

Storage studies of restructured products from beef, mutton and turkey

(Kajian penyimpanan produk yang distruktur semula daripada daging lembu, kambing dan ayam belanda)

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Key words: restructured meat, storage study, shelf life, quality

Abstrak

Produk seakan-akan stik yang distruktur semula telah dihasilkan daripada potongan daging lembu dan kambing yang bermutu rendah serta daging ayam belanda tua. Produk tersebut dibungkus dalam beg laminat aluminium yang divakum dan disimpan pada suhu -20°C . Mutu deria dan warna produk ini masih boleh diterima selepas produk disimpan selama 12 bulan. Nilai kemerahan produk daging lembu menurun sedikit daripada nilai awal a^* 11.57 kepada 9.64, sementara nilai bagi daging kambing menurun lebih banyak iaitu daripada 18.00 kepada 8.92. Sebaliknya, nilai keputihan bagi stik ayam belanda tidak banyak berubah dengan nilai L^* berjulat antara 46.72 dan 49.55. Walaupun nilai asid tiobarbiturik bagi ketiga-tiga produk meningkat sejajar dengan tempoh simpan, tiada ulasan negatif diterima daripada panel penilai rasa. Jumlah kiraan hidup berada pada julat 10^6 cfu/g bagi produk daging lembu dan ayam belanda sepanjang tempoh simpan. Kiraan bagi produk daging kambing rendah sedikit iaitu 10^4 – 10^5 cfu/g. Tiada mikroorganisma utama yang boleh menjejaskan kesihatan awam dikesan dalam kesemua contoh. Pada keseluruhannya, kiraan mikrobiologi masih pada tahap yang boleh diterima pada akhir tempoh simpan.

Abstract

Restructured steak-like products were produced from low quality cuts of beef and mutton as well as spent turkey meat, vacuum packed in aluminium laminate bags and stored at -20°C . Organoleptic qualities and colour of these products were still acceptable after 12 months of storage. The redness value of the beef product decreased slightly from an initial a^* value of 11.57 to 9.64, while that for mutton showed a greater decrease from 18.00 to 8.92. On the other hand, the whiteness value of the turkey steak did not change much, with L^* values ranging from 46.72 to 49.55. Although the thiobarbituric acid value increased with storage time for all the three samples, there were no adverse comments from the taste panelists on any off-flavour. Total viable counts were in the range of 10^6 cfu/g for both the restructured beef and turkey products throughout the storage period while that for mutton product was slightly lower at 10^4 – 10^5 cfu/g. No organisms of public health significance were detected in all the samples. Overall the microbiological counts were still within the acceptable limits at the end of the storage period.

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Introduction

The value of cheaper meat cuts such as plate and brisket as well as dark poultry meat and meat from spent animals can be enhanced by converting the meat to value-added products such as restructured steak-like products. These products are made from broken-down meat through various means such as flaking and mincing, and reformed with a certain amount of pressure into different shapes and sizes with the incorporation of spices and flavours. Restructuring allows the processing of products with precise control of portion and composition to meet the specific needs and demands of consumers.

Meat and meat products are highly perishable commodities, unless properly packed and stored. Besides deterioration due to microbial growth, other adverse effects include colour changes and rancidity. These changes can, however, be slowed down by reducing the storage temperatures. Under frozen storage conditions, although microbial growth can be substantially reduced, colour changes and rancid flavour development can still continue at an undesirable pace, especially when salt and fat are present in the products. Packaging also plays a very important role, especially for products to be stored for extended periods. Exposure of the meat products to light not only affects the colour stability but also hastens the degree of lipid oxidation. The presence of oxygen has also been found to have adverse effects on lipid oxidation. Furthermore, during prolonged frozen storage, the products would also lose moisture unless properly packed. Thus by packing the meat products under vacuum in opaque laminated aluminium bags, the onset and the degree of both colour deterioration and rancid flavour as well as moisture loss will be reduced.

During frozen storage, the adverse effect of rancidity on restructured steak has been observed (Chu et al. 1988; Akamittath et al. 1990; Andersen and Skibsted 1991; Chen and Trout 1991). Studies have also

been conducted on the effect of adding various antioxidants to restructured steak (Crackel et al. 1988; Stoick et al. 1991; Swanson et al. 1994). Olsen and Terrell (1981) replaced salt with potassium chloride and magnesium chloride but found the resulting restructured beef steak to be inferior in flavour and texture to that made with the addition of sodium chloride.

