GOLD SHIELD®
PetFoodSolutions.com

Gold Shield®
Refined Chicken Fat:

A Multi-Benefit Ingredient for Improving Safety, Quality, Sustainability, and Efficiency for Pet Food Manufacturers.

By James C. Peterson, Ph.D. Technology Consultant, Pet Food Solutions, LLC

IMPORTANT NEEDS
for Pet Food Manufacturers:

Manufacturers face a multitude of challenges in the production of Pet Food. First is always safety, and this should be part of every ingredient and system involved in the production process. Brand and product quality is also a key focal point and finding ways to improve key attributes that influence quality is a never-ending search. Finally, running the best operation and doing it in a predictable, dependable, sustainable, and profitable manner will determine the long-range success of the operation. We've heard these needs from multiple pet food manufacturers, and we're happy to report that we have a revolutionary product that can address them all.

WHO
is Pet Food Solutions?

Pet Food Solutions is a highly respected refiner of animal fats, serving unique industries including pet food production. Our processes and ingredients are driven by technology that is designed to provide multiple benefits which lead the industry in the clean and green approach, with zero waste. Our record of safety and quality is unmatched and we pride ourselves on providing service that aligns with the exceptional quality of our ingredients.

WHAT
is Gold Shield® Refined Chicken Fat?

Gold Shield® Refined Chicken Fat is a multi-benefit ingredient for use in pet food that has been designed to replace standard higher risk, rendered chicken fat. Gold Shield® Refined Chicken Fat will reduce the risk of *Salmonella* contamination, increase product stability and quality, improve plant operations, and may enhance sustainability. Gold Shield® Refined Chicken Fat (available from Pet Food Solutions, LLC) is a consistent high quality chicken fat from which most of the non-fat impurities found in standard rendered chicken fat have been removed.

HOW
is Gold Shield® Refined Chicken Fat Produced?

Gold Shield® Refined Chicken Fat is produced using a highly automated, patent pending process. We currently produce large scale volume of Gold Shield® Refined Chicken Fat, and we are rapidly growing our capacity. Standard rendered chicken fat contains about 4% of non-fat components including inorganic salts, organic impurities, and insoluble particulates. We remove these undesirable components, so they don't contaminate the pet food or affect your operations. This translates to 4% more product with every shipment. Our process carefully balances four key variables: water, pressure, heat, and time. In the photo are 3 jars. First (left), the raw materials most manufacturers use now. Second (center) is the extraction material we remove, and third (right) is our Gold Shield® Refined Chicken Fat. We treat the standard fat and then separate the not-fat components from the purified fat. The extraction material (i.e. the non-fat components) are used for land application and biodiesel production, so our process does not generate any waste. Gold Shield® Refined Chicken Fat provides the pure fat food value of chicken fat without the impurities that can cause problems in pet food production, and in the quality of the formulated pet food.

Our processing is the key to providing a high quality and safe ingredient. Beyond removing chemical impurities, our processing will also remove microbial impurities. To test this hypothesis, we inoculated standard rendered chicken fat in water with *Salmonella*, and then submitted the sample to simulated process conditions that are obtained during the production of Gold Shield® Refined Chicken Fat. *Salmonella* was killed in under 5 min. giving us a significant safety margin during our processing. If any *Salmonella* were to enter our process from the standard chicken fat, it would be quickly killed. Therefore, we are confident about the microbiological quality of Gold Shield® Refined Chicken Fat, and we have a specification of undetectable levels of *Salmonella* as tested by a third-party lab on every batch.

Experiments Conditions	CELL POPULATION Time (min)	CFU/mL	Log 10	Log Reduction
Salmonella newport	0	1.56E +10	10.19	-
Sample = CF 2018-56a	1	780	2.89	-7.3
Low Process Temperature	2	2	.3	-9.89
0.5 mL CF + 0.5 mL of cell is in TSB	3	0	-	-
	10	0	-	-
	30	0	-	-

The bird flu virus can also be inactivated with heat. A recent paper found that at 63°C, HPAI A(H5N1) virus was inactivated from initial titers of 106 TCID50 per milliliter to undetectable levels within 2 minutes. Our process conditions provide a significant safety factor to those conditions insuring inactivation of any HPAI A(H5N1) virus that may be present in the standard rendered chicken fat.

Realize 4% more product with every Gold Shield® Refined Chicken Fat shipment!

For more information please contact craig.grantham@petfoodsolutions.com, or connect with us at petfoodsolutions.com

THE DIFFERENCE.

