INFLUENCE OF DEGREE OF PRECOOKING ON QUALITY OF FROZEN SLICED BEEF AND PATTIES

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Industrially precooked frozen meat products are finding increasing use both on the institutional and consumer markets. For fried meats, a pre-browned product may be preferable so that microwave ovens and convection ovens may be used for the reheating step.

The objective of our study was to determine the influence on final product quality and yield (after reheating to complete doneness) from the degree of pan frying prior to freezing. For sliced beef of 15 mm thickness, sensory quality and yield gradually decreased with increasing completeness of precooking, the pretreatment conditions used being raw and frying to centre temperatures of +10°, +40° and +70°C. This was true also for 10 mm thick meat patties with regard to yield. However, light crust browning was preferred for sensory quality both over raw and completely precooked products.

Plausible explanations are believed to be the combined influence of catalytic fat oxidation through denaturated hemo-proteins and an antioxidative effect from maillard substances formed at the surface crust of the meat patties during prefrying.

INFLUENCE DU DEGRÉ DE PRÉ-CUISSON SUR LA QUALITÉ DE BOEUF TRANCHÉ ET DE STEAKS HACHÉS CONGELÉS

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Les produits congelés, à base de viande, pré-cuits à l'échelle industrielle, sont de plus en plus utilisés sur les marchés des institutions et dés consommateurs. Quant aux viandes frites, un produit pré-bruni peut être préférable, si bien que les fours à micro-ondes et ceux à convection peuvent être employés pour la phase du réchauffage.

L'objectif de notre étude a été de déterminer l'influence sur la qualité finale du produit et sur le rendement (après réchauffage dans le but d'achever la cuisson) à partir du degré de friture à la poêle avant la congélation. Pour ce qui est du boeuf tranché, d'une épaisseur de 15 mm, la qualité sensorielle et le rendement ont diminué graduellement avec l'accomplissement de la pré-cuisson. Les modalités préparatoires utilisées ont été cru et frire jusqu'aux températures du centre de +10°C, de +40°C et de +70°C. Ceci s'applique également aux steaks hachés d'une épaisseur de 10 mm quant au rendement. Cependant, la cuisson donnant une petite croûte a été préférable pour la qualité organoleptique, aussi bien aux produits crus, qu'a ceux entièrement pré-cuits.

Des explanations vraisemblables paraissent être les influences combinées d'oxydation catalytique par des hémo-protéines dénaturées et un effet anti-oxydatif provenant des substances Maillard, formées au cours de la pré-friture sur la surface de la croûte des steaks hachés.

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EINFLUSS DES VORBEREITUNGSGRAD AUF DIE QUALITÄT VON GEFRIERTEM FLEISCH IN SCHEIBEN UND AUF HAMBURGERN

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Industriell vorgebratene Fleischprodukte finden steigende Verwendung in Grossverpflegung und Haushalt. Für gebratenes Fleisch könnte ein vorgebräuntes Erzeugnis vorzuziehen sein um die Anwendung von Mikrowellenöfen und Konvektionsöfen für das Wiedererwärmen möglich zu machen.

Ziel der Untersuchung war, den Einfluss des Bratens vor dem Gefriereren auf die Qualität des fertigen Erzeugnisses und die Ausbeute (nach Wiedererwärmung zu fertiger Zubereitung) zu bestimmen. Für Fleischscheiben von 15 mm Dicke nimmt die sensorische Qualität und die Ausbeute mit steigendem Grad des Vorbratens kontinuierlich ab. Die Vorbehandlung war roh oder Braten bis zu Zentrumtemperaturen von +10°, +40° und +70°C. Dasselbe Resultat wurde hinsichtlich der Ausbeute auch für 10 mm dicke Hamburger erhalten. Jedoch wurde bei den sensorischen Qualitätsmessungen leichte Oberflächenbräunung sowohl über rohe als auch fertigvorbereitete Erzeugnisse vorgezogen. Dies kann möglicherweise mit dem Einfluss von durch denaturierte Hämoproteine katalysierter Fettoxydation und einem antioxydativen Effekt von Maillard-Substanzen, die während des Vorbräunen auf der Oberfläche der Hamburger gebildet werden, erklärt werden.