This study was carried out to develop restructured steak from beef, mutton and turkey by reducing the salt content and with the addition of a binder. As light has been found to hasten rancidity development in meat (Andersen and Skibsted 1991), the study also evaluated the physical, chemical, microbiological and organoleptic qualities of the products, vacuum packed in opaque aluminium laminate bags.

Materials and methods

Preparation and storage of restructured steak-like products

Restructured steak-like products from beef, mutton and spent turkey (Chuah and Mohd. Yunus 1997) were produced (*Figure 1*). The products were vacuum packed separately in aluminium laminate bags. The bags were then stored at -20°C .

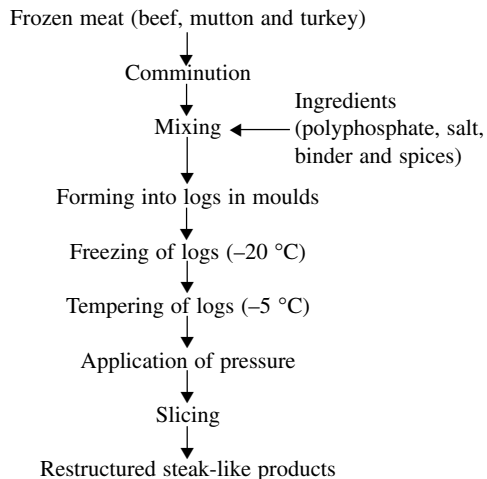


Figure 1. Production of restructured steak-like products from beef, mutton and turkey

Sampling

At monthly intervals, samples of the three products were randomly selected, removed from the freezer and thawed overnight at 4 °C. The samples were then evaluated for their physical, chemical and microbiological characteristics. Organoleptic evaluations were carried out to evaluate the acceptability of the grilled products, after the results of the microbiological evaluations obtained showed that the products were safe for consumption.

Colour

Surface colour intensity of the three types of restructured meat products during storage was measured after thawing, using a Minolta CR-300 series chroma meter. Readings were taken at four separate areas on the surface of each type of restructured steak and the average of the four readings recorded.

Chemical analysis

Frozen samples of the three types of restructured steaks were thawed as described earlier. These raw samples were analysed monthly for their fat content and thiobarbituric acid value up to 12 months of storage.

Fat content was analysed using the AOAC (1990) method while the thiobarbituric acid value by the distillation method of Egan et al. (1981).

Microbiological methods

Standard microbiological methods were used for the analysis of the samples (Brown and Baird-Parker 1982). Approximately 10 g of core samples which had been aseptically sampled, were blended with sterile quarter strength Ringer's solution for 2 min using a Stomacher Lab Blender 400. Appropriate serial dilutions were made as required. For detection of Salmonella, 25 g samples were used. The media and conditions of incubation used are shown in *Table 1*.

Cooking method

The restructured steaks were removed from the freezer, weighed and cooked directly over an electrically heated griddle which was adjusted to a temperature of 160 °C. Prior to grilling, the griddle was brushed with a thin layer of oil. A total grilling time of 12 min was given, i.e. 6 min for each side of the steak. The surface of the steak was then dabbed with tissue to remove any excess oil and the steak weighed again to determine the cooking loss.

Sensory evaluation

For organoleptic evaluations, the restructured steaks were cooked as described earlier. While still warm, the steaks were randomly presented to 10 taste panelists (Kramer et al. 1963; Lowe 1963) to evaluate the acceptability of the steak. The evaluation was made based on a 9-point hedonic scale

Table 1. Microbiological media used for the examination of restructured steak-like products

Microorganism	Media	Incubation
Mesophilic aerobes (TVC)	Plate count agar	30 °C, 3 days
Psychrotrophic aerobes (PSY)	Plate count agar	4 °C, 14 days
Coliforms	MacConkey's broth (MPN)	37 °C, 24 h & 48 h
<i>Escherichia coli</i>	MacConkey's broth (MPN) Tryptone water & Indole test	44.5 °C, 24 h & 48 h 44.5 °C, 48 h
Salmonella	Nutrient broth Tetrathionate & Selenite broth Brilliant green agar	37 °C, 24 h 37 °C, 24 h 37 °C, 24 h & 48 h
Staphylococcus	Salt meat broth Baird-Parker Agar	37 °C, 48 h 37 °C, 24 h & 48 h

of 1 to 9, with 9 being the highest score. Factors evaluated were cohesiveness, flavour, texture, juiciness, tenderness and overall acceptability.

