# SENSORY QUALITY OF PICKLE-INJECTED, VACUUM PACKED AND COOKED DFD AND NORMAL BEEF

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## SUMMARY

Sensory profile of colour, texture and flavour of pickle-injected beef LD (young bulls) of normal and DFD quality after vacuum packaging, storing (11 days at 0 to 2 °C) and thermal treatment by two methods (cookingin water, roasting) were studied. The content of residual nitrite, MbNO and total pigment was determined.

The colour and texture properties of DFD cured beef were scored mostly higher after both thermal treatments. Normal and DFD samples did not differ in the juiciness and flavour. In spite of better colour the DFD samples contained significantly (P≤0.001) less MbNO and total pigment but more residual nitrite than the normal samples. Cooked samples of both qualities contained significantly (P≤0.001) more residual nitrite but less MbNO and total pigment than roasted one.

## INTRODUCTION

The latest investigations show that curing is first of all a process of forming the typical and thermostable pigment and the specific flavour and texture of cured meat. Extensive reports on this problematics have been made regarding the chemical composition and colour forming and microbiological quality of cured meat. Only little data about descriptors of sensory properties can be found in literature. Although there are numerous kinds of cured meat most topics dealt with are about pork and products, rare are treatises about cured beef. Therefore in our experiment emphasis was given to sensory properties of cured beef and adequate chemical quality parameters were followed.

The cured meat is a special sort of raw meat which is cured, somewhere a bit smoked on the surface and is being distributed as fresh meat and prepared in different culinary forms by all heat treatments. Basic components of the pickle influence the formation of sensory properties of meat and durability ( Gray, 1984; Kolb et al., 1990; Wirth, 1991). The important pigment for the formation of the bright red colour of the cured meat is predominantly nitrosylmyoglobin (MbNO) and denaturated stable pigment nitrosylmyohromo- is for the bright red colour of heat treated cured meat.

Colour descriptors were found in literature but mostly for pork and products, as are characteristics, hue, uniformity and depth of colour (Gray, 1984; Wirth, 1985; Đorđević, 1982). The main topic is research of results about the influence of myoglobin quantity and additional nitrite respectl. nitrate on colour properties. No data the descriptors of flavour of cured meat were found in literature. Similarly as colour also the flavour of cured meat was investigated first of all for its chemical nature and flavour components. Nearest real descriptors of the flavour of cured meat are Berry and Blumer ( 1981) who defined the flavour profile of bacon after heat treatment. Schults (1977) has researched the influence of additional nitrite respectl.nitrate on the formation of the typical flavour of beef. Least investigated is the texture of cured meat and only few descriptors exist for this property. Investigators defined these descriptors first of all for the texture of ham ( Kramlich, 1973; Brown, 1974), bacon ( Berry and Blumer, 1981) and other pork products.

## MATERIALS AND METHODS

For the investigation 46 hours post mortem six beef muscles m. longissimus dorsi ( LD) of normal (N) (pH= 5.58) and six muscles of DFD quality ( pH=6.67) were chosen. Samples were pickle injected (17.6% pickle in N and 21.1% in DFD) of two combinations such as : $R_1$ = nitrite salt for curing ( 10.36% NaCl, 57.74 mg/100 g nitrite) and $R_2$ = Sofos Salt K ( with added sugar) ( 10.31% NaCl, 59.75 mg/ 100 g nitrite). Directly after curing samples were vacuum packed in PA/PE bags and stored for 11 days at T= 0 to +2°C. Samples of cured beef were treated by two cooking procedures by cooking in water at T= 95°C and by roasting in oven at T= 175°C both till the final internal temperature $T_i$ = 74°C. Total loss of mass during the storage and heat treatment was 34% in average at normal and 24% at DFD samples . Prepared samples treated by heat were sensory evaluated ( external appearance, profile of colour, texture and flavour, total impression). Contents of nitrite, MbNO and total pigment was chemically analysed.

Temperature measurement was done by the electric thermometer ELLAB, type TEC and stitch feelers TCK 8.

pH measurement was done by the pH meter ISKRA, type 5721 by a combined glass stitch electrode.

Sensory evaluation was done by an experienced commission on hot treated samples (surface, slices, cubes). Sensory properties were evaluated by scoring properties from a group of analytical descriptive terms with a non-structured scoring scale ( 1-7 scores). The following sensory properties were evaluated : surface form, surface colour;hue, uniformity and intensity of the cross-section colour, mouth feeling, juiciness, tenderness, chewiness, cochesivenes, mouth coating with particles, apsorption of moisture, total impression of texture, cured flavour, nitrite flavour, saltiness and total impression. All properties were evaluated by scores 1 to 7 where 7 scores mean a strong property, 1 score too weakly expressed property. An exeption is saltiness where in the system 1-4-7 scores, 4 scores mean the optimal saltiness, 1 score too weakly expressed saltiness for cured meat. The results are an average of six repetitions.