Sustainability

Gold Shield® Refined Chicken Fat is a sustainable ingredient, aligning with the international guidelines for an ingredient that minimizes carbon footprint, and waste. Common measures of sustainability are as follows:

- Carbon footprint
- Waste streams including emissions
- Use of natural resources
- Impact on natural ecosystems and habitats
- Water usage

The production and use of Gold Shield® Refined Chicken Fat qualifies it as a cost-effective, sustainable ingredient by all these measures.

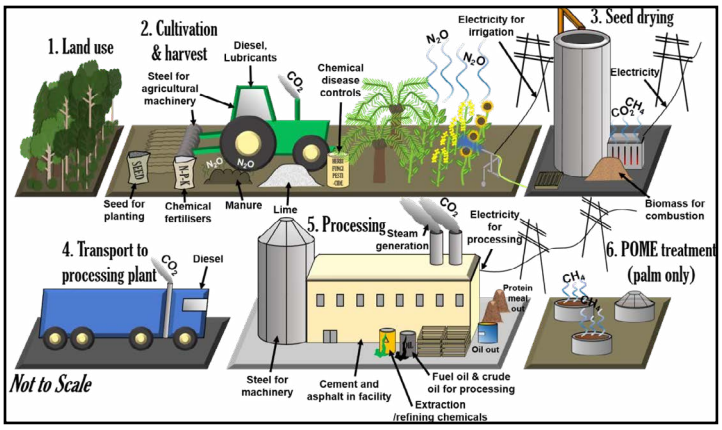
The sustainability of standard rendered chicken fat has been extensively researched. Americans only consume about half of a chicken. Rendering the parts of a chicken that are not consumed by humans is a sustainable way to recover the full value of a chicken and eliminate a waste stream from landfills. This ultimately leads to a reduction of carbon dioxide generation that would have resulted from decomposition of the chicken components if they ended up in a landfill.

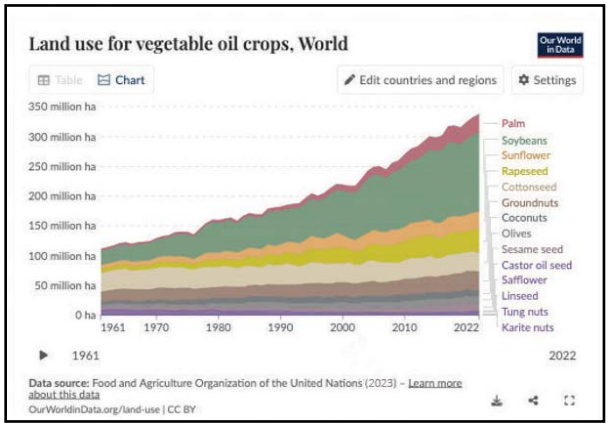
However, standard rendered chicken fat has risks that lead some pet food manufacturers to consider and ultimately incorporate alternative fat products into their formulated diets. The major risks include contamination by *Salmonella*, and quality issues about consistency and insoluble impurities.

Salmonella can be present in the standard rendered chicken fat and then grow on the non-fat impurities in the fat during shipping. We have shown that *Salmonella* won't grow in Gold Shield® Refined Chicken Fat because we remove the not-fat impurities.

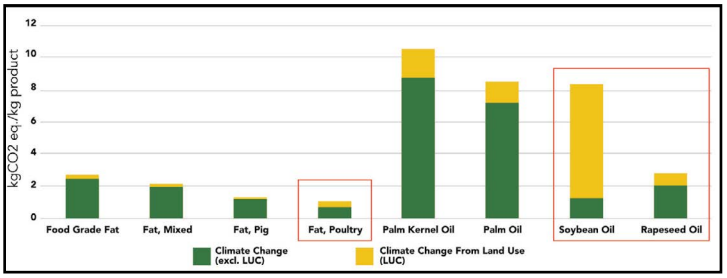
By removing the impurities from standard chicken fat, Gold Shield® Refined Chicken Fat has consistent quality and low insolubles. The risk of clogged nozzles is significantly reduced. Recent analysis of insolubles in standard chicken fat (our starting material) showed variability with one lot at 3.0% insoluble. All the lots of Gold Shield® Refined Chicken Fat were below 0.2% insolubles.

