



GOLD SHIELD[®]
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GUARDIAN!
Read on to see why
The Difference
is **CLEAR!**



Gold Shield[®] **Refined Chicken Fat:**

A Multi-Benefit Ingredient
for Improving Safety,
Quality, 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 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.

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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 while leading 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 (now 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. 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 significantly reduce the risk of *Salmonella* contamination, increase product stability and quality, and improve plant operations.



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 have recently expanded our capacity. Standard rendered chicken fat contains about 5% 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 5% more product with every shipment. Our process carefully balances four key variables: water, pressure, heat, and time.

In the photo are three 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 chicken fat and then separate the not-fat components from the purified fat. The extraction material (i.e. the non-fat components) is repurposed for use in other industries, 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.

Experiments Conditions	CELL POPULATION			Log Reduction
	Time (min)	CFU/mL	Log 10	
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	-	-

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 minutes, 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.

Realize 5% more product with every Gold Shield® Refined Chicken Fat shipment!





THE DIFFERENCE.

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® Refined Chicken Fat 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 of the product we ship them. Because we remove the impurities, you won't have to. This translates to **5% more product** with every shipment, 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 components in the fat have 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 TOXIC METALS
in your product!**

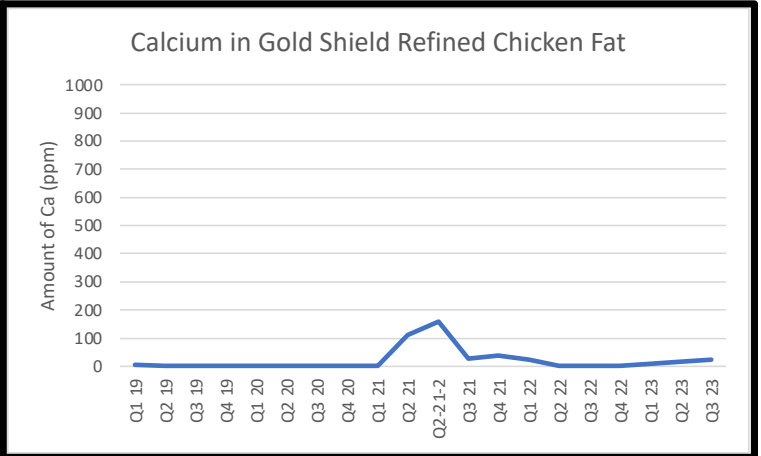
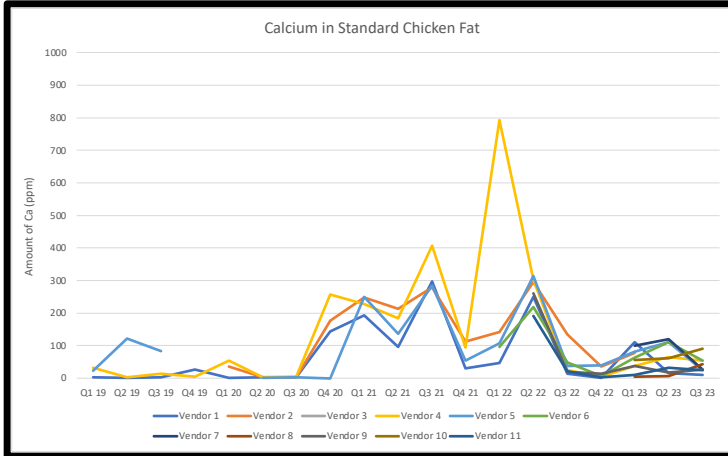
**Check out the
SAFETY podcast and
product videos at
PetFoodSolutions.com.**



