

Back fat substitution in raw fermented sausage

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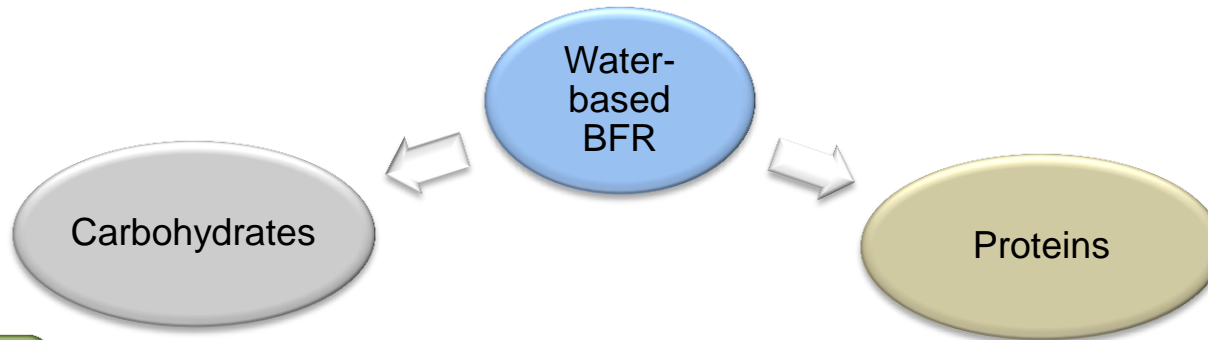


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Back fat substitution in raw fermented sausage

- Goals: innovative strategies for back fat substitution in raw fermented sausage
- Challenges by raw sausage:
 - traditional appearance (visible fat particles)
 - technological necessity during the production
 - sensory properties of end products such as texture or mouthfeel as well as taste delivery

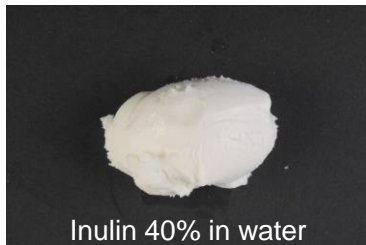
Water-based commercial BFR



Alginate



Cellulose 4% in water



Inulin 40% in water

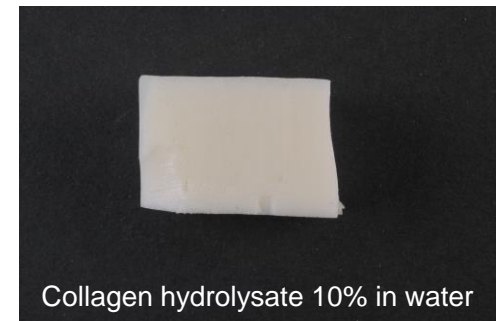
Advantages:

- lower nutritional energy compared to oil-containing BFR
- existing recipes

Drawbacks:

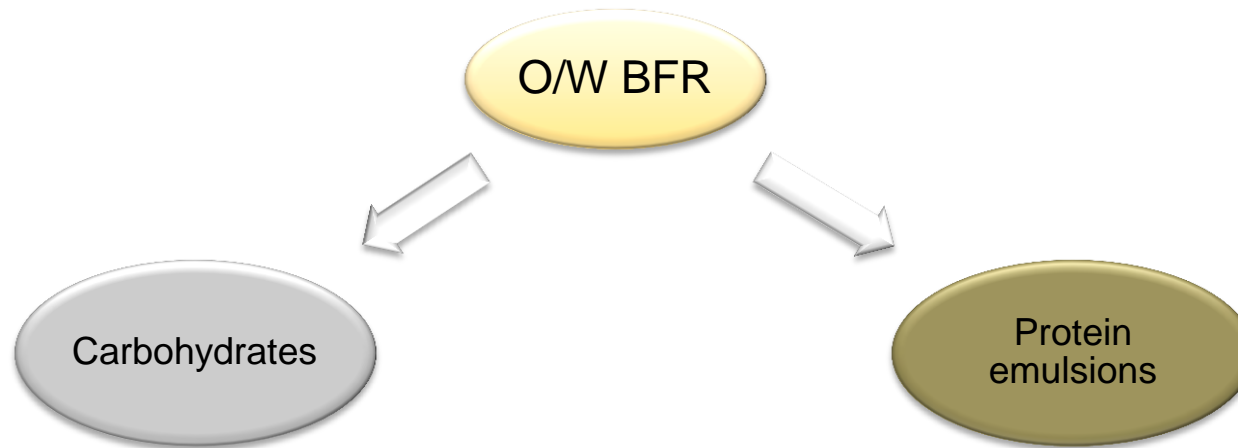
- higher water content in raw sausage (technologically challenging)
- microbiologically unfavorable
- loss of specific taste and aroma