Plant-based oils (soy, canola, or coconut) are sometimes thought of as sustainable alternatives to chicken fat that avoid some of the risks of standard rendered chicken fat. In reality, the production of plant-based oils is comparatively resource intensive in production, processing, and transportation. Since 1960 there has been a dramatic increase in the land use from the production of the major plant-based oils which has led to deforestation and threats to biodiversity. Production of tropical oils like coconut oil have an even greater impact on the environment by altering especially sensitive ecosystems which causes an increase in extinction risks.[iii]





A comparison of the amount of carbon dioxide created from the production of different types of oils showed that poultry fat generated much less CO2 than alternatives and is the most sustainable fat by this criteria. The production of rendered chicken fat generates eight times less CO2 than the production of soybean oil and three times less than the production of canola oil.



Gold Shield® Refined Chicken Fat is produced from a clean process from standard rendered chicken fat without the addition of organic solvents or other reagents. The small amount of waste from our process is used either as animal feed or for bioenergy. The additional carbon footprint from the production of Gold Shield® Refined Chicken Fat from rendered chicken fat is minimal and is mainly due to steam production and transportation. Even that can be reduced by utilization of rail instead of trucks for delivery.

Gold Shield® Refined Chicken Fat is a sustainable ingredient that can be used in pet food without the risks associated with standard rendered chicken fat. Gold Shield® Refined Chicken Fat has significant advantages to alternative plant-based oils from both a sustainability and nutrition perspective.

A Clean, Clear Choice.

How Does Gold Shield® Refined Chicken Fat Differ From Standard Chicken Fat?

Chicken fat is an important ingredient in a pet's diet to provide energy, help cells and organs function well, and support a healthy skin and coat. Gold Shield® is one of the purest forms of chicken fat on the market. The benefits of chicken fat are obtained with Gold Shield® Refined Chicken Fat without the problems associated with the non-fat components that usually accompany the standard grades of chicken fat. Because the fatty acid profile is not different from the standard grades, no labeling change is required to fully utilize Gold Shield® Refined Chicken Fat instead of standard chicken fat. As noted above, our customers use ALL the product we ship them. Because we remove the impurities, you won't have to. This translates to 4% more product with every load and is only one of the ways this product adds value to pet food manufacturers.

Gold Shield® Refined Chicken Fat is a translucent amber to light brown colored product that looks and performs differently from standard rendered chicken fat. The Table below shows a comparison between Gold Shield® Refined Chicken Fat and standard chicken fat on a typical batch. Although the non-fat component in the fat has been significantly reduced, the fatty acid profile of Gold Shield® Refined Chicken Fat is the same as the standard chicken fat. For example, the linoleic acid content that is important for coat health is the same in Gold Shield® Refined Chicken Fat as that in standard chicken fat (about 20 wt-%).

The benefits from the fat are maintained, but many of the problems associated with the standard chicken fat are eliminated. Most of the insoluble material that can cause clogs in lines and residue in storage tanks is removed from the standard fat. The table above showed that typically a 67% reduction in insoluble material is observed (reduced from 0.24% to 0.08%). What this means for the manufacturer is far fewer unscheduled line stops, requiring maintenance and costing valuable production time.

Soluble impurities are also decreased. The soluble impurities include metals which are known to be catalysts for oxidation. Metal levels (e.g. iron and magnesium) are reduced from 2-4 ppm to less than 1 ppm. Levels of inorganic water-soluble salts such as phosphate and sulfates are decreased. The phosphorus content can decrease by over 95% (from 280 ppm to 6 ppm). Organic water-soluble impurities (e.g. nucleic acids, and amino acids) are also removed. These organic impurities can function as pro-oxidants that impact product stability and nutrients for microbial growth.

The use of Gold Shield® Refined Chicken Fat allows for the production of a precisely formulated diet achieving all the benefits of pure chicken fat without the problems associated with the non-fat impurities in standard chicken fat.

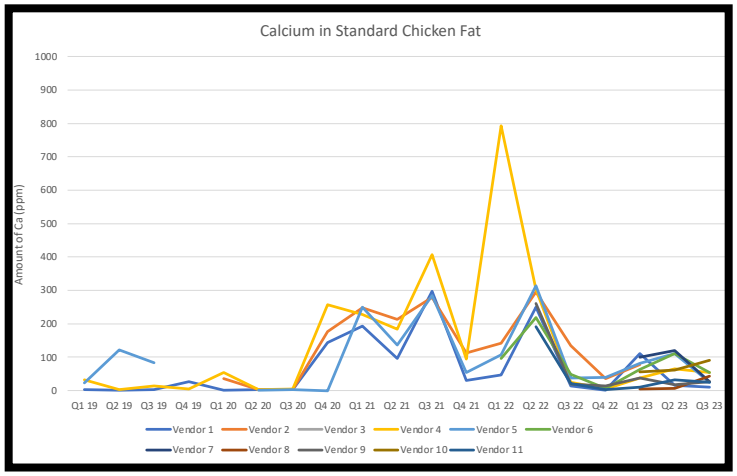
Learn how to REDUCE TRACE METALS in your product!