ВЛИЯНИЕ СТЕПЕНИ БЛАНШИРОВАНИЯ НА КАЧЕСТВО МОРОЖЕНОЙ ГОВЯДИНЫ В ЛОМТИКАХ И "ПАТТИ"

МАГНУС ДЕГЕРСКУГ, БАРБРУ КАРЛСТРЕМ и НИЛЬС БЕНГТССОН

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Промышленная бланшировка мороженых мясных продуктов позволяет расширить рынок этих продуктов в потребительской сети и на предприятиях общественного питания. При жарке мяса предпочтительно иметь предварительно обжареный продукт, что позволит использовать для подогрева печи УВУ и конвекционные печи.

Предмет нашего изучения состоял в определении влияния на качество и выход готового продукта /после вторичного подогрева до полной прожарки/ степени обжаривания на противне перед замораживанием. Для говядины в ломтиках толщиной 15 мм дегустационные качества и выход постепенно понижались с увеличением степени бланшировки; условия предварительной обработки: сырое мясо и обжаривание до температур в центре +10°, +40° и +70°. Это действительно также в отношении выхода для "патти" толщиной 10 мм. Следует заметить однако, что с точки зрения дегустационных свойств предпочтительно обжаривание с получением легкой корки как на сырых, так и на полностью бланшированных продуктах.

Вероятным объяснением этого, очевидно, является совместное влияние окисления каталитического жира /через денатурированные гемопротеины/ и противокислительного эффекта, вызываемого образованием на поверхности корки мясных "патти" в процессе предварительного обжаривания.

INFLUENCE OF DEGREE OF PRECOOKING ON QUALITY OF FROZEN SLICED BEEF AND PATTIES

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INTRODUCTION

In Sweden, the use of industrially precooked and frozen foods is increasing both in catering services and in the home. For fried meats, a prebrowned product is often preferable because both convection ovens and microwave ovens may then be used for reconstitution or reheating, and because reheating may be limited to thawing or heating to eating temperature only. On the other hand, prebrowning prior to freezing, frozen storage and reheating may involve problems both with regard to yield and to sensory quality because of the repeated heating operation and the effects on product stability that prebrowning may cause.

For frozen meats, whether raw or precooked, fat oxidation and rancidity is often the limiting factor in storage. According to Tappel (1953), the molar activation energy for hemoglobine catalyzed fat oxidation is only 3.3 kcal compared to 15-20 kcal for common autoxidation. Particularly denaturated hemoproteins appear to have a strong catalytic effect (Tarladgis 1962, Eriksson et al. 1971 and Ledward, 1971). For this reason precooked meat products will suffer reduced stability (Younathan and Watts, 1959, Chang et al, 1961). On the other hand, Zipser et al.(1961)found that heat treatment to higher centre temperatures than normally used (70-80°C) resulted in improved stability against fat oxydation. According to Sato et al (1973), the browning reaction products found during heat treatment have even shown an inhibiting effect on fat oxidation.

In a preliminary investigation with sliced beef, Jakobsson (1972) compared three different degrees of precooking by pan frying (corresponding to rare, medium and well done) in combination with 3 months' frozen storage and reheating by pan frying to eating temperature and equal doneness. He found better sensory scores and higher total yield for the lowest degree of prebrowning. Temperature- and moisture profiles determined during reheating demonstrated higher temperature and lower moisture content in the surface layers with increased degree of prebrowning. The objective of the present study was to try and confirm the findings of Jakobsson and to extend the study to include both sliced beef and hamburgers for three different degrees of precooking, using raw, frozen meat as a reference.

MATERIALS AND METHODS

Raw material

For the experiments with sliced beef, both LD muscles from six 2-year old steers of Swedish SLB breed were used. Fat content in the muscles varied from 1 to 5% and water content from 72.5 to 77%. After ageing for 2 weeks at +3°C, the muscles were dissected and cut into sixteen 15 mm slices each, which were allocated to the different experimental variables and methods of analysis in a systematic manner. Hamburgers were made to the following recipe:

Beef	40%
Pork	39%
Soy protein	1.9%
Bread crumbs	3%
Water	15%
Spices, salt	1.1%

They were formed to 10 mm thickness, with a resulting water content of 63% and fat content of 18%.