Protein isolates



Collagen hydrolysate 10% in water

Commercial and experimental BFR: **oil-in-water (O/W) emulsions**



Alginate

Carrageenan

Konjac gel

Advantages:

- Texture, taste delivery, mouthfeel
- Unsaturated fatty acids

Drawbacks:

- High water content in raw sausage (technologically challenging)
- Mikrobiologically unfavorable
- Oxidation of unsaturated fatty acids
- Oil leakage

Protein isolate






Collagen hydrolysate

	BFR	acceptancy	TBARS mg MDA/kg	Perox. value
1.	Control	Yes	0.145	0
2.	50% Alginate (O/W 1/1)	No	-	-
3.	100% Alginate (O/W 1/1)	No	0.208	0
4.	50% Collagen hydrolysate (O/W1/1)	Yes	-	-
5.	100% Collagen hydrolysate (O/W1/1)	No	-	-



Dry edges at treatment 3 and considerable oxidation

Raw fermented sausage production according to producer's recommendations

	BFR		Acceptancy	pH	a_w -value
1.	Control		Yes	4.99	0.893
2.	50% Rapeseed oil as BFR		No	4.94	0.885
3.	50% Alginate 1 (water)		Yes	4.92	0.913
4.	50% Alginate 2 (W/O 11/9)		Yes	4.73	0.924
5.	50% Alginate 3 (water)		Yes	4.63	0.919