Data were collected using a randomised complete block design (Cochran and Cox 1956). Sensory evaluation scores were assessed using a 9-point hedonic rating ranging from 1 (dislike extremely) to 9 (like extremely) (Larmond 1970). The sensory evaluation studies of the three products were carried out monthly over a period of 12 months. Mean values of the hedonic scale rating for each attribute during the storage period were evaluated using the PROC Means and SAS Package.

Results and discussion

Colour

Although there are several quality attributes of meat, colour is one of the most important criteria consumers look for when buying

meat and meat products. Although fresh beef and mutton are reddish, the colour of restructured steak-like products which include other ingredients such as soy protein isolate and spices, tend to lose some of the redness. There was, nevertheless, no adverse comments from the taste panelists although the redness value a^* had dropped slightly in both types of restructured products towards the end of the storage period (*Table 2*). Similarly, there were also negligible changes in the L^* value for the restructured turkey steak throughout the 12-month storage period. Negligible changes in the colour of these restructured steaks during the storage period could be attributed to the packaging and storage conditions as the products were vacuum packed in aluminium laminate bags and stored at $-20\text{ }^{\circ}\text{C}$. Miles et al. (1986) also found that there was a negligible change in the colour of restructured pork during storage when the product was

Table 2. Effect of storage on the overall colour score of restructured steak-like products from beef, mutton and turkey

Meat type	Storage period (months)	L^*	a^*	b^*
Beef	0	40.78 ± 0.70	11.57 ± 1.78	3.57 ± 0.43
	2	36.95 ± 1.06	13.98 ± 0.65	4.76 ± 0.99
	4	39.92 ± 1.51	10.57 ± 1.06	4.04 ± 0.52
	6	38.01 ± 3.16	11.41 ± 0.69	3.69 ± 1.17
	8	38.86 ± 1.80	11.70 ± 1.10	5.19 ± 0.32
	10	37.24 ± 2.75	11.12 ± 0.71	4.72 ± 0.63
	12	36.97 ± 1.76	9.64 ± 0.30	9.57 ± 0.62
Mutton	0	38.22 ± 1.25	18.00 ± 1.64	8.00 ± 0.56
	2	39.32 ± 1.40	13.36 ± 0.41	5.39 ± 1.10
	4	38.04 ± 0.97	12.77 ± 0.75	7.57 ± 0.88
	6	37.09 ± 1.00	11.50 ± 0.84	6.55 ± 0.56
	8	36.39 ± 0.81	10.67 ± 1.43	4.99 ± 0.85
	10	38.39 ± 1.25	9.19 ± 0.53	5.67 ± 0.81
	12	37.03 ± 1.37	8.92 ± 0.61	6.08 ± 0.27
Turkey	0	46.27 ± 2.06	6.71 ± 1.05	11.67 ± 1.02
	2	46.43 ± 1.11	5.99 ± 0.22	11.13 ± 0.82
	4	45.74 ± 1.46	4.53 ± 0.64	9.01 ± 0.94
	6	45.60 ± 0.87	5.01 ± 0.37	10.94 ± 0.56
	8	47.02 ± 1.30	4.82 ± 0.50	8.85 ± 0.66
	10	46.75 ± 1.37	4.38 ± 0.56	7.61 ± 0.89
	12	49.55 ± 0.17	4.60 ± 0.39	11.99 ± 0.84

*Mean values of four readings

Table 3. Proximate composition of restructured steak-like products from beef, mutton and turkey

Meat type	Protein (%)	Fat (%)	Moisture (%)	Ash (%)
Beef	20.92 ± 0.00	6.50 ± 0.02	72.99 ± 0.20	2.11 ± 0.05
Mutton	20.18 ± 0.32	6.27 ± 0.31	69.58 ± 0.32	2.15 ± 0.03
Turkey	19.04 ± 0.22	1.88 ± 0.30	70.87 ± 0.23	2.55 ± 0.01

vacuum packed and stored at low temperatures.

