



PFAS in Chicken Eggs – 2017 Study Findings

Army Aviation Centre Oakey Stage 2C Environmental Investigation

PFAS Investigation and Management Program

Background to the Chicken Egg Study

To inform the 2017 Human Health Risk Assessment (HHRA), and contribute to addressing data gaps identified in the 2016 HHRA, a study was conducted to better understand the concentration of per- and poly-fluoroalkyl substances (PFAS) in chicken eggs and the PFAS concentrations in the hens' drinking water.

The 2016 HHRA Report identified one of the exposure pathways contributing to PFAS exposure was the ingestion of home grown eggs from backyard chickens that consume soil, water or feed containing detectable concentrations of PFAS. Queensland Health has recommended that in areas where PFAS-impacted water has been identified, human exposure to PFAS can be minimised by not consuming food products, including eggs, produced using, or in, contaminated water.

The 2016 HHRA included data on PFAS concentrations within backyard chicken eggs collected from a limited number of properties within the Oakey Investigation Area. Perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (PFHxS) were detected above the laboratory level of reporting in a number of the egg samples collected. No other PFAS were detected in the eggs sampled.

Due to the limited number of samples collected in 2016, there was uncertainty whether the results were representative of PFAS concentrations that could be encountered in backyard chicken eggs throughout the entire Investigation Area. The purpose of this study was to address this data gap by examining the relationship between the PFAS concentrations in chicken eggs and the PFAS concentrations in their drinking water.

Study Methodology

A specialist bird health consultancy was engaged to undertake a study to evaluate PFAS concentrations in eggs from chickens exposed to a range of PFAS concentrations in their drinking water. The study also

investigated the rate that PFAS concentrations in chicken eggs decline over time, after PFAS exposure stops.

The study involved 119, 30-week-old Hy-Line Brown hens that had started egg-laying. Hy-Line Brown are a commercial laying breed of chickens used widely in Australia for commercial farming systems and domestic households.

There were four treatment groups for the study. Chickens in each treatment group were provided drinking water with different concentrations of PFAS. There was also one control treatment group, where the chickens were provided drinking water with no detectable PFAS. The study concentrated on the four types of PFAS considered in the HHRA (PFOS, PFHxS, perfluorooctanoic acid [PFOA] and perfluorohexanoic acid [PFHxA]).

Treatment group	PFOS (µg/L)	PFHxS (µg/L)	PFOA (µg/L)	PFHxA (µg/L)
T1 (control)	<0.01	<0.02	<0.02	<0.01
T2	0.3	0.3	0.3	0.3
T3	3	3	3	3
T4	30	30	30	30
T5	300	300	300	300

The chickens involved in the study were managed with due regard for their welfare as required under animal ethics approval. Animals were observed at least twice daily for the duration of the study and regularly by a qualified veterinary practitioner.

The study commenced in March 2017 and the last egg collection occurred in July 2017. The study was structured in three phases:

- **Phase 1:** 14 day initial pre-treatment phase to acclimatise birds to the study conditions.
- **Phase 2:** 61 day treatment phase aiming to evaluate long-term average egg PFAS concentrations likely to be encountered at each treatment concentration.
- **Phase 3:** 28 day post-treatment phase aiming to evaluate the rate of decline of PFAS concentrations in eggs after PFAS exposure via drinking water ceased.





Egg samples and drinking water samples were collected during each phase of the study. During the course of the study, a total of 1,322 egg samples were analysed.

Key Findings and Outcomes

Health effects in hens

- No changes in health or productivity (e.g. chicken body weight, egg weight, egg laying rate or water consumption rate) were observed in hens from all treatment groups during Phase 2 and Phase 3 of the study.

Transfer of PFAS from drinking water to eggs

- The amount of PFAS present in the edible part of the egg was found to be proportional to the amount of PFAS consumed by chickens in their drinking water.
- PFAS was primarily detected in the yolk of the egg, with much lower concentrations detected in the egg white.
- The amount of PFOS transferred to eggs each day was estimated, on average, to be equal to the amount of PFOS ingested by a chicken via their drinking water each day.
- Other PFAS were found to have a lower rate of transfer from the drinking water to the eggs:
 - PFHxS: approximately 70% of PFHxS consumed by the hen each day via their drinking water is transferred to the egg.
 - PFOA: approximately 45% of PFOA consumed by the hen each day via their drinking water is transferred to the egg.
 - PFHxA: less than 1% of PFHxA consumed by the hen each day via their drinking water is transferred to the egg.
- The information from the study was used to estimate PFAS concentrations in eggs, based on soil and water PFAS concentrations reported in the Oakey Investigation Area.

PFAS reduction in eggs after exposure ceased

- The time that was required for the concentration of PFAS in eggs to decrease by half, after exposure to PFAS via drinking water ceased, ranged between 7 days for PFHxS and 2 days for PFHxA.
- It was estimated that it would take a period of 100 days for the PFAS (PFOS, PFOA, PFHxS and PFHxA) within eggs of backyard poultry to reduce to below the Laboratory Limit of Reporting (LOR) once the poultry have been removed from PFAS exposure (such as PFAS contaminated water, soil, feed).

Recommendations

The 2017 HHRA concluded that people in the Investigation Area should follow Queensland Health advice to restrict consumption of eggs from backyard chickens that have access to PFAS-impacted water, soil or feed.

The PFAS concentrations in eggs will decrease over time where exposure of backyard chickens to water, soil and feed containing detectable PFAS can be prevented (e.g. supply chickens with town water from the mains supply, move free range chickens to areas where soils are not impacted by PFAS and avoid feeding the hens food scraps containing detectable PFAS).

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