Chemical methods. The contents of nitrite was analysed by the method with Griess s reagent according to Grau and Mirna ( Grau,1960). The contents of MbNO and the total pigment is determined by a modified method according to Hornsey (1956) as stated Koniecko ( 1979).
Statistical methods. All results of sensory and chemical analyses were statistically evaluated by analysis of variance and analysis of system influences.

RESULTS AND DISCUSSIONS

In the experiment the influence of different meat qualities , composition of the pickle and different processes of heat treatment on the quality of cured beef was investigated. As the technology of raw cured beef accentuation was given to quick curing and immediate vacuum packing by minimal neede quantities of curing ingredients. The accentuation of the experiment was on setting up profiles of sensory quality of cured beef, as about this problem as already mentioned, no data were traced in literature.
The results of the sensory analyses of cured beef of two qualities after heat treatment and the dealt-with-influences are stated in tables 1 to 3, the results of chemical analyses in tables 4 and 5.

The colour profile of cured beef of two qualities was defined on the surface and on the cross-section colour hue, uniformity and intensity . The surface colour was evaluated higher at DFD samples, especially after the roasting treatment, and the influence of differences between N and DFD quality and between two thermal treatments is significant. The colour hue of the cross-section, this is the typical bright red colour of cured meat, is more evident at cured DFD samples than at normal ones ( P≤0.001). The uniformity of the cross-section colour is very unique at all samples and evaluated practically to the maximum. DFD samples show a bit higher intensity of the bright red colour than N samples ( P≤0.05). The colour intensitx was significantly higher evaluted at roasted samples as compared to cooked ones. The composition of the pickle brine had no influence on the colour profile characteristics. High evaluation of the colour of our samples of cured beef correspond with the findings of Mendenhall (1989) who states that beef is raw material with a high contents of myoglobin which affects the hue and intensity of colour. Among other these characteristics are influenced by the meat quality and pH ( Mendenhall, 1989) which corresponds to our results as the cross-section of DFD samples with a higher pH (6.67) was more hue colour as N samples (5.58). The heat treatment has also contributed to better intensity of the cross-section colour and the colour of surface, especially roasting where also products of Maillard's reaction contributed at their formation. Although compared to N samples we have found a higher expressed and colour hue of DFD samples the chemical analyses show less contents of MbNO and total pigment and a higher contents of nitrite, just in the DFD samples. Such tendecies correspond to the findings of several investigators, who state that the origin of MbNO is forced by decrease of pH (Kolb et al., 1990). Our results correspond also to the findings of Đorđević (1980) that the in the DFD meat less residual nitrite is formed. On basis of this it can be concluded that for the formation of a suitable colour of cured meat it is possible to use less nitrite just at DFD meat.

At heating of our samples we achived the internal temperature 74 °C which additionaly affected the formation of a more intensive colour of cured meat and also corresponds to the findings of Okayama et al. (1991), who accentuates the meaning of temperature influence on colour. Cooked DFD samples compared to N samples were softer and less cochesiven, had better chewiness and therefore differences between qualities after cooking in water were significant ( P≤0.001), but not in roasted one.
We have found in our experiment that after curing there were no significant differenecs in juicness between N and DFD samples although literature data show that noncured DFD meat is less juicy than N and therefore this was also expected from cured meat. Probably there is a higher quantity of injected and kept pickle and so a higher quantity of water and NaCl and the loss of mass is lower after treatment on DFD samples what contributed to better juiciness. As our samples were treated to $T_i$=74°C the influence of the changing relation between pH and temperature on protein is important, because at 75°C these changes at both qualities are so extensive that the juiciness become equal ( Stabursvik and Martens, 1982). Combined with juiciness in DFD samples the feeling in the mouth was highly evaluated and the absorption of moisture low. A less juicy meat namely shows a higher need for additional moisturizing of the sample during chewing and therefore the apsorption of moisture at N samples which were less juicy was significantly higher. Profile of cured beef flavour was defined as a cured flavour , nitrite flavour and saltiness. We found an important decrease of differences in flavour between the flavour of N and DFD samples. It is well known that at noncured N beef the flavour with a sour component is better taste and therefore something similar was expected at cured beef. But the differences in the cured flavour between both meat qualities decreased. In our experiment a small concentration of salt and nitrite was used. But during the evaluation a mild flavour of nitrite was recognized as a consequence of the presence of residual nitrite which after numerous reactions of decomposition still remain in this form (Okayama et al.,1991). In DFD samples which after heat treatment contained more nitrite as N samples the nitrite flavour is also more percieved. The saltiness of all evaluated samples was suitable as the scores are close to optimal value which was planned in the experiment itself. Significant is the influence of heat treatment on the saltiness of cured beef which is a bit higher than at roasted samples of both qualities. The total impression of samples was highly evaluated irrespective of the dealt-with influences. From table 4 and 5 it is evident that the contents of nitrite significantly (P≤0.001) differs between experimetal groups. More nitrite contained DFD samples with a higher pH which corresponds to the statement of Đorđević (1980) and there is more of it in cooked samples as compared to roasted ones. The content of denaturated MbNO in N is significantly higher (P≤0.001) as at DFD samples , similar relations are valid also for the contents of total pigment. The contents of denaturated MbNO at both qualites is higher after roasting than after cooking in water.

