Rapeseed feeds affect the iodine status of farm animals and the iodine in some animal-source food

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Rapeseed glucosinolates (GSL) are hydrolysed to isothiocyanates, thiocyanates and further compounds acting, dose dependent, as antagonists of the organism´s iodine household. Establishing a valid quantification of iodine in food and feed by the ICP-MS method in the last two decades, animal experiments were performed to find out possible relationships between the iodine dosage of diets without or with rapeseed feeds and the animal/products´ iodine status. Rapeseed meal (RSM) in diets for fattening pigs (15 % RSM, 1.2 mg GSL/kg diet) combined with high supplementary iodine did not change the iodine level of blood (65 µg/L serum) and meat (3 µg/kg meat) as comparison with the control without dietary RSM (Schöne et al. 2006). Contrasting with the meat, the iodine in milk (Fig.1) and eggs (Table 1) shows a significant and strong response to the feed iodine content. In cows, testing diets with and without RSM, both with the same dietary iodine amounts, dose response for the milk iodine was lowered by a half up to two thirds when the GSL are part of the diet (Fig.1, Fig. 2). Otherwise, the trials with variable rapeseed feeds (Fig. 2) did not show differences in the strength of the milk iodine depression depending on dietary GSL content. The mammary iodine transfer is realized by a sodium/iodide symporter (Na^+/I^- symporter, NIS) and the above-mentioned products of GSL hydrolysis competitively inhibit this cotransporter. For the bird ovary, a NIS was not determined up till now.

Figure 1: Effect of iodine and solvent extracted rapeseed meal (RSM) in the cow feed on the milk iodine concentration (Fanke et al. 2009)

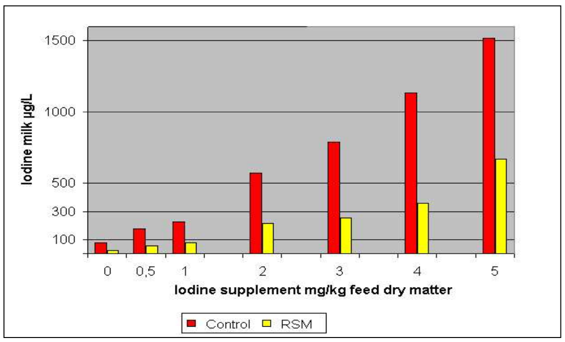

Table 1: Iodine content of eggs (µg/kg edible part) from hens[1] depending on the iodine addition to diets without (control) or with 10 % rapeseed press cake (RPC, 13.8 µmol GSL/g dry matter) – means of the results from Day 8,15,29, 85 and 164 in the experiment, each sampling day represents 6 eggs per group [2] (Flachowsky et al. 2017)

Added iodine (mg/kg diet)	Control	RPC
0	116	92*
0.50[2]	255	151*
2.50[2]	638	545*

* significance of the difference (P<0.001)
[1] n=12 per group, selected for monooxygenase 3 (FMO3) genotype resulting in oxidation ability of trimethyl amine TMA to prevent fishy tainting eggs
[2] two iodine sources with two hen groups were tested: KI and $Ca(IO_3)_2$ resulting in 12 eggs per sampling day

Figure 2: Milk iodine in cow experiments with rapeseed meal (RSM) and press cake (RPC). Control groups without rapeseed feeds and glucosinolates (GSL); iodine addition in the sequence of ref. 2.2, 1.8, 1.4, 0.8 and 1.7 mg/kg feed dry matter (DM), means ± SD; P<0,001 controls *vs.* RSM or RPC (Lit. until 2010 in Flachowsky et al. 2014)

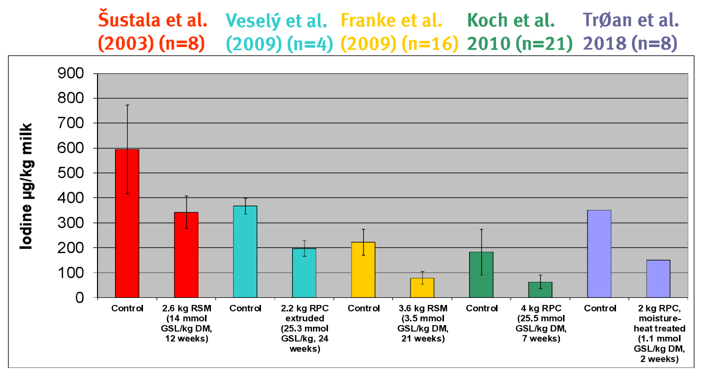

Table 2: Mean iodine intake in Germany via food produced from cows and laying hens with present 1 or recommended 2 mg iodine/kg feed including iodized salt and seafish (for details see JTEMB 39, 2017, 202-209)

	Intake food (g/day)	Content iodine (µg/kg)	Human intake iodine (µg/day)
Milk (products)	350[1]	100 or 280	35 or 98
Eggs	30[1]	500[3] or 700	15 or 21
Seafish/-food)	35[1]	750	26
Iodized salt, mainly via processed food	3.3[2]	20000	66
			Total 142 or 211

[1] calculation from consumption per capita and year, German Agristatistic Book, BMELV 2013
[2] mean salt intake from studies is 10 g/day, one third is estimated to be iodized
[3] magnitude in the eggs from the market at 1 mg added iodine/kg feed (Schöne et al. 2006)

Conclusions and recommendations

Cows transfer the feed iodine into the milk and hens do this for the eggs. The total iodine output via milk related to the added feed iodine is in the range of 30-40% *vs.* 10-20% for cow diets without *vs*. with rapeseed feeds. Laying hens have shown 20 *vs.* 14% egg iodine in relation to the iodine amount via diets without *vs*. with the iodine antagonists. Milk and eggs are significant iodine sources for the consumer and any optimization of their iodine content by animal feeding contributes to public health. The, according to a present monitoring, too low iodine supplementation of cow diets with RSM, the dominating protein feed, causes a too low milk iodine content in Germany (Table 2). The feed-iodine supplementation should be increased from 1 to 2 mg/kg dry matter to realize ≥200 µg iodine/litre milk (instead of one-half of this content at present). In other European countries, there is too much of iodine in the milk. This situation could be improved by lowering the iodine supplementation and/or by inclusion of RSM into the cow feed.

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