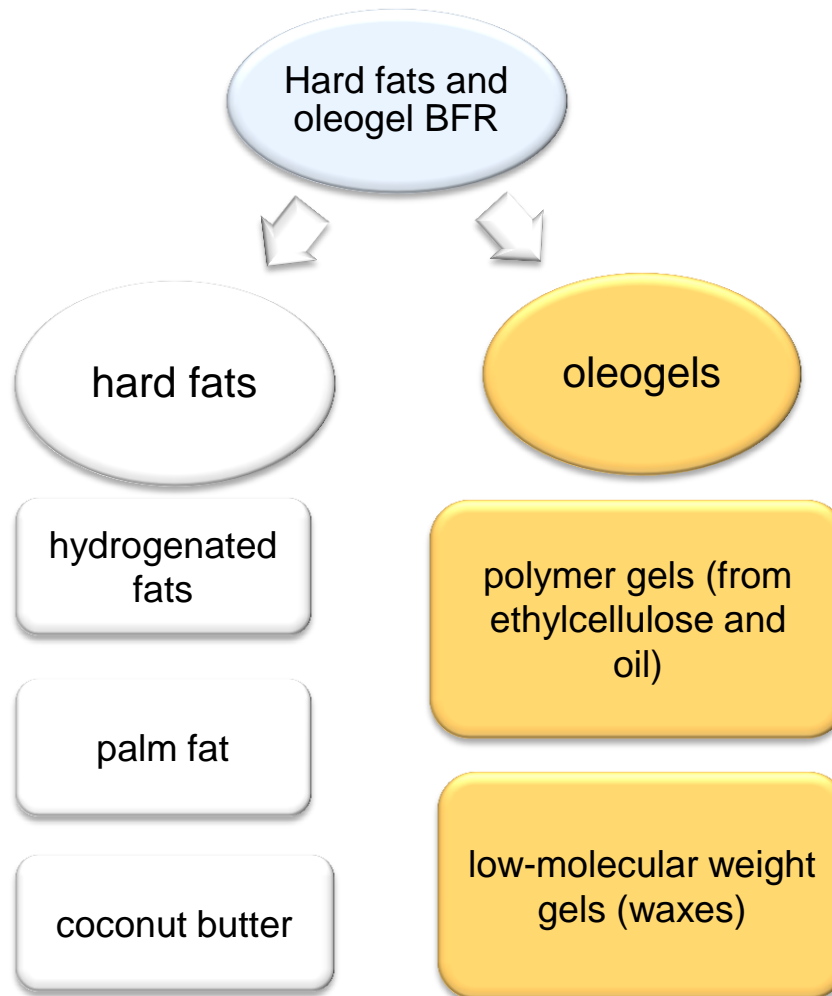
Hard fats and oleogels

Advantages:

- Texture, taste delivery, mouthfeel – similar to back fat
- Technological similarity to back fat

Drawbacks :

- Saturated fatty acids



Advantages :

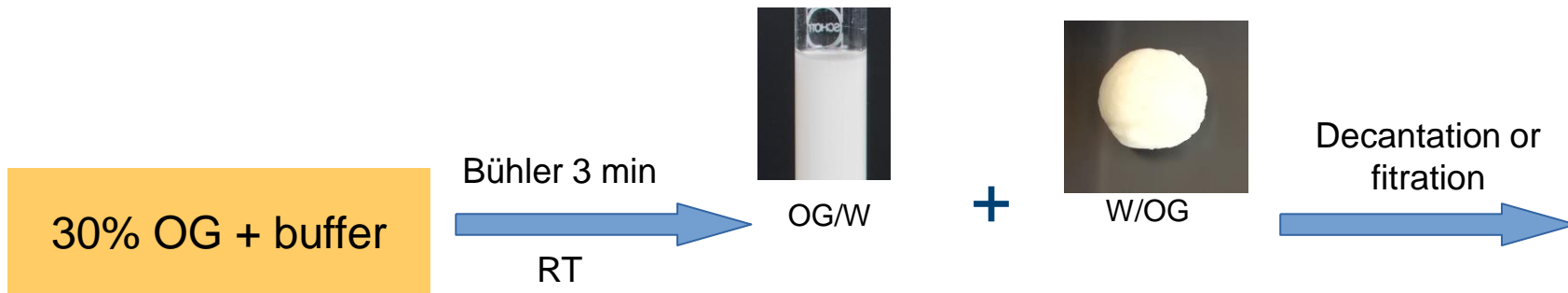
- Texture, taste delivery, mouthfeel – similar to back fat
- Technological similarity to back fat
- Unsaturated fatty acids

Drawbacks :

- Oxidation of unsaturated fatty acids
- Weak gels: oil leakage
- **Oleogels from ethylcellulose are transparent**

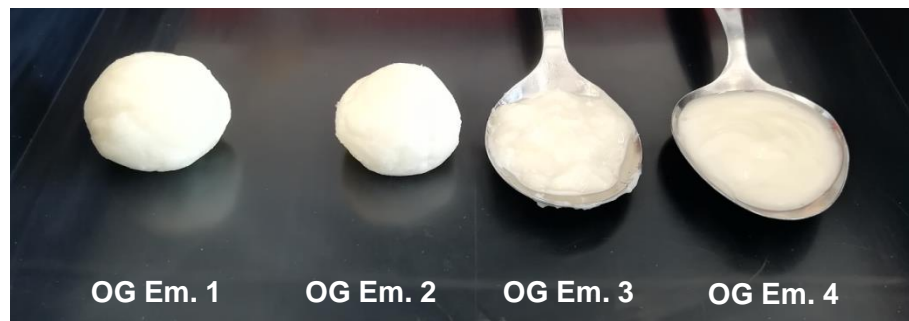
Production of novel oleogel emulsions

1. Oleogels were prepared from ethylcellulose (Dow Chemicals) 100 cP and 45 cP (7% and 10%) by heating above 130°C with rapeseed oil (*Zetzl 2013 Ph. D. thesis*)
2. The optimal emulsification of oleogels in TWEEN 80 phosphate buffer was reached by using high-speed homogenizer (Bühler)
3. The formed mixture of oleogel-in-water (OG/W) and water-in-oleogel (W/OG) emulsions has been separated. The emulsions are physically stable within months



Ready-to-use back fat replacer!