REFINED CHICKEN FAT: TYPICAL ANALYSIS VS. STANDARD CHICKEN FAT					
	Refined Chicken Fat	Standard Chicken Fat	Fatty Acid Profile (Avg wt-%)	Refined Chicken Fat	Standard Chicken Fat
Moisture (Avg wt-%)	0.40	0.18	C12 Lauric Acid	0.06	0.05
Insolubles (Avg wt-%)	0.08	0.24	C14 Myristic Acid	0.56	0.63
Unsaponifiables (Avg wt-%)	0.99	0.92	C14:1 Myristoleic Acid	0.17	0.18
Total MIU (Avg wt-%)	1.47	1.33	C16 Palmitic Acid	23.90	24.32
Free Fatty Acids (Avg wt-%)	2.75	3.15	C16:1 Pantoic Acid	6.64	6.58
Peroxide Value (meq/kg)	0.70	0.70	C16:2 Hexadecadienoic Acid	0.00	0.02
METALS AND SALTS			C17 Margaric Acid	0.11	0.09
Iron (ppm)	<1.0	1.8	C17:1 Maraleic Acid	0.08	0.03
Magnesium (ppm)	<1.0	4.2	C18 Stearic Acid	5.83	5.99
Calcium (ppm)	5.1	15.9	C18:1 Oleic Acid	39.90	39.94
Phosphorus (ppm)	6.4	280.9	C18:2 Linoleic Acid	20.39	19.73
Sodium (ppm)	2.0	48.0	C18:3 Linolenic Acid	1.25	1.22
Potassium (ppm)	4.6	82.4	C20 Arachidic Acid	0.06	0.08
Sulfur (ppm)	26.3	43.2	C20:1 Eicosenoic Acid	0.33	0.29
FAC Color	Translucent Amber to Medium Brown		Total FFA (wt-%)	99.28	99.10
Physical Appearance	Mobile Liquid				
Flavor/Odor	Neutral/Bland				



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.¹ 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 intense and is expected to increase in the future.

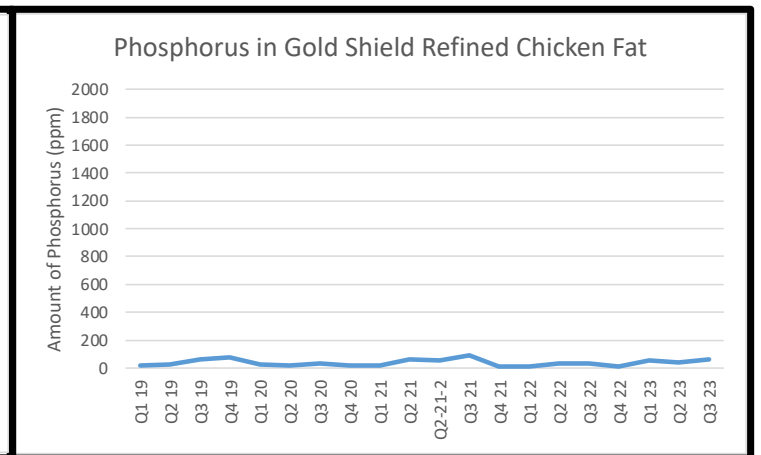
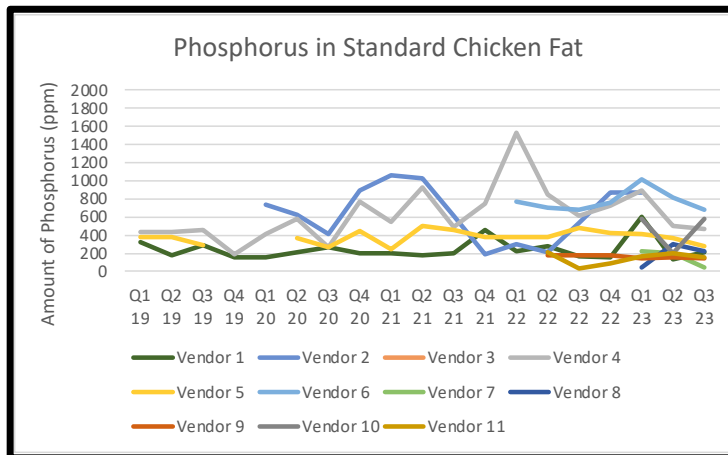
We have been testing standard chicken fat and Gold Shield® Refined Chicken Fat for over five years for a number of the key elements that are of concern. Our patent-pending process significantly reduces the levels of many key elements in the chicken fat resulting in a pure chicken fat with a consistent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