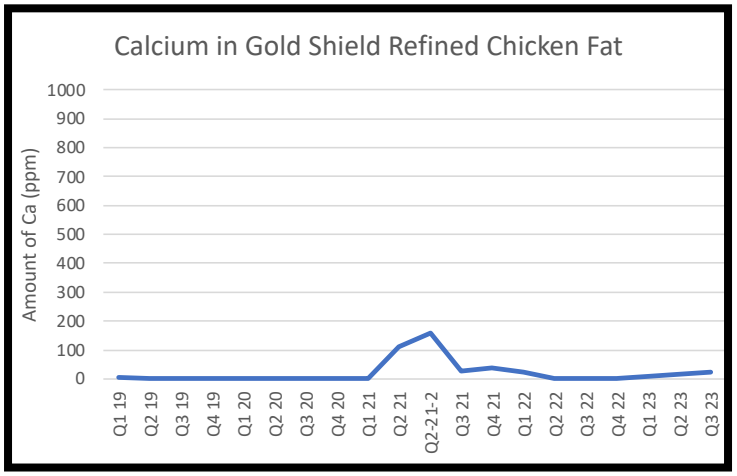
Check out the SAFETY podcast and product videos at PetFoodSolutions.com.

REFINED CHICKEN FAT: TYPICAL ANALYSIS VS. STANDARD CHICKEN FAT

	Refined Chicken Fat	Standard Chicken Fat
Moisture (Avg wt-%)	0.40	0.18
Insolubles (Avg wt-%)	0.08	0.24
Unsaponifiables (Avg wt-%)	0.99	0.92
Total MiU (Avg wt-%)	1.47	1.33
Free Fatty Acids (Avg wt-%)	2.75	3.15
Peroxide Value (meq/kg)	0.70	0.70
METALS AND SALTS		
Iron (ppm)	<1.0	1.8
Magnesium (ppm)	<1.0	4.2
Calcium (ppm)	5.1	15.9
Phosphorus (ppm)	6.4	280.9
Sodium (ppm)	2.0	48.0
Potassium (ppm)	4.6	82.4
Sulfur (ppm)	26.3	43.2
FAC Color	Translucent Amber to Medium Brown	
Physical Appearance	Mobile Liquid	
Flavor/Odor	Neutral/Bland	

Fatty Acid Profile (Avg wt-%)	Refined Chicken Fat	Standard Chicken Fat
C12 Lauric Acid	0.06	0.05
C14 Myristic Acid	0.56	0.63
C14:1Myyristoleic Acid	0.17	0.18
C16 Palmitic Acid	23.90	24.32
C16:1 Pamitoleic Acid	6.64	6.58
C16:2 Hexadecadienoic Acid	0.00	0.02
C17 Margaric Acid	0.11	0.09
C17:1 Maraoleic Acid	0.08	0.03
C18 Stearic Acid	5.83	5.99
C18:1 Oleic Acid	39.90	39.94
C18:2 Linoleic Acid	20.39	19.73
C18:3 Linolenic Acid	1.25	1.22
C20 Archidic Acid	0.06	0.08
C20:1 Eiscosenoic Acid	0.33	0.29
Total FFA (wt-%)	99.28	99.10





Higher Purity Fat Required to Facilitate Precision Diets

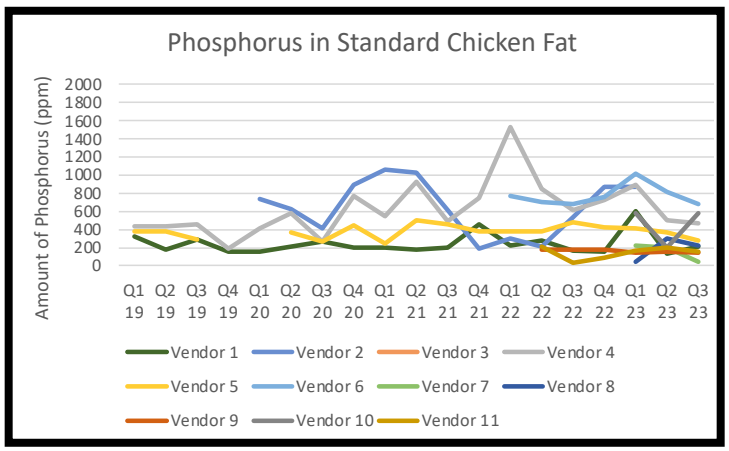
Pure ingredients are becoming more and more important as pet parents want diets that are designed specifically for the breed, age, and health of their pet. To enable accurate supplementation of key macronutrients (e.g. Ca and P) and micronutrients (e.g. Fe) and to avoid any toxic metals (e.g. Cd, Pb, Hg, and As), it is important that the purity of the other ingredients in the formulation are known and consistent.