All samples were stored frozen at -40°C for a short period of time until prebrowning, which was made after thawing at +5°C.

Heat treatment and storage

Browning or precooking was made in margarine on a carefully thermostated frying table, using the following temperature setting and frying times (based on preliminary experiments) to give the desired degrees of precooking.

Table 1. Frying times (50% each side) and temperature settings used for precooking

Centre temperature °C	Pan temperature °C	Frying time, minutes Sliced beef	Hamburgers
+10	195	1	0.7
+40	180	4	3
+70	180	8	6

The treatments correspond to "surface browning", "rare" and "well done", respectively. A higher pan temperature was used for the lowest degree of precooking in order to reach a desirable color while maintaining a low centre temperature.

All samples were blast frozen at -35°C, packed in pouches of Nylon-polyethylene laminate and stored at -20°C. Samples were taken out and thawed at +5°C prior to finish cooking after 1 week and 3 months' of frozen storage.

Temperature settings and times for finish cooking by pan frying are given in table 2. For the two highest degrees of precooking, finish cooking was made at a lower temperature setting in order to get very nearly the same degree of crust color for all samples. To avoid serious overcooking of the fully precooked variable, this was reheated to a final centre temperature of +60°C only.

Table 2. Frying times (50% each side) and temperature settings used for finish cooking

Degree of precooking	Pan temperature °C	Final centre temp. °C	Finish frying time, minutes Sliced beef	Hamburgers
Untreated (raw)	180	+70	8	6
surface browned	180	+70	8	6
rare	150	+70	6	8
well done	150	+60	5	7

Water content was determined from weight loss on freeze dehydration, and fat content by ether extraction by the SBR method.

TBA-analysis was made according to Tarladgis et al. (1960), expressing TBA-value as extinction at 530 nm/1000g fat.

Sensory analysis was carried out using a 9-degree rating scale for appearance, flavor, off flavor, juiciness and tenderness (for hamburgers texture) and a five member trained laboratory panel. The rating scale ranged from extremely good, strong, juicy, tender (soft) to extremely bad, none (off flavor), extremely dry, solid.

Samples were judged immediately after finish cooking and after warm holding at +75°C in closed aluminium trays for 2 hrs, corresponding to the common range of handling occurring in catering establishments.

RESULTS

The preliminary evaluations after 1 week of frozen storage (see fig. 1) showed an advantage in most sensory properties for hamburgers stored raw or only surface browned. The highest TBA-value was obtained for the fully precooked variable, but no clear correlation was observed between TBA-value and off-flavor score (see table 3).

For sliced beef, appearance was rated the lowest for the reference (stored raw), while no statistically significant differences were noted between the different degrees of pretreatment in other sensory properties. The lowest TBA-value and off flavor score were noted for the "raw" sample, while the fully precooked one was the highest in these respects (table 3).

The main evaluations, made after 3 months' of frozen storage, gave the following results:

Sliced beef

Results from the sensory evaluations are given in fig. 1 together with LSD-values (Least Significant Difference) at the 0.05 level as determined by analysis of variance. Significant differences were obtained in all sensory properties except appearance. After reheating or reconstitution to the same degree of final done-ness, the "raw" reference rated better than fully precooked both with regard to flavor, juiciness and tenderness. For tenderness it rated significantly better than the "surface browned" and "rare" as well. Except for appearance, a clear trend is seen in the direction of decreasing sensory quality with increasing degree of precooking.

Two hours of warm holding after reheating resulted in significantly reduced sensory quality and a leveling out of differences with regard to pretreatment.

Weight loss from the different treatment steps are given in table 4. Of particular interest are the accumulated losses before warm holding and the losses occurring during warm holding. The former increase and the later decrease with increasing degree of precooking.

TBA-values and off flavor scores are listed in table 3. No clear correlation between the two was observed. With warm holding off flavor increased, while TBA-value decreased. The highest TBA-value was obtained for the "raw" variable.

