

Plant gelling agents for the production of canned meat

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**SUMMARY:** For canned meat products like corned beef, coarse comminuted meat is heated in cans. An enhanced amount of meat juice separates during the heating process. After cooling this liquid has a low gel strength and it is common to improve the strength by adding connective tissue (rind, sinew) or gelatin. This gels are stable at storage temperatures of to 20°C. At higher storage temperatures it liquefies. The purpose of our experiments with carrageenan and agar-agar in canned and fully preserved "German Corned Beef" was that limited knowledge is available about the suitability of marine hydrocolloids for producing canned meat products. The gelling capacity of the examined carrageenan-preparations on the market was different; only some of them proved to be sufficient. Also in case of agar-agar we found a variation in the different products. An important aspect is that some agar-agar-products are able to carry a bad taste over to the meat products.

**INTRODUCTION:** For canned meat products like corned beef, coarse comminuted meat is heated in cans. An enhanced amount of meat juice separates during the heating process. After cooling this liquid has a low gel strength and it is common to improve the strength by adding connective tissue (rind, sinew) or gelatin. This gels are stable at storage temperatures of to 20°C. At higher storage temperatures it liquefies. Higher storage temperatures are usual in Southern countries and the canned meat must be microbiologically stable and firm for cutting. This is possible by adding 1 % carrageenan or agar-agar to canned pork, beef or corned beef. Agar-agar and carrageenan are marine hydrocolloids, produced by extraction of marine algae like "Gracilaria Gelidium" (agar-agar) and "Chondrus Eucheuma Gigartina" (carrageenan). These hydrocolloids have a high waterbinding capacity and gel strength which guarantees the firmness to cutting at 30°C. The purpose of our experiments with carrageenan and agar-agar in canned and fully preserved "German Corned Beef" was that limited knowledge is available about the suitability of marine hydrocolloids for producing canned meat products.

**MATERIALS and METHODS:** The raw material was beef from cow fore-quarters, defatted and sinews roughly reduced. The meat was cut into fist-size pieces, salted with 12 g/kg curing salt for 4 days at 5°C. The cured meat was filled into bags and cooked at 95°C until a cooking loss of 30 % was reached. After cooking the meat was grinded. Meat and broth were chilled down to 40°C. Now various amounts (0,5-1,0 %) and kinds of carrageenan and agar-agar also in combination with finely chopped rinds of pigs in different amounts (5 and 10 %) and pre-cooked as well as combinations with gelatin of different gel strength and 0,3 % of an spice mixture were added. In order to prevent a formation of clumps a whisk was used while adding the carrageenan, agar-agar or spices into the broth. The proportion of the broth was calculated so that the final weight of the corned beef corresponds with the initial weight of the raw meat. Broth and meat was good mixed and filled in aluminium cans of 100 grams. The cans were closed and then heated up to 120°C at 2 bar pressure for 30 minutes (rotation and standing heating) to a Fc-value of or higher 4,5. After some days of storage the cans were brought for 24 hours to 20°C and 30°C, sensorily tested and the firmness measured with a penetrometer S & R, falling rod of 98 g, a calott with a weight of 50 g and a penetration time of 2 sec.

**RESULTS and DISCUSSION:** It is not possible to produce "corned beef with jelly" ("German Corned Beef") independently from the treatment of the rinds, as fully preserved cans which are stable for cutting at 20° and 30°C. However, it is possible to produce fully preserves stable for cutting at 20°C but not 30°C by adding 4 % of a special beef gelatine (280 bloom) and an adjusted technique of processing in cans appropriate to the heating process (100 g cans, size 73 x 58 mm). Using 4 % gelatine proportion, however, it is necessary that the initial material is low of connective tissue in order not to be under 75 % BEFFE content of the product.