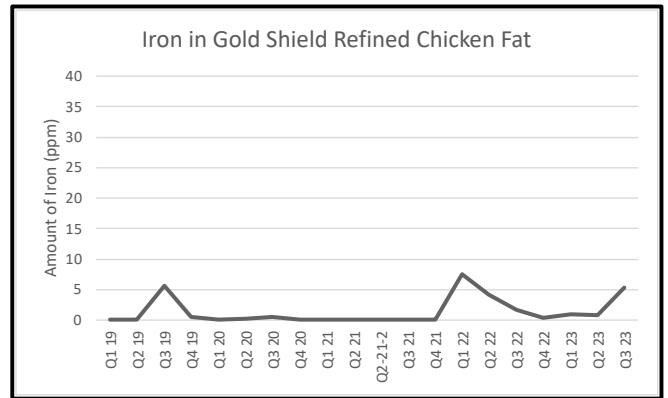
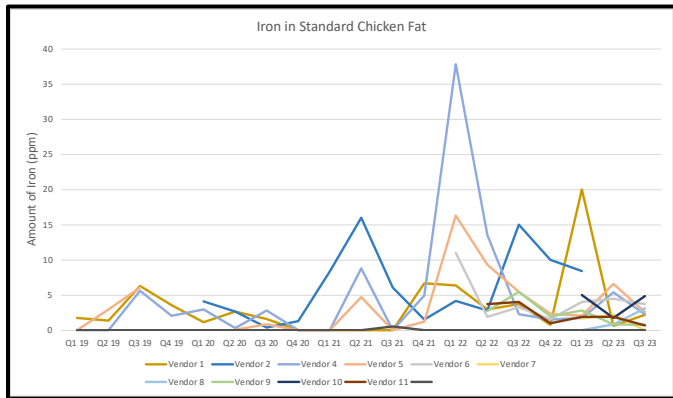
Ca and P is important. However, an excess of either calcium or phosphorus can lead to kidney disease as well as contribute to the formation of bladder stones. Below are graphs showing the amount of Ca and P in both standard chicken fat and in Gold Shield® Refined Chicken Fat. Standard chicken fat can 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.² We have been testing for iron for over five years and as shown in the graph, **our process significantly reduces the amount of iron in the fat.**



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,³ 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.



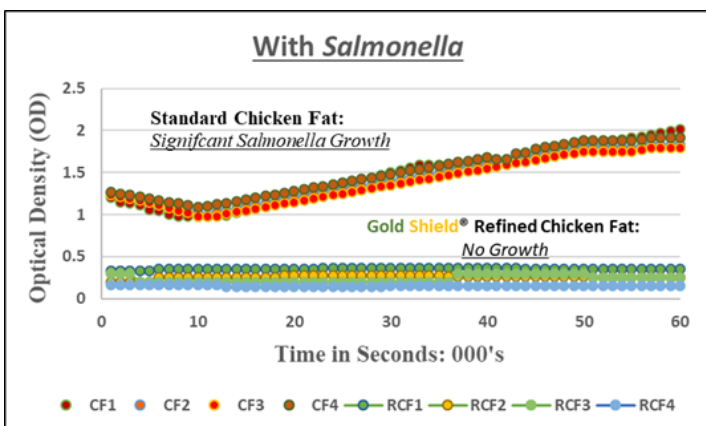
BENEFITS

of Gold Shield® Refined Chicken Fat

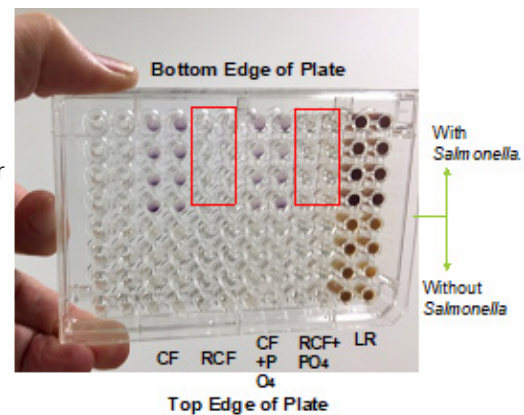
SAFETY

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 33% of all recalls in recent years including serious recalls in late 2023. All manufacturers need to proactively reduce the possibility of *Salmonella* contamination in their products. To that end we have recorded a *Salmonella* safety podcast which can be accessed along with product description videos at PetFoodSolutions.com

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.⁴ Any *Salmonella* contamination of the chicken fat could result in contamination of the food itself.

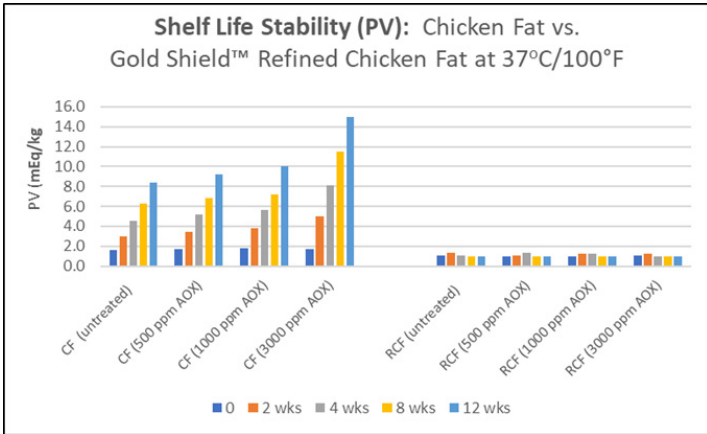


Recently, low water activity products like chicken fat were thought to not harbor *Salmonella*, but it is now known that if water is present (and it is almost always present due to water in transfer lines and vessels used during transportation) *Salmonella* can survive and grow.⁵ A key to the growth 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 above. 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 above.