Hamburgers

Results from sensory evaluations are given in fig. 2 with LSD-values at the 0.05 level of

significance. Significant differences were obtained in all sensory quality aspects. The "surface browned" variable was judged better than "raw" in appearance, flavor and off flavor, and better than "well done" for flavor, off flavor, juiciness and texture. Also for the intermediate degree of precooking an advantage in flavor was obtained over the "raw" and "well done" variables. The "raw" variable was juicier than the "well done" and had a softer or looser texture.

Like for sliced beef, warm holding for 2 hrs significantly reduced sensory quality and tended to level out differences between precooking variables so that significant difference only remained in appearance.

Weight loss data are listed in table 4. Accumulated weight loss increases with the degree of precooking, and losses during warm holding show the reversed trend. The differences obtained in yield are due to differences in water loss and not in fat content.

TBA-values are listed in table 3 together with off flavor scores. The highest TBA-value was obtained for the "raw" pretreatment variable. The lowest TBA-values and off flavor scores were obtained for the two lower degrees of precooking. Warm holding for 2 hrs increased off flavor and raised TBA-values.

DISCUSSIONS AND CONCLUSIONS

In the heating experiments pan frying was used throughout, both for prebrowning and for reheating, since the objective was to investigate the influence of degree of precooking on final quality after finish cooking, with as few additional variables as possible.

For sliced beef sensory quality, after frozen storage and reheating to the same degree of final doneness, decreased with increasing degree of precooking. This is partly explained by the increasing total moisture loss which may be expected to influence juiciness and, perhaps indirectly, tenderness and flavor score. However, the fact that flavor scores decrease and off flavor scores increase with increasing degree of precooking only after frozen storage, may be taken as an indication of catalyzed oxidation through denaturated hemoproteins, in agreement with the findings by others previously cited, even if our TBA-values do not give any clearcut support. Raw frozen storage resulted in the best sensory quality but a higher TBA-value, for which we have no ready explanation.

For the hamburgers a general sensory advantage for "raw" and "surface browned" after 1 week's storage turned into an advantage for a low degree of precooking over both "raw" and fully precooked samples after 3 month's storage. Both TBA-values and off flavor scores were then the lowest for the two low degrees of precooking. For the hamburgers, with carbohydrates added to the recipe, considerably stronger frying crust and color was obtained as a result of maillard reactions between proteins and carbohydrates. According to Sato et al. (1973) and others, browning reaction products may have a strong antioxidative effect. This may explain why higher flavor scores were obtained for the lower degrees of prebrowning and not for the "raw" sample. The antioxidative effect of maillard reaction products would then be assumed to more than counteract the catalyzing effect from denaturated hemoproteins for partially fried samples, but not for the fully precooked one. For juiciness and texture no such "optimum" was found, and scores drop gradually with increasing degree of precooking at the same time as the accumulated total weight loss increases.

For sliced beef as well as for hamburgers warm holding after reconstitution lead to significantly lowered sensory quality and lower yield. At the same time warm holding tended to level out differences between the pretreatment variables.

It may be concluded from our investigation that sliced beef should preferably be frozen stored raw and not in the pre-fried condition. If a prebrowned product is required, the pretreatment should be light. For a minced hamburger recipe (with added carbohydrates), limited surface browning is to be preferred over both raw and more complete precooking for frozen storage. Warm holding after reheating should be kept as short as possible so as not to loose the advantage gained by proper pretreatment.

Litterature

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Table 3 TBA-values and off-flavor scores

for sliced beef and hamburgers precooked to different centre temperatures, after frozen storage and reconstitution.

