that ratios of urea:100% acid between about 0.6 and 1.2 are particularly preferred inasmuch as free ammonia levels are substantially reduced under these conditions.

In the next step, the resulting mixture is heated at an elevated temperature to hydrolyze the cellulose and other polysaccharides and cause the chemical reaction of the resulting sugars with urea. For this portion of the reaction a temperature of between about 50° and 120°C, preferably between about 80° and 110°C, is utilized. The heating is continued for a sufficient period of time to bind the desired degree of urea, which will preferably be greater than 40% of theoretical based upon potential monosaccharide, assuming a 1:1 ratio of monosaccharide:urea. At the preferred temperature range of 80° to 110°C the desired degree of bind will normally be achieved within about 2 and 20 hours. Additional heating beyond this point may result in undesired charring or carbonization of the product.

After the above step has been completed, the mixture is cooled and the pH is adjusted to between about 3 and 7, most preferably between about 3.5 and 4.5. This may be accomplished by the addition of a suitable base to neutralize the mineral acid present. For example, bases such as calcium hydroxide, sodium hydroxide, potassium hydroxide, and the like may be employed.

The use of sodium and potassium bases results in the formation of soluble salts whereas the use of, e.g., a calcium base, results in the formation (in the case of calcium sulfate and calcium phosphate) of an insoluble salt, which may then be separated from the product, if desired, by standard means such as centrifugation, filtration, and the like. The type of salt formed will thus dictate, to a certain extent, the salt content of the final product.

The crude product resulting from the pH adjustment step may be utilized as is, or by appropriate concentration or dilution in the form of an aqueous solution; or it may be dried by conventional methods to afford a solid material. Either the solids or liquid supplement can be utilized separately, or preferably in admixture with other conventional ruminant feed components, for administration to the animal.

Example: To 42.11 kg of 3 N HCl was added 6.02 kg urea (feed grade) and the mixture stirred until the urea was dissolved. While stirring, 20.05 kg of rice hulls (20 mesh) was slowly added in small portions, keeping the temperature below 40°C. The temperature was then raised to 90°C and held for 10 hours. The mixture was then cooled to below 40°C and a solution of 3.38 kg sodium hydroxide in 5.80 kg water was then added to bring the pH to between 3.8 and 4.0. Analysis of the wet material was as follows:

Nitrogen = 3.86% = 24.3% protein equivalent,
Free urea = 3.5%,
Ammonia = 0.7%,

Percent urea bound (of total) = 42%,
Total ash = 10.1%,
Solids = 38%, and
Sodium chloride = 6.1%.

Urea Reaction Product with Furfural

L.P. Milligan, A.R. Robblee, J.C. Wood and S.K. Chakrabartty; U.S. Patent 3,736,146; May 29, 1973; assigned to Canadian Patents & Development Limited, Canada described a nonprotein nitrogen source which is readily fermented by microorganisms which inhabit the rumen, and which can be substantially completely utilized by ruminant animals. The process involves the controlled reaction of urea with an aldehyde (furfural) to produce materials which are shown to be suitable nitrogen supplements to the diet of ruminant animals.

Urea is condensed with furfural under acidic conditions to give a granular solid of about 21 to 26 (preferably 24 to 26) wt % nitrogen. The dried relatively insoluble nonhygroscopic (but slowly hydrolyzable in water) product may then be incorporated in animal feeds or rations as was done for urea in the past. A suitable supplement rate is about 1 to 4 wt % based on feed solids, although any amount up to about 10% may be useful depending on many factors. The supplement may be masterbatched with the feed for subsequent dilution, e.g., in amounts up to about 40 wt %.

