THE UNIVERSITY OF MAINE
Cooperative Extension *and* School of Food and Agriculture

PFAS and Dairy Animals

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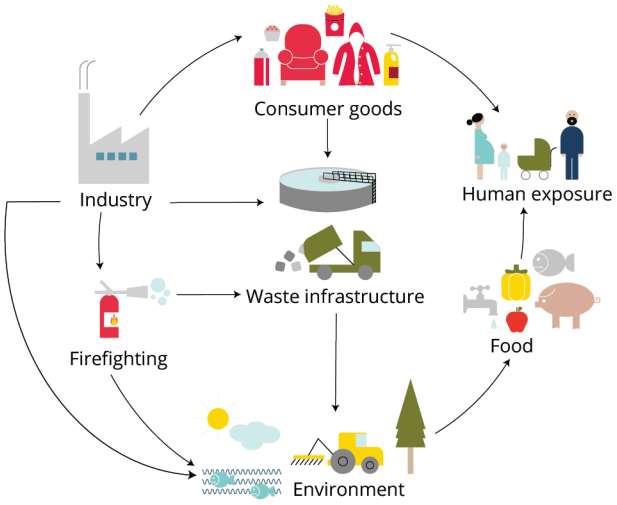
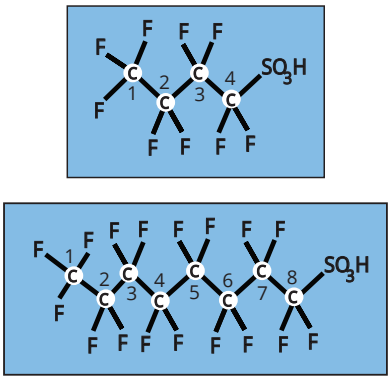
Per-and polyfluoroalkyl substances (PFAS) are a group of more than 4,000 chemicals composed of carbon and flourine bonds. PFAS have been in use since 1940 and are found in various consumer and industrial products because of their resistance to grease, oil, water and heat. Exposure to PFAS via food, water and dust can lead to adverse health outcomes in humans.[1]



Sources of PFAS:
industry, consumer goods and firefighting foam



Length of carbon chain and polar head makes a difference:
Cattle can urinate short carbon chains (7 or less), whereas perfluooctane sulfonic (PFOS, 8) acid bioaccumulates. The sulfonate group in PFOS further restricts its excretion via urine compared to PFAS with carboxyl groups.

Dairy animals can be exposed to PFAS if they eat or drink contaminated feed or water.[1] Long chain PFAS such as perflourooctane sulfonic acid (PFOS) accumulate in dairy animals because they mostly are not urinated and are re-circulated through the enterohepatic cycle (EHC).[2] PFOS is present in milk even after the animal consumes clean feed because it can take 39-106 days for 50% of the accumulated PFOS to clear from blood.[5]

Milk is made from blood and contains 3.1-3.8% proteins[9] → **PFOS like to be with proteins[5]** → **Transported serum proteins in milk have a major role in PFOS blood-to-milk transfer.[5]**

Heifers

- Enterohepatic circulation (see back) facilitates bioaccumulation of PFOS in the animal until first lactation[3,4]
- There is potential for reducing PFOS with pre-partum feeding management

Lactating Animals

- Milk is a major excretion route of PFOS in contaminated cattle because it is rich in proteins[5]
- As milk yield increases, PFOS concentration in milk seems to decrease[6]

How do PFOS recirculate?