			Degree of precooking			
			Raw	+10°C	+40°C	+70°C
SLICED BEEF	1 week	TBA	70.3	76.6	75.0	85.9
		Off flavor	1.9	2.6	2.4	2.4
	3 months		101.6	69.5	77.3	57.8
			1.3	1.6	2.1	2.9
	3 months 2 hrs warm holding		50.0	54.9	71.3	51.6
			3.9	4.5	3.8	3.7
HAMBURGERS	1 week		26.2	24.4	24.1	29.3
			1.9	1.4	2.5	2.4
	3 months		36.6	29.3	23.8	28.8
			3.0	1.5	1.8	2.9
	3 months 2 hrs warm holding		43.2	34.3	33.9	45.1
			3.2	2.8	3.2	3.4

Table 4. Weight loss for the different treatment steps for sliced beef and hamburgers

SLICED BEEF	Raw	+10°C	+40°C	+70°C	F-value	LSD 0.05 level
Precooking, %	--	3.2	14.6	24.7	189.8	1.10
Freezing & storage,%	1.4	2.4	3.4	3.8	106.2	0.15
Reheating,%	26.3	24.6	17.8	11.7	119.1	0.87
Accumulated loss,%	27.4	28.7	32.2	36.0	23.8	1.13
Warm holding 2 h, %	14.8	13.4	11.8	8.0	3.3	2.27
Accumulated total, %	37.9	38.0	39.7	40.4	7.2	0.67
HAMBURGERS						
Precooking, %	--	3.2	15.2	27.6	4008.7	0.27
Freezing & storage, %	1.3	1.1	2.0	2.4	47.4	0.12
Reheating, %	25.7	26.2	19.8	7.0	881.7	0.42
Accumulated loss, %	26.4	29.3	33.2	34.3	126.1	0.46
Warm holding 2 h, %	4.5	3.8	1.9	1.3	18.4	0.50
Accumulated total, %	29.1	31.7	34.9	35.0	33.4	0.71

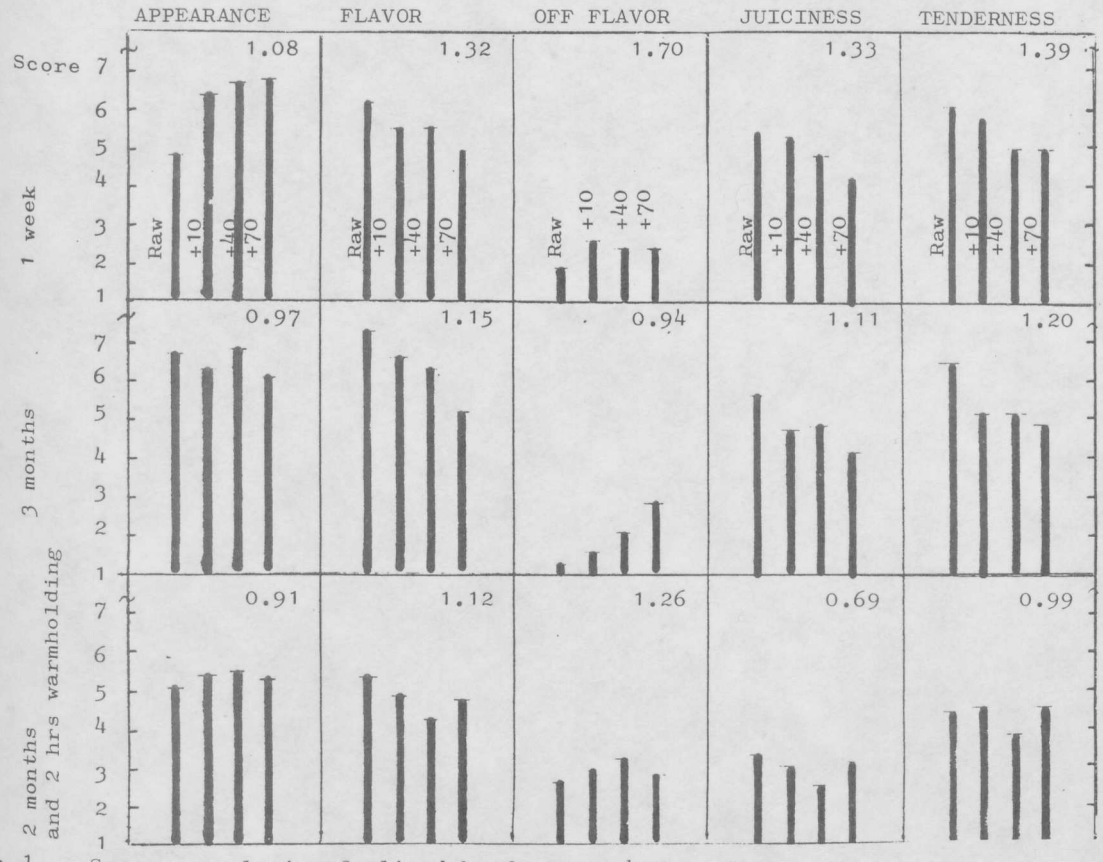

Fig. 1 Sensory analysis of sliced beef, precooked to different center temperatures after frozen storage and reconstitution. (LSD-values in top corners)