The offered carageenan-preparations on the market vary strongly in their gel strength (consistency), the taste neutrality is not so strong. The selection of the preparations has a decisive influence on the quality of the final product. Only the cappa-fraction of the carrageenans is suitable for the production of corned beef or a like meat products. This cappa-carrageenan needs potassium ions for a sufficient gel stability. However, for sensory reasons (bitter taste) the propotion of potassium chloride in the carrageenan preparation should not be over 20 %. With the appropriate carrageenan preparations of 1 % it is possible to produce corned beef with gelatin without sensorical restrictions. Standing heat treatment should be used. At rotation heat treatment one will find the formation of dull, soft gel proportion which can be traced back to the fat-stabilizing effect of the used carrageenan-preparations. In combination with added rinds of pork and carrageenan processing is the concentration of carrageenen decisive for the cutting stability at 30°C. An addition of 1 % carrageenan has proved as sufficient. The allowed addition of 5 % pork rind to the corned beef with gelatin influences the cutting stability unessentially, but leads to an intensivation of color and palatability by improving the meat and spice flavor. The heating time of the rind (5 minutes and 60 minutes) has no influence an the consistency (Table 1). The exchange of rind with gelatine in combination with carrageenan can not be recommended since it creates only disadvantages concerning the consistency and taste.

It is not possible to use the Carrageenan-Preparations according their specification. There are differences in the gel strength by the species of algae, origin of the algae, harvesting and cleaning process as well as the standardization of the gel strength by adding potassium chloride and sugar. Therefore each carrageenan preparation has to be checked on the suitability for the Production of corned beef or alike meat products.

The agar-agar-preparations offered in "Food-grade" quality may have distinct differences concerning their influence on the taste of the final product (Table 2). 4 of 11 checked agar-agar-preparations showes almost none or only small influences on the taste while using the highest allowed amount of 1 %.

Table 1: Corned beef-recipes with carrageenan and pork rind/results of the sensory evaluations

Recipe (%) / Batch Nr.	1	2	3	4	5	6	7
Beef, cooked	70	70	70	70	70	70	70
Broth	24	19	24	19	29	25	20
Rinds ( 5 minutes heated)	-	-	5	10	-	5	10
Rinds (30 minutes heated)	5	10	-	-	-	-	-
Carrageenan	1	1	1	1	1	-	-
Sensory Examination							
Cutting stability at 20°C	*	*	*	*	*	-	#
Color 30°C	*	*	*	*	*	-	-
Taste	*	*	*	*	#	*	*
	+	+	+	#	o	*	o

- \* Fulfilment of quality expectation
- + Small devitation
- # noticeable faults
- o disting faults
- strong faults

**Table 2:** Corned beef recipis with agar-agar, carrageenenan and gelatine/results of the sensory evaluations

Recipe (%) /Batch Nr.	1	2	3	4	5	6	7	8	9	10	11	12	13
Beef, cooked	70	70	70	70	70	70	70	70	70	70	70	70	70
Broth	29	29	29	29	29	29	29	29	29	29	29	29	22,5
Carrageenan	1	-	-	-	-	-	-	-	-	-	-	-	-
Agar-Agar	-	1	1	1	1	1	1	1	1	1	1	1	-
Gelatine	-	-	-	-	-	-	-	-	-	-	-	-	7,5
Sensory Examination													
Cutting stability at	20°C	*	*	*	*	*	*	*	*	*	*	*	o
	30°C	*	*	*	*	+	*	*	+	*	*	+	#
Taste		+	*	+	+	*	o	*	+	-	*	o	o

- \* Fulfilment of quality expectation
- + Small devitation
- # noticeable faults
- o disting faults
- strong faults