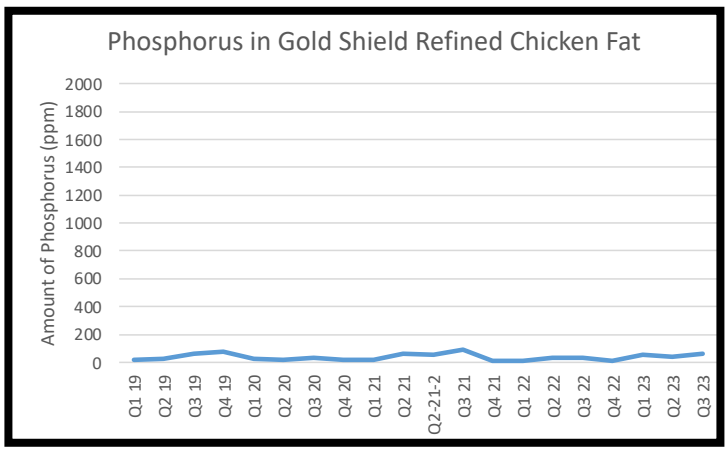
Recent analyses of dry pet foods have shown that over half of the pet food was not compliant with government nutritional guidelines. Most often the findings showed that essential macro nutrients and essential trace nutrients were above recommended levels. In addition, some pet foods had high concentrations of toxic metals. Scrutiny of pet food composition by government agencies and independent researchers is expected to increase in the future.

We have been testing standard chicken fat and Gold Shield® Refined Chicken Fat for over five years for a number of the key elements that are of concern. Our patent-pending process significantly reduces the levels of many key elements in the chicken fat resulting in a pure chicken fat with a consistent profile.

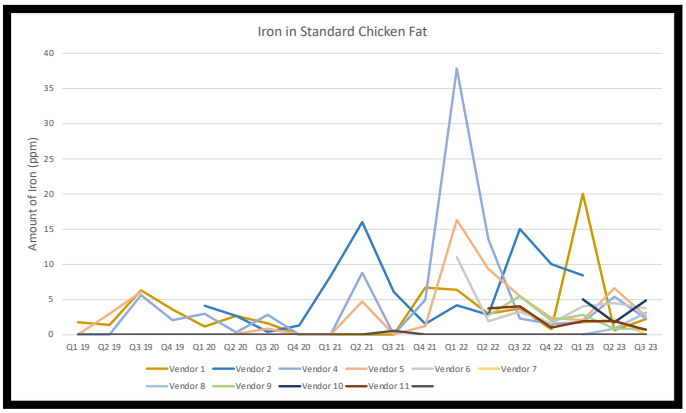
Calcium and phosphorus are important macronutrients for teeth and bone growth and for many cellular functions for pets. Not only is the overall amount of each element important, but the ratio between Ca and P is important. However, an excess of either calcium or phosphorus can lead to kidney disease as well as contribute to the formation of bladder stones. Below are graphs showing the amount of Ca and P in both standard chicken fat and in Gold Shield® Refined Chicken Fat. Standard chicken fat can have significant levels of each element and there is variability based on the supplier and other factors. Our process removes the variability, providing a fat with very low levels of both calcium and phosphorus, allowing for accurate supplementation.