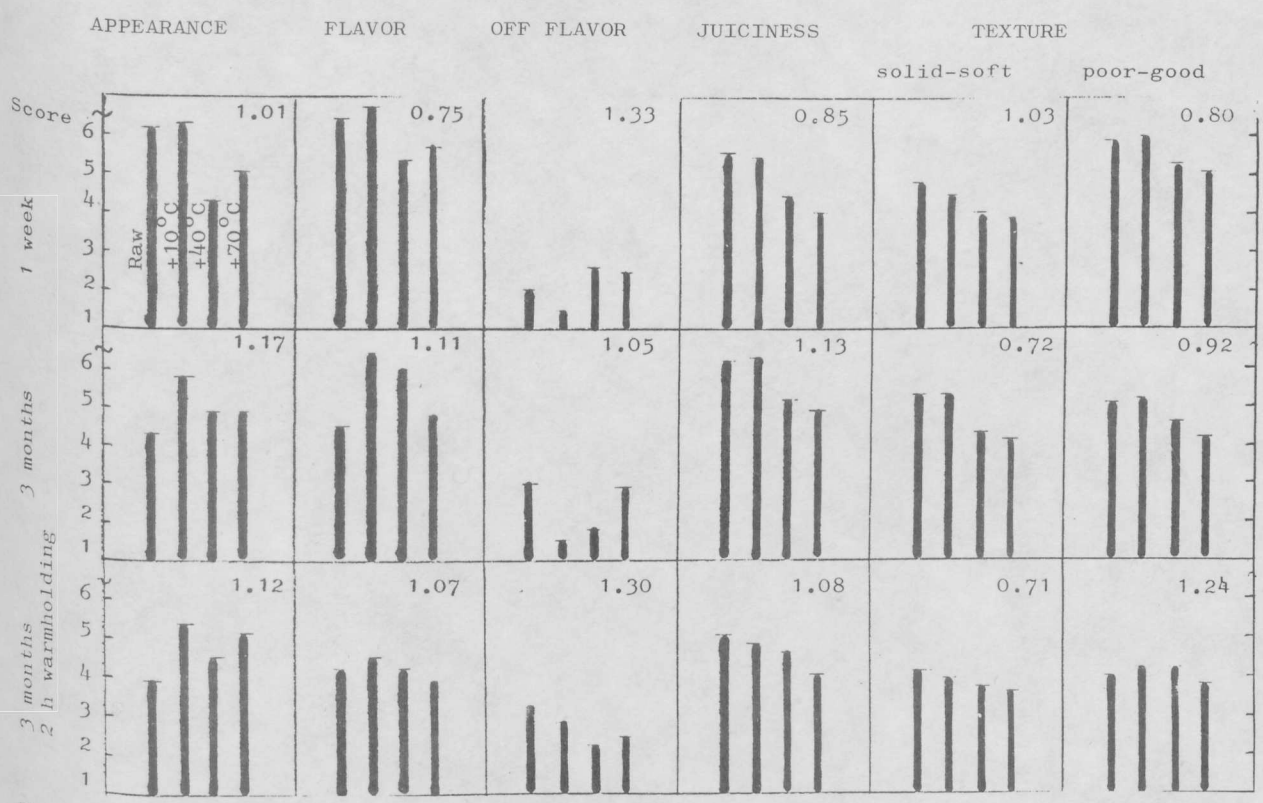

Fig. 2 Sensory analysis of hamburgers precooked to different centre temperatures after frozen storage and reconstitution. (LSD-values in top corners)