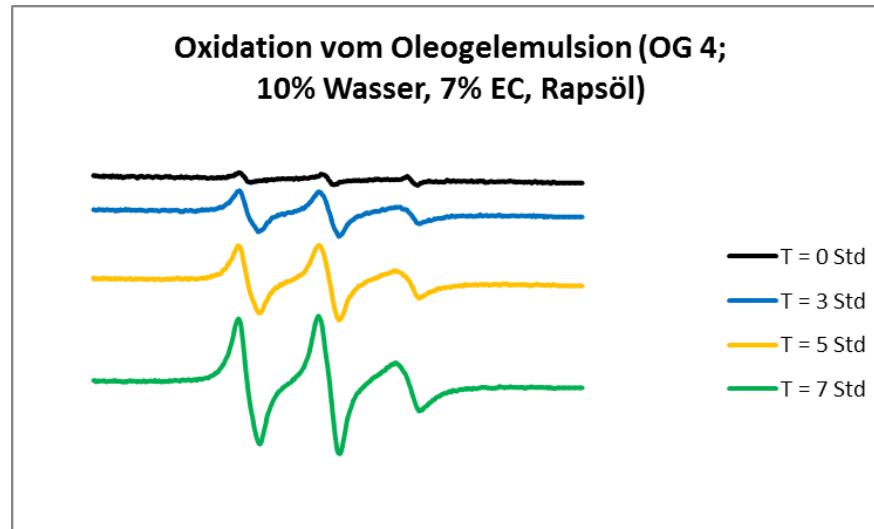
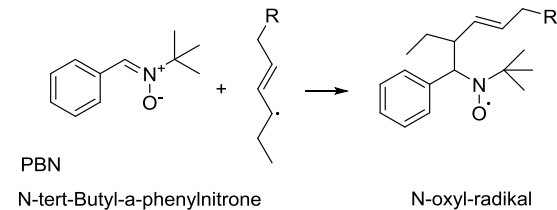
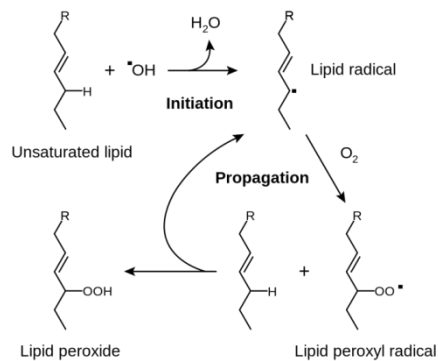
	Back fat (Wood et al. Livestock Prod Science 22 (1989) 351-362)	Oleogel emulsions (W/OG)
Water	14 - 22%	10 - 22%
Fibers	Collagen 2 – 4.5%	Ethylcellulose 5.5 - 9%
Lipids	69 - 82%	70 - 84%



	OG1 Em	OG2 Em	OG3 Em	OG4 Em
Oil	81%	83.7%	70.2%	72.5%
Ethylcellulose	9% 100 cP	6.3% 100 cP	7.8% 45 cP	5.5% 45 cP
Water	10%	10%	22%	22%