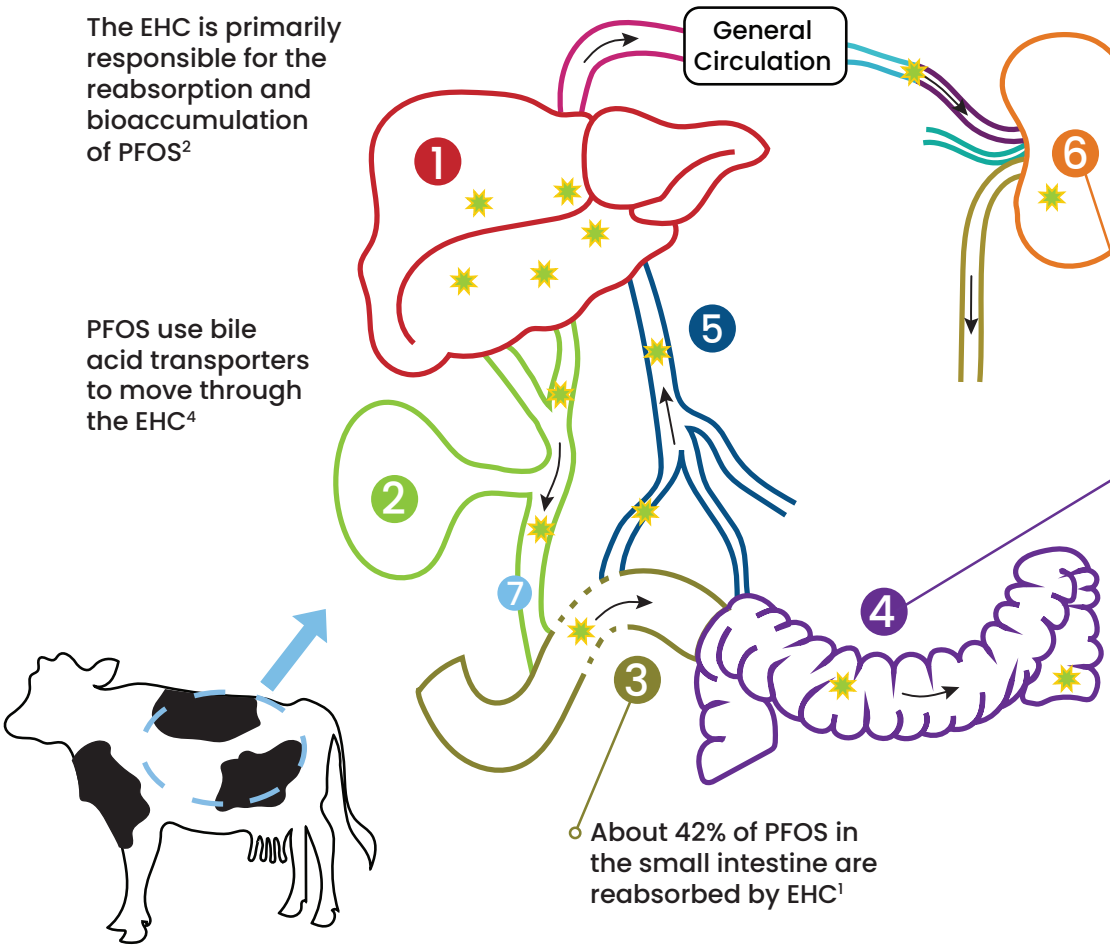
Enterohepatic circulation (EHC) is the movement of bile acids from the liver to the small intestine and back to the liver. Bile acids are an important component in the movement of PFOS in dairy animals.

LEGEND

1. Liver: cleans blood, aids in disgestion by secreting bile
2. Gallbladder: stores bile
3. Small Intestine: main site of nutrient and water absorption
4. Large Intestine: primarily forms feces
5. Portal Vein: carries blood to the liver
6. Kidney: removes metabolic waste and extra water from blood
7. Common bile duct
8. PFOS

The EHC is primarily responsible for the reabsorption and bioaccumulation of PFOS[2]

PFOS use bile acid transporters to move through the EHC[4]



Urine is the main route of elimination for other PFAS, like PFOA and PFBS, but not PFOS[5]

About 5% of PFOS are eliminated via feces[4]

1-14% of PFOS are eliminated via milk[5]

About 42% of PFOS in the small intestine are reabsorbed by EHC[1]

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