CONCLUSION
Data of our investigation show that beef, especially better cuts, is a suitable raw material for the production and distribution of cured meat intended for culinary preparation. Eating quality of DFD cured beef do not differ or are even better from normal beef which is completely different from the culinary prepared noncured beef of both qualities.

Table 1: Sensory properties of cured beef of two qualities after heat treatment

| GROUPS | N | | | | DFD | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | P1 | | P2 | | P1 | | P2 | | |
| PROPERTIES[a] | C | R | C | R | C | R | C | R | F-value |
| EXTERNAL APPEARANCE | | | | | | | | | |
| surface form (1-7) | 6.25 | 6.13 | 6.15 | 6.19 | 6.09 | 5.96 | 6.17 | 6.19 | 0.78 |
| surface colour (1-7) | 5.59 | 5.90 | 5.52 | 5.93 | 5.50 | 6.23 | 5.29 | 6.25 | 0.64 |
| CROSS-SECTION COLOUR | | | | | | | | | |
| colour hue (1-7) | 6.32 | 6.40 | 6.29 | 6.34 | 6.94 | 6.86 | 6.81 | 6.88 | 34.55*** |
| uniformity(1-7) | 6.98 | 7.00 | 6.83 | 7.00 | 7.00 | 7.00 | 7.00 | 6.88 | 0.12 |
| intensity (1-7) | 6.23 | 6.59 | 6.02 | 6.46 | 6.48 | 6.75 | 6.27 | 6.71 | 6.01* |
| TEXTURE PROFIL | | | | | | | | | |
| juiciness (1-7) | 5.88 | 5.94 | 5.54 | 5.92 | 5.84 | 5.88 | 5.73 | 6.13 | 0.49 |
| tenderness (1-7) | 6.03 | 6.13 | 5.73 | 5.98 | 6.63 | 6.32 | 6.50 | 6.23 | 9.58** |
| mouth feeling (1-7) | 5.80 | 5.84 | 5.44 | 5.75 | 6.02 | 5.63 | 5.67 | 5.84 | 0.41 |
| chewiness (1-7) | 5.48 | 5.57 | 5.38 | 5.61 | 5.98 | 5.63 | 5.71 | 5.65 | 3.10 |
| cochesivenes (1-7) | 2.59 | 2.65 | 3.06 | 2.55 | 2.11 | 2.44 | 2.17 | 2.32 | 11.20** |
| mouth coating (1-7) | 1.98 | 1.96 | 2.15 | 1.92 | 2.00 | 2.04 | 2.13 | 1.98 | 0.16 |
| moisture apsorption (1-7) | 2.30 | 2.42 | 2.82 | 2.21 | 2.04 | 2.05 | 2.15 | 2.00 | 11.26** |
| total impression texture (1-7) | 5.88 | 5.90 | 5.56 | 5.86 | 6.36 | 6.00 | 6.00 | 6.09 | 5.11* |
| PROFILE OF FLAVOUR | | | | | | | | | |
| cured flavour (1-7) | 6.04 | 6.04 | 6.04 | 6.07 | 6.06 | 5.98 | 5.75 | 5.80 | 3.76 |
| nitrite flavuor(1-7) | 1.08 | 1.02 | 1.09 | 1.06 | 1.19 | 1.28 | 1.36 | 1.54 | 9.52* |
| saltiness (1-7) | 4.00 | 4.02 | 4.06 | 4.11 | 3.96 | 4.02 | 3.94 | 4.19 | 0.23 |
| TOTAL IMPRESSION (1-7) | 6.13 | 5.96 | 5.73 | 6.00 | 6.38 | 6.04 | 5.96 | 6.03 | 1.08 |

a = score range at sensory evaluation
* P ≤ 0.05
** P ≤ 0.01
*** P ≤ 0.001

N - normal quality
C - cooking in water
P1 - pickle 1

DFD - dark,firm,dry
R - roasting
P2- pickle 2

Table 2: Significance of influences of different meat quality and composition of pickle on sensory properties of cured beef after cooking and roasting