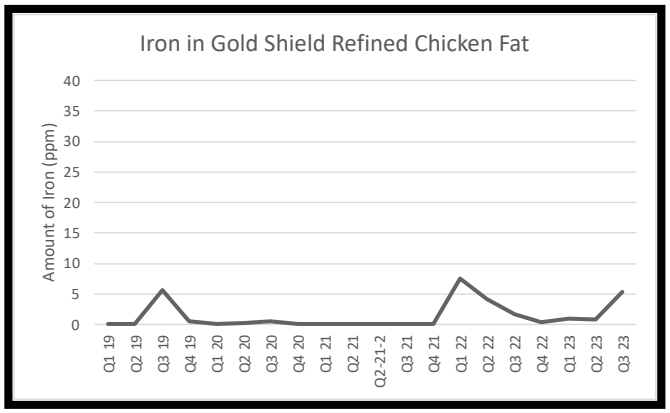
Iron is a key micronutrient for pets, utilized for key functions in almost all cells in the body. However excess iron can cause damage to the gastrointestinal, liver, metabolic, nervous, and cardiovascular systems. A recent analysis of pet food found that over half of the pet food tested had more than a ten-fold excess of iron in the formulation compared to the minimum recommended level and 13% of the pet food tested had more than the maximum legal limit. We have been testing for iron for over five years, and as shown in the graph below, our process significantly reduces the amount of iron in the fat. Variability is removed and accurate supplementation of iron can then occur.





Lastly, we have tested Gold Shield® Refined Chicken Fat for toxic metals for over five years with undetectable levels of Cd, Pb, Hg, and As in our finished product. It has been reported in the literature that Cd can be present in some standard chicken fat samples, so the use of Gold Shield® Refined Chicken Fat in a formulation can be an important part of a program to keep toxic metals out of a pet's diet.





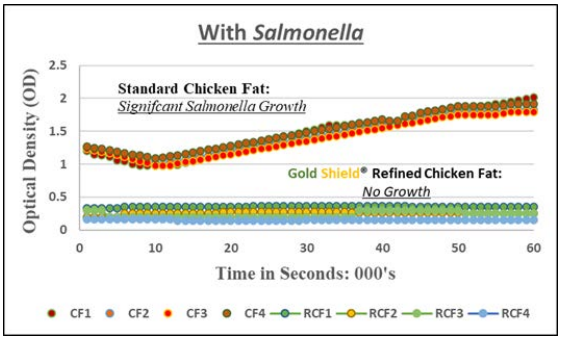
BENEFITS
of Gold Shield® Refined Chicken Fat

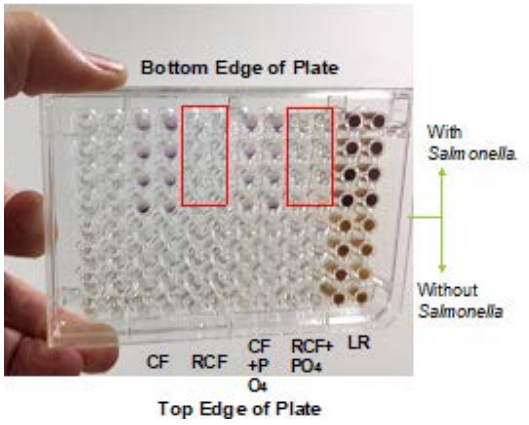
SAFETY

Gold Shield® Refined Chicken Fat was designed to provide many benefits to the pet food manufacturer, pet food consumers and ultimately to pets. It all starts with improved safety by reducing the risk of *Salmonella* contamination of pet food. The FDA has a zero-tolerance policy for *Salmonella* contamination in pet food and treats which has led to over 44% of all recalls in 2017-2023. All manufacturers need to proactively reduce the possibility of *Salmonella* contamination in their products.

Salmonella contamination of pet food often occurs through *Salmonella* contamination of the chicken fat ingredient since it is typically added to coat the extruded pellet after the high temperature kill step in the process. Any *Salmonella* contamination of the chicken fat could result in contamination of the food itself.

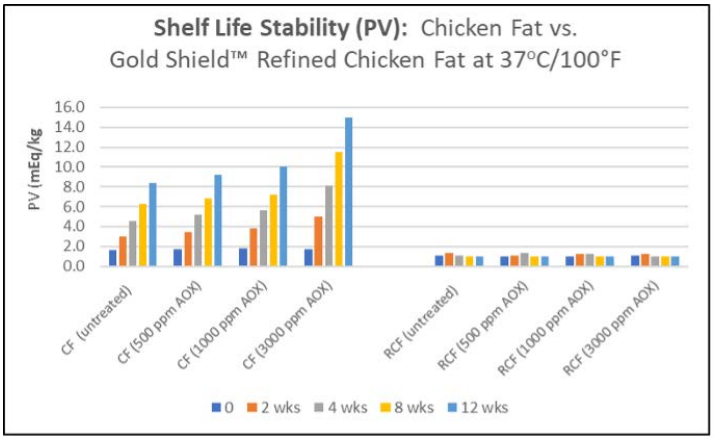
Recently low water activity products like chicken fat were thought to not harbor *Salmonella*, but it is now known if water is present (and it is almost always present due to water in transfer lines and vessels used during transportation) *Salmonella* can survive and grow. A key to the growth is the level of nutrients in the chicken fat that can be easily metabolized by *Salmonella*. These key nutrients for *Salmonella* growth in chicken fat include water, essential metals, and organic materials (e.g. amino acids and nucleic acids).