Formation of metmyoglobin during storage as a result of myoglobin oxidation would result in darker colour of the restructured products. However, according to Chu et al. (1988), vacuum packaging of the restructured steaks in air-tight barrier bags may be an effective method of reducing the rate of surface metmyoglobin formation during frozen storage. In this study, the restructured steaks were vacuum packed in aluminium laminate bags and this may have a positive effect on the colour as the taste panelists did not notice any significant change in colour.

Chemical analysis

The proximate compositions of the restructured steak-like products from beef, mutton and turkey are shown in *Table 3*. It can be seen that the product made from turkey had lower fat content than that of beef and mutton even though the contents of protein, moisture and ash did not differ very much.

Although the thiobarbituric acid (TBA) values of these restructured products were found to have increased substantially during frozen storage (*Table 4*), the taste panelists were unable to detect any off-flavour. The mean TBA values for restructured steak-like products from beef, mutton and turkey were 0.69 ± 0.25 , 1.00 ± 0.55 and 1.30 ± 0.54 mg malonaldehyde/kg respectively. Higher TBA values noted in the turkey samples were probably due to the use of thigh meat which contains twice the amount of lipid than the breast meat (Salih et al. 1989).

Akamittath et al. (1990) have found that, in comparison with beef, turkey had a

Table 4. Effect of storage on the thiobarbituric acid content of restructured steak-like products from beef, mutton and turkey

Storage period (months)	Thiobarbituric acid (mg malonaldehyde/kg)		
	Beef	Mutton	Turkey
0	0.35	0.90	0.44
1	0.46	0.33	0.58
2	0.81	0.66	0.70
3	0.43	0.42	1.08
4	0.92	0.36	1.09
5	0.58	0.84	1.10
6	0.70	0.59	1.37
7	0.70	0.95	1.47
8	0.80	1.54	1.84
9	0.64	1.58	1.95
10	0.39	1.84	1.50
11	0.94	1.59	1.95
12	1.19	1.62	2.04

greater proportion of unsaturated fatty acids which are more susceptible to lipid oxidation. Furthermore, Kanner et al. (1988) indicated that poultry meat (chicken and turkey) contains a significant amount of free catalytic iron which may be responsible for the susceptibility of the muscle tissues to lipid oxidation. The use of sodium tripolyphosphate (STPP) in the formulation could have helped to a certain extent in reducing the rancidity in the products. Lamkey et al. (1986) found that the addition of phosphate to restructured beef steaks reduces the rate of rancidity development. The study by Swanson et al. (1994) on frozen restructured reindeer steak showed that the use of an antioxidant system was not necessary as it would not be of much potential benefit.

Microbiological examination

Microbiological examination of the restructured steak-like products was carried out monthly over a period of 12 months. These results are the average of duplicate samples (Figure 2). Salmonella and staphylococcus were not detected in all the samples.

The initial mesophilic total viable count for the restructured beef sample was about 4.8×10^6 cfu/g. There was a sharp drop in counts within the first 2 months of storage, and continued to show a decreasing trend to 1.2×10^6 cfu/g after 12 months at -20°C . The psychrotrophic count showed a similar trend decreasing from 1.5×10^6 to 4.4×10^5 cfu/g. There were variations within the log cycle for the counts as can be expected for microbial counts. The counts for coliforms were less than 240 MPN/g throughout the storage period while *Escherichia coli* counts were negligible (varied from 0 to 4 MPN/g).

For the restructured mutton samples, the initial mesophilic total viable count was about 1.8×10^5 cfu/g. The value decreased to 8.3×10^4 cfu/g after 12 months. A similar trend was shown by the psychrotrophic count which decreased from 8.9×10^4 to 4.0×10^3 cfu/g. Again, there was a sharper drop within the first 2 months of storage, and variations within the log cycle for the rest of the storage period. Counts for coliforms were low, ranging from 1 to 92 MPN/g throughout the storage period, while *E. coli* was not detected.

In the case of restructured turkey, the initial mesophilic total viable count was about 1.8×10^6 cfu/g, decreasing to 1.0×10^6 cfu/g after 12 months. Over the same period, the psychrotrophic count decreased from an initial 2.5×10^4 to 1.0×10^3 cfu/g. Counts for coliforms were very low, ranging from 2 to 9 MPN/g through the storage period while *E. coli* counts were between 0 and 5 MPN/g.

For all three types of samples, the results showed similar trends, with counts decreasing over the storage period but more