| PERTIES | C | | R | |
|---|---|---|---|---|
| | F - value | | F - value | |
| | quality | pickle | quality | pickle |
| se form | 0.49 | 0.01 | 0.32 | 1.02 |
| ce colour | 1.27 | 0.96 | 4.55* | 0.03 |
| ur hue | 16.72*** | 0.28 | 16.59*** | 0.03 |
| rmity colour | 2.18 | 1.35 | 1.00 | 1.00 |
| sity colour | 3.29 | 2.28 | 2.52 | 0.41 |
| ness | 0.17 | 1.50 | 0.48 | 1.22 |
| ness | 11.28** | 1.05 | 1.13 | 0.31 |
| feeling | 1.34 | 3.25 | 0.16 | 0.16 |
| ness | 5.95* | 1.20 | 0.07 | 0.03 |
| sivenes | 21.23** | 3.28 | 1.05 | 0.28 |
| coating | 0 | 1.19 | 0.35 | 0.18 |
| ure apsorption | 5.16* | 2.58 | 9.57* | 1.78 |
| texture | | | | |
| impression | | | | |
| flavour | 6.95* | 3.68 | 0.61 | 0.01 |
| te flavour | 1.41 | 1.90 | 2.26 | 0.54 |
| ness | 5.03* | 1.00 | 5.15* | 0.92 |
| l impression | 2.56 | 0.16 | 0.40 | 3.70 |
| | 1.70 | 4.94* | 0.05 | 0 |

reviations as in table 1.

Table 3: Significance of influences of different heat treatments and composition of pickle on sensory properties of cured beef in two qualities

| PROPERTIES | DFD | | N | |
|---|---|---|---|---|
| | F- value | | F - value | |
| | treatment | pickle | treatment | pickle |
| surface form | 0.18 | 1.59 | 0.13 | 0.03 |
| surface colour | 41.82*** | 0.52 | 4.93 | 0.01 |
| colour hue | 0.07 | 0.12 | 0.21 | 0.10 |
| uniformity colour | 1.00 | 1.00 | 2.18 | 1.35 |
| intensity colour | 7.84* | 0.98 | 7.74* | 1.37 |
| juicines | 2.20 | 0.25 | 2.16 | 1.39 |
| tenderness | 2.84 | 0.36 | 0.56 | 0.90 |
| mouth feeling | 0.43 | 0.18 | 0.86 | 1.31 |
| chewiness | 1.72 | 0.60 | 0.54 | 0.02 |
| cochesivenes | 2.23 | 0.04 | 1.16 | 0.79 |
| mouth coating | 0.14 | 0.05 | 1.21 | 0.32 |
| moisture apsorption | 0.27 | 0.05 | 1.88 | 0.79 |
| total texture impression | 0.55 | 0.54 | 0.56 | 0.72 |
| cured flavour | 0.02 | 3.04 | 0.04 | 0.03 |
| nitrite flavour | 0.62 | 1.62 | 0.55 | 0.15 |
| saltiness | 4.63* | 1.01 | 0.54 | 2.83 |
| total impression | 0.68 | 1.69 | 0.06 | 0.72 |

Abbreviations as in table 1.

Table 4: Contents of nitrite, nitrosylmioglobin and total pigment of cured beef in two qualities after heat treatment

| | N | | | | DFD | | | | F-value |
|---|---|---|---|---|---|---|---|---|---|
| | P1 | | P2 | | P1 | | P2 | | |
| | C | R | C | R | C | R | C | R | |
| nitrite (mg/100g) | 2.21 | 2.03 | 2.16 | 2.36 | 5.46 | 5.32 | 5.67 | 4.61 | 12.48*** |
| MbNO (ppm) | 209.51 | 218.13 | 188.56 | 194.68 | 120.67 | 126.92 | 104.4 | 16.98 | 111.91*** |
| total pigment (ppm) | 329.42 | 342.89 | 376.40 | 329.30 | 270.27 | 258.05 | 260.33 | 276.20 | 26.07*** |

MbNO - nitrosylmyoglobin
Other abbreviations as in table 1.

Table 5: Significance of influences of treatment and meat quality on the properties of cured beef

| | F - value | | | |
|---|---|---|---|---|
| | N treatment | DFD treatment | C quality | R quality |
| nitrite (mg/100g) | 11.84*** | 22.43*** | 123.60*** | 43.89*** |
| MbNO (ppm) | 235.67*** | 72.25*** | 89.86*** | 36.37*** |
| total pigment (ppm) | 38.68*** | 71.64*** | 16.21*** | 9.63*** |

Abbreviations as in table 1.

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