The method of production of the reaction product of furfural and urea involves a number of parameters. For example, experiments have shown that:

(1) The reaction will take place in alcohol, water, or other solvents or, if sufficient furfural is used, without any solvent at all. It was found, however, that a dilute solution of the reactants produced the best results. Water is the preferred reaction medium.
(2) An acid pH favors the reaction, and while a pH of about 3.5 appears to be best, the reaction will proceed at virtually any acidic pH.
(3) Various mol ratios of furfural to urea up to about 1:1 all appear to produce the same (or a similar) product. A preferred mol ratio is about 0.5/1. A low ratio was used in order to react most or all of the furfural. The recovery of unreacted furfural was found to be difficult and somewhat inconvenient. It is preferred to use a stoichiometric excess of urea to assure reaction of all the furfural, and to obtain a high nitrogen product. The unreacted urea is readily recycled. However, the crude mixture of urea and reaction product can be fed directly.
(4) The reaction product was found to darken rapidly upon standing, or even during the drying process; however, this darkening was found to be not detrimental and controllable if desired, by the addition of small amounts of antioxidants such as butylated hydroxyanisole or butylated hydroxytoluene.
(5) The temperature at which the reaction proceeded did not appear to be critical; however, the amount of discoloration (darkening) could be materially reduced by keeping the temperature below 30°C. Such discoloration does not appear detrimental to the performance of the product as a feed supplement.

Example: 62.4 pounds of feed-grade urea was dissolved and/or suspended with stirring in 40 lb of cold water. The temperature rapidly fell to 9°C but was allowed to rise spontaneously to 23°C. At this time, 3.5 lb of glacial acetic acid was added, followed immediately by addition of 25 lb of furfural and 98 g of butylated hydroxyanisole. (The mol ratio of furfural to urea in the mixture was about 0.3/1.)

The whole mass was vigorously stirred for 4.5 hr, during which time a further 80 lb of water was added in small portions. At the end of this period, the reaction mixture was a very thick slurry and its temperature had risen to 31°C. The product was a very granular precipitate which was easily filtered and washed with water. After drying, the product weighed 36 lb and had a moisture content of 3.7% and a nitrogen content of 23.2% by weight.

Urea and Ammoniated Phosphoric Acid

D.M. Steen; U.S. Patent 3,733,203; May 15, 1973; assigned to Allied Chemical Corporation prepared a feed supplement for ruminant animals comprising a supply of nonprotein nitrogen, such as urea, a water-soluble sulfate and ammoniated phosphoric acid, providing a sulfur-nitrogen ratio of not more than 15 parts of nitrogen to 1 part of sulfur by weight. Pyrophosphate included in the feed acts as a sequestering agent upon the trace minerals therein. The feed may also contain vitamins, antibiotics, hormones and/or salt as desired. The feed supplement provides a desired nutrition for animals, increasing their growth rate, health and digestive efficiency.

The following steps are carried out in producing the supplement, considering the resultant product to be the total liquid bulk weight of 2,000 lb:

Step 1: In a separate container, mix 370 lb of water with 245 lb of urea and 100 lb of a water-soluble sulfate such as sodium sulfate or sulfate of ammonia.

Step 2: In a separate mixing container, mix one pound of a hormone, such as diethylstilbestrol, with 2 lb of an emulsifier. Agitate and add equal parts (3 lb) of water while agitating.

Step 3: Mix thoroughly the products of Step 1 and Step 2.

Step 4: Add 1,000 lb of molasses or other liquid carrier and 100 lb of salt. Mix thoroughly with the product of Step 3.

Step 5: Mix in a separate container, 3.5 lb of antibiotic (40 g/lb), 0.4 lb of vitamin A (250,000 international units/gram), approximately 0.05 lb of trace minerals, 1.26 lb of pyrophosphate as a sequestering agent and 27 lb of water. Mix thoroughly with the product of Step 4.

Step 6: Combine phosphoric acid and ammonium phosphate at a 1 to 4 molecular ratio, resulting in a mixture having an average composition corresponding to the formula $(NH_4)_{1.6}H_{1.4}PO_4$. Whatever the exact composition, the resultant substance is a mixture of monoammonium phosphate and diammonium phosphate and is referred to herein as ammoniated phosphoric acid. Mix in 135 lb of this ammoniated phosphoric acid to obtain the final product.

In the event that the ammoniated phosphoric acid is processed in such a manner as to contain sufficient quantities of pyrophosphates to accomplish the desirable sequestering effect provided for in Step 4, then the addition of pyro-