Gold Shield® Refined Chicken Fat has been designed to be bacteriostatic to *Salmonella* contamination. By removing the non-fat components in standard chicken fat, we remove the nutrients necessary for *Salmonella* growth. Even if water is present, *Salmonella* is unable to grow in Gold Shield® Refined Chicken Fat.

To prove this concept, we designed an experiment using a 96 well plate (picture above). The wells were charged with either standard chicken fat or with Gold Shield® Refined Chicken Fat. Some of the wells were challenged with *Salmonella* cells (others were maintained as controls), and all of the wells were monitored for growth over 24 hours. The results are shown in the graph to the left. All the wells of standard chicken fat showed significant *Salmonella* growth and all the wells with Gold Shield® Refined Chicken Fat showed no growth. By removing the non-fat components from standard chicken fat, Gold Shield® Refined Chicken Fat is proven to be bacteriostatic against *Salmonella* contamination. When Gold Shield® Refined Chicken Fat is used instead of standard chicken fat in a pet food formulation, the risk of *Salmonella* contamination of the pet food will be significantly reduced.



STABILITY

Gold Shield® Refined Chicken Fat is significantly more stable and resistant to oxidation than standard chicken fat. Peroxide value (PV) is a measure of oxidation that has occurred in a food or ingredient due to exposure to air. We have measured PV at 37°C (100°F) of both standard chicken fat and Gold Shield® Refined Chicken Fat over a 12-week timeframe and the results are shown in the graph below. No significant oxidation occurred in Gold Shield® Refined Chicken Fat while considerable oxidation occurred in standard chicken fat even when antioxidants (standard mixed tocopherols) were added at various levels. Even with 3000 ppm antioxidant, the PV increased from about 2 to over 14 mEq/kg over the 12 weeks in the standard chicken fat. The PV for Gold Shield® Refined Chicken Fat did not change in that same time period. Our recommendation is that customers consider lower levels of antioxidant in Gold Shield® Refined Chicken Fat compared to what they currently use in standard chicken fat.

Oxidized fat has also been shown to have detrimental effects on canine health by reducing weight gain in puppies and impairing bone and immune functions. As shown above, Gold Shield® Refined Chicken Fat is less susceptible to air oxidation because the catalysts for oxidation (e.g. metals and enzymes) are removed. Formulations with stable fat will lead to healthier pets and proper growth.

IMPROVED OPERATIONS

Current customer feedback has provided real world examples of the efficiency benefits for Gold Shield® Refined Chicken Fat. Because of the lack of materials which can clog lines and nozzles, fewer unscheduled maintenance stops are required. Also, fewer tank cleanings are required with this product over time. The value of this extra benefit can be a material difference, resulting in tens or hundreds of thousands of dollars per year. Most manufacturing facilities put a high premium on materials that improve efficiency and save cost, and this has been reflected in the feedback from current users.

PALATABILITY

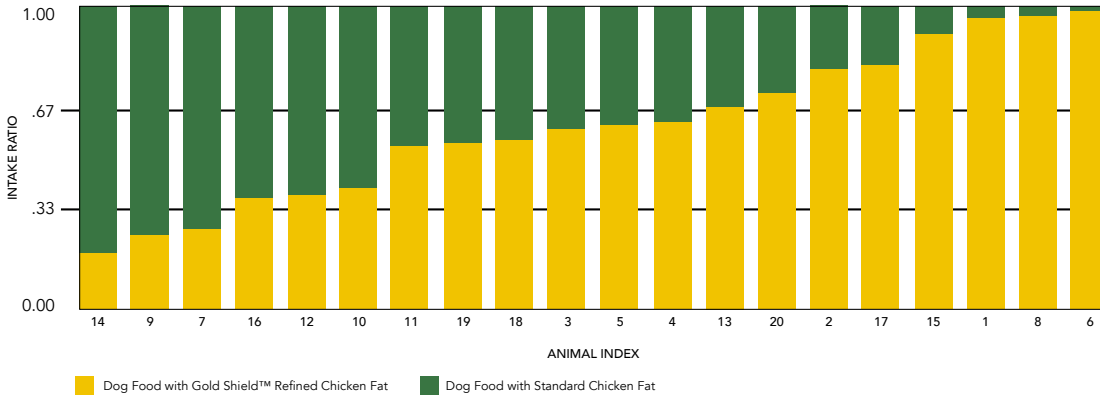
Gold Shield® Refined Chicken Fat provides all of the noted benefits below, while maintaining or improving the palatability of pet food formulations. We have evaluated the palatability of pet food formulations made with Gold Shield® Refined Chicken Fat compared to pet food formulations made with standard chicken fat in side-by-side tests. Gold Shield® Refined Chicken Fat was either preferred or had parity in all the tests that we have run either independently or in collaboration with customers.