**Table 3:** Corned beef recipis with agar-agar, pork rind and gelatine/results of the sensory evaluations

Recipe (%) /Batch Nr.	1	2	3	4	5	6	7	8	9	10	11	12
Beef, cooked	70	70	70	70	70	70	70	70	70	70	70	70
Rinds, cooked	-	-	-	-	5	5	5	5	5	5	5	5
Broth	29,75	29,50	29,25	29,00	24,75	24,50	24,25	24,00	18,00	18,00	21,50	21,50
Agar-Agar	0,25	0,50	0,75	1,00	0,25	0,5	0,75	1,00	-	-	-	-
Gelatine	-	-	-	-	-	-	-	-	7,0	7,0	3,5	3,5
Sensory Examination												
Cutting	20°C	-	+	*	*	-	+	*	*	*	*	*
stability at	30°C	-	+	+	*	o	+	+	*	+	#	o
Taste		*	*	+	#	*	*	+	#	+	#	*

- Batch: 9 + 11 beef gelatine, 280 bloom
- Batch: 10 + 12 gelatine 270 bloom
- \* Fulfilment of quality expectation
  - + Small devitation
  - # noticeable faults
  - o disting faults
  - strong faults



Table 4: Corned beef recipis with agar-agar and gelatine/results of the sensory evaluations

Recipe (%) /Batch Nr.	1	2	3	4	5	6	7	8	9	10
Beef, cooked	99,5	85	70	70	70	70	70	70	70	70
Broth	-	14,5	29,5	28	26	24	24	24	27,75	25,75
Agar-Agar	0,5	0,5	0,5	-	-	-	-	-	0,25	0,25
Gelatine	-	-	-	2	4	6	6	6	2	4
Sensory Examination										
Cutting	20°C	+	*/+	*	o	+	*	*	+	# +/#
stability at	30°C	o	+	*	-	-	-	-	-	o o
Taste		*	*	*	+	+	+	+	+	+

- Batch: 4 - 6 and 9 - 10 beef gelatine, 280 bloom
- Batch 8: gelatine 260 bloom
- Batch 7: gelatine 240 bloom
- \* Fulfilment of quality expectation
- + Small devitation
- # noticeable faults
- o disting faults
- strong faults

The other agar-agar-preparations however affected the taste from small to strong, named old, dull, mouldy, musty, fishy or train-oily. This bad taste come from a poor cleaning while producing the agar-agar. A better cleaning process however increases the cost of the agar-agar . Only a few preparations revealed the demand that adding 0,5 % agar-agar and a completete replacement of the cooking loss by broth a corned beef with jelly could be produced which was cutting stable at a storage of 20°C and 30°C after heating treatment as fully preserves in cans of small sizes (73 x 58 mm).

The corned beef was getting drier and softer when exchanges 5 % of the broth to cooced rinds. At recipes with 5 % rinds it is therefore necessary to add agar- agar of at least 0,75 %, better would be 1 %, higher propotions of soluble connective tissue may disturb the formation of an agar-agar matrix (Table 3). This observation could be observed too at the combinations of gelatin and agar-agar. Combinations of gelatin and agar-agar showed no advantage (Table 4).

CONCLUSIONS: The cappa structure of the carrageenan can be applied only, but it needs potassium ions for a strong jelly. The bitter taste of potassium chloride limits the content in the carrageenan-product to 20 %. The gelling capacity of the examined carrageen-products on the market was different; only some of them proved to be sufficient. Also in case of agar-agar we found a variation in the different products. An important aspect is that some agar-agar-products are able to carry a bad taste over to the meat products. With suitable agar-agar-products the use of 0,5-0,75 % agar-agar is sufficient. The application of connective tissue and these plant gelling agents at the same time hinders the formation of strong gel structures.

REFERENCES:

HEIDTMANN, R. (1960): Herstellung von Corned beef. Fleischwirtschaft 12: 757.

KELCH, F. (1960): Einfuhr von Corned beef. Fleischwirtschaft 12: 114.

MÜLLER, W.-D. (1982): Fachfrage - Corned beef. Fleischwirtschaft 62: 544-545.

REUTER, H. (1957): Herstellung von Corned beef. Fleischwirtschaft 9: 422.