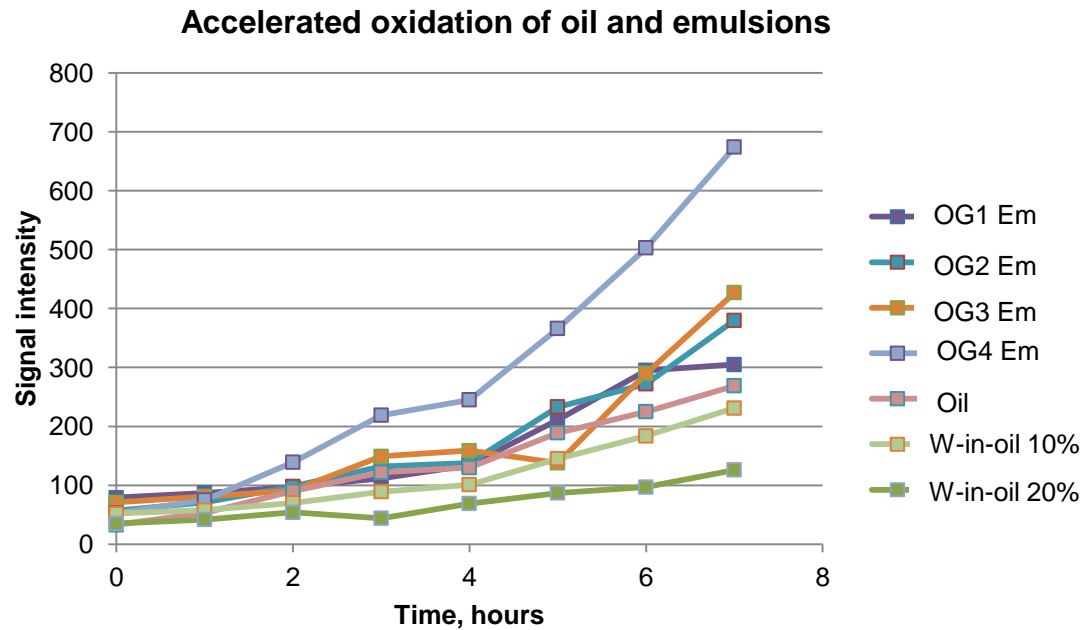
spin-trapping method:

- Detection of primary oxidation products by detection of free radicals in the 1st oxidation phase



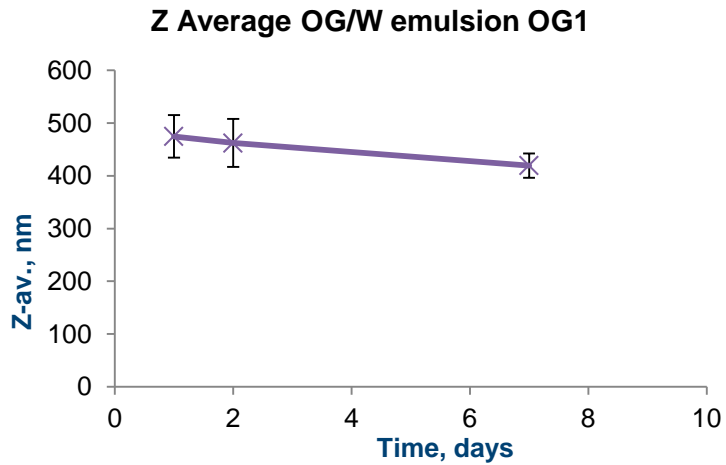
Oxidation of oleogel emulsion with 22% water, 5.5% EC and 72.5% rapeseed oil

spin-trapping method

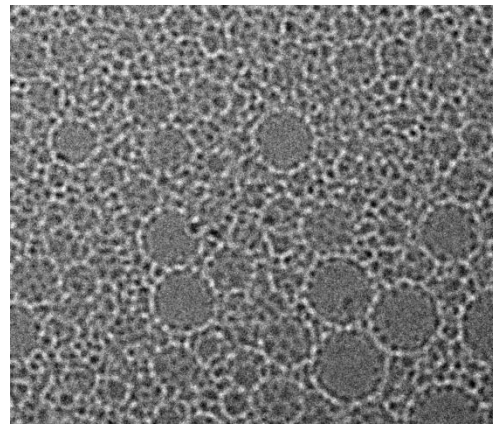


Batch	OG1 Em	OG2 Em	OG3 Em	OG4 Em	Rapeseed oil	Water in rapeseed oil 10%	Water in rapeseed oil 20%
Rapeseed oil	81%	83,7%	70,2%	72,5%	100%	90%	80%
Ethylcellulose	9% 100 cP	6,3% 100 cP	7,8% 45 cP	5,5% 45 cP	0	0	0
Water	10%	10%	22%	22%	0	10%	20%