In one independent study, we produced a fat coated kibble with one of our customers. Everything in the formulation was identical except that some pet food was produced with standard chicken fat and some pet food with Gold Shield®. We then compared the palatability of the food by presenting both foods to twenty beagles over two days and monitoring the total consumption and the first choice.

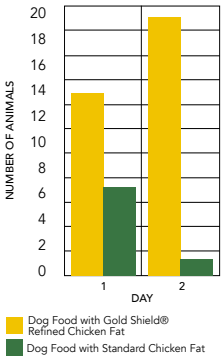
The results below show the preference of the beagles after storing the pet food in a bag for 10 weeks. The product was tested at this time to replicate the typical supply chain, and the likely product as it would be purchased by the consumer. For this formulation our Gold Shield® Refined Chicken Fat was preferred, and the pets chose food made with Gold Shield® Refined Chicken Fat first.

Every formulation is different of course including ingredients, type and quantity of palatants, and other factors. Your results will depend on these variants, and we encourage testing to determine all of our benefits.

Intake Ratio



First Preference



For more information please contact craig.grantham@petfoodsolutions.com, or connect with us at petfoodsolutions.com

VALUE

Gold Shield® Refined Chicken Fat: Value for Pet Food Producers

GOLD SHIELD® RCF TECHNOLOGY FEATURES	BENEFIT	IMPLICATIONS FOR MANUFACTURERS
Bacteriostatic Properties	• RCF process kills bacteria and removes bacterial contaminants • Inhibits future *Salmonella* growth	• Improved consumer food safety by eliminating *Salmonella* product contamination - risk of recalls, etc • Lowers process & plant worker risk of exposure
Improved Operations Efficiency	• Residual, non-fat compounds are eliminated	• Easier to handle/pump - reduced agitation • Reduced process maintenance and cleanup cost - extend run times, simplify cleaning, etc.
Much Better Stability: - Higher Purity - Process Consistency	• Far better shelf life and product quality • Lot-to-lot uniformity - tighter specifications • RCF process eliminates non-fat impurities	• Cost savings on expensive antioxidants • Minimize process variation, expense • Higher nutrient density - pure fat - no "extras"
Supports "Clean Label" E.U. Certification	• Labeled simply as "Chicken Fat" • Value for exporters	• No charge, cost impact vs. current label • Key benefit to serve markets beyond U.S.
Clean & Green Model for Pet Food Scrutiny *(increasing constantly)*	• No chemicals in our refining process • Focused on sustainability • ZERO waste - full circle process	• Natural from start to finish • Sustainable process with large scale ease • Environmentally friendly technology
Palatability Performance	• Parity or better in testing vs. standard higher-risk chicken fat	• Protects (may enhance) palatability and quality • Pets & pet owners love the product
Limits Need for Additives	• Minimal microbial load reduces need for chemical additives	• Ingredient, handling, and process cost, simplification and control
Potential Health Benefits	• Reduced salts and metals	• Possible joint and kidney health improvement

About James C. Peterson

Dr. James Peterson is the Technical Consultant at Pet Food Solutions, LLC. Dr. Peterson joined the PFS team in 2018 and has led the efforts to define and characterize our products by designing and implementing scientific studies in collaboration with outside research institutions. Prior to coming to PFS, he held multiple leadership positions in research and development at Novus International, Pfizer, Pharmacia, and Monsanto. He earned a Bachelor of Arts degree in Chemistry in 1977 from Lawrence University in Appleton, Wisconsin. He then earned his Ph.D. in Synthetic Organic Chemistry in 1984 from Northwestern University. Over the course of 35 years in research and development, he has nineteen patents and publications.

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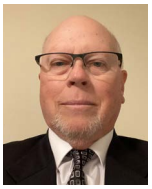

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PET FOOD SOLUTIONS LLC

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