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. Because of the significant cost of antioxidants, this is another added value benefit.

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.⁶ 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, far 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 above, 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® Refined Chicken Fat. 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.

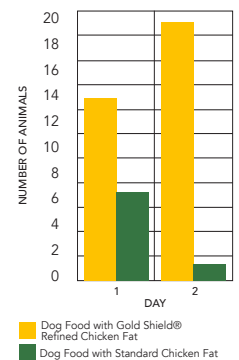
The results below show the preference of the beagles after storing the pet food in a bag for 10 weeks. The product was tested at this time to replicate the typical supply chain, and the likely product as it would be purchased by the consumer. For this formulation our Gold Shield® Refined Chicken Fat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

Consumption Ratio



First Preference





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\$ VALUE

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

GOLD SHIELD® RCF TECHNOLOGY FEATURES	BENEFIT	IMPLICATIONS FOR MANUFACTURERS
Precision Diets	<ul style="list-style-type: none"> • Consistency of ingredients • Reduced trade metals • Increased legal compliance 	<ul style="list-style-type: none"> • Uniform, dependable formulations • Predictable performance every time • Stand up to scrutiny
Bacteriostatic Properties	<ul style="list-style-type: none"> • RCF process kills bacteria and removes bacterial contaminants • Inhibits future Salmonella growth 	<ul style="list-style-type: none"> • Improved consumer food safety by eliminating <i>Salmonella</i> product contamination - risk of recalls, etc • Lowers process & plant worker risk of exposure
Improved Operations Efficiency	<ul style="list-style-type: none"> • Residual, non-fat compounds are eliminated 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Far better shelf life and product quality • Lot-to-lot uniformity - tighter specifications • RCF process eliminates non-fat impurities 	<ul style="list-style-type: none"> • Cost savings on expensive antioxidants • Minimize process variation, expense • Higher nutrient density - pure fat - no "extras"
Supports "Clean Label" E.U. Certification	<ul style="list-style-type: none"> • Labeled simply as "Chicken Fat" • Value for exporters 	<ul style="list-style-type: none"> • No charge, cost impact vs. current label • Key benefit to serve markets beyond U.S.
Clean & Green Model for Pet Food Scrutiny (increasing constantly)	<ul style="list-style-type: none"> • No chemicals in our refining process • Focused on sustainability • ZERO waste - full circle process 	<ul style="list-style-type: none"> • Natural from start to finish • Sustainable process with large scale ease • Environmentally friendly technology
Palatability Performance	<ul style="list-style-type: none"> • Parity or better in testing vs. standard higher-risk chicken fat 	<ul style="list-style-type: none"> • Protects (may enhance) palatability and quality • Pets & pet owners love the product
Limits Need for Additives	<ul style="list-style-type: none"> • Minimal microbial load reduces need for chemical additives 	<ul style="list-style-type: none"> • Ingredient, handling, and process cost, simplification and control
Potential Health Benefits	<ul style="list-style-type: none"> • Reduced salts and metals 	<ul style="list-style-type: none"> • 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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¹ Pereira, A., et al. Mineral Composition of Dry Dog Foods: Impact on Nutrition and Potential Toxicity. J. Agric. Food Chem. 2018, 66, 7822-7830

² Kazimierska, K. et. al. Mineral Composition of Cereal and Cereal-Free Dry Dog Foods versus Nutritional Guidelines Molecules 2020, 25, 5173

³ Zafalon, R. et. al Toxic Element Levels in Ingredients and Commercial Pet Foods. Scientific Reports 2021, 11 21007

⁴ Jones, F. T. A review of practical Salmonella control measures in animal feed. 2011. Journal of Applied Poultry Research 20:1 102-113

⁵ Finn, Sarah, et. al.. Mechanisms of survival, responses, and sources of Salmonella in low-moisture environments. 2013. Frontiers in Microbiology 4, Article 331, 1-15.

⁶ Tureck, J. et al. Oxidized Lipid Depresses Canine Growth, Immune Function, and Bone Formation. J. of Nutritional Biochemistry, Vol. 14, Issue 1, Jan. 2003, p. 24-31