Physical stability and structure

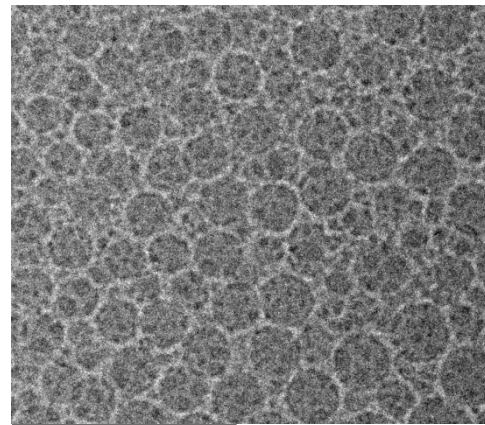
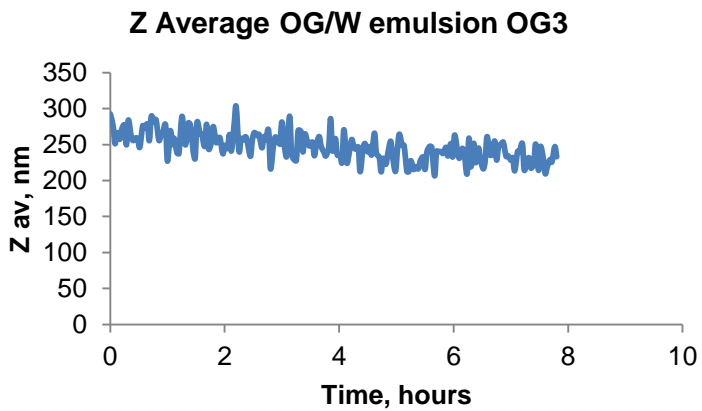


OG/W emulsion OG1



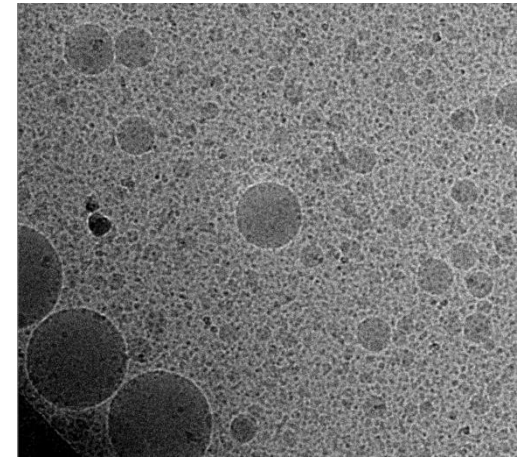
500 nm

OG/W emulsion OG3



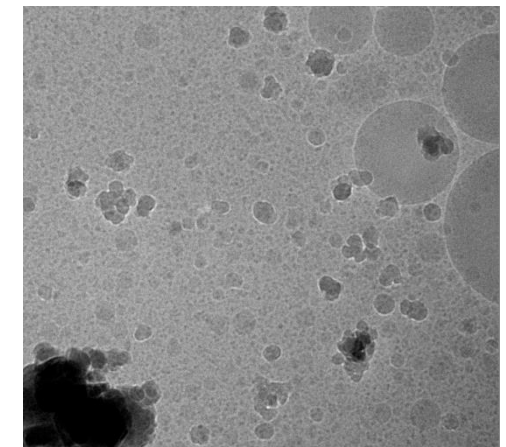
200 nm

W/OG emulsion OG1



500 nm

W/OG emulsion OG3



500 nm

Still to do's...

- Evaluation of oxidative stability of oleogels versus oleogel emulsions also after longer storage time:
 - Determination of vitamin E by HPLC
 - TBARS
- Application of antioxidants (with regard to the prooxidative ferrous compounds in meat)
- Production of raw fermented sausages containing oleogel emulsions as BFR for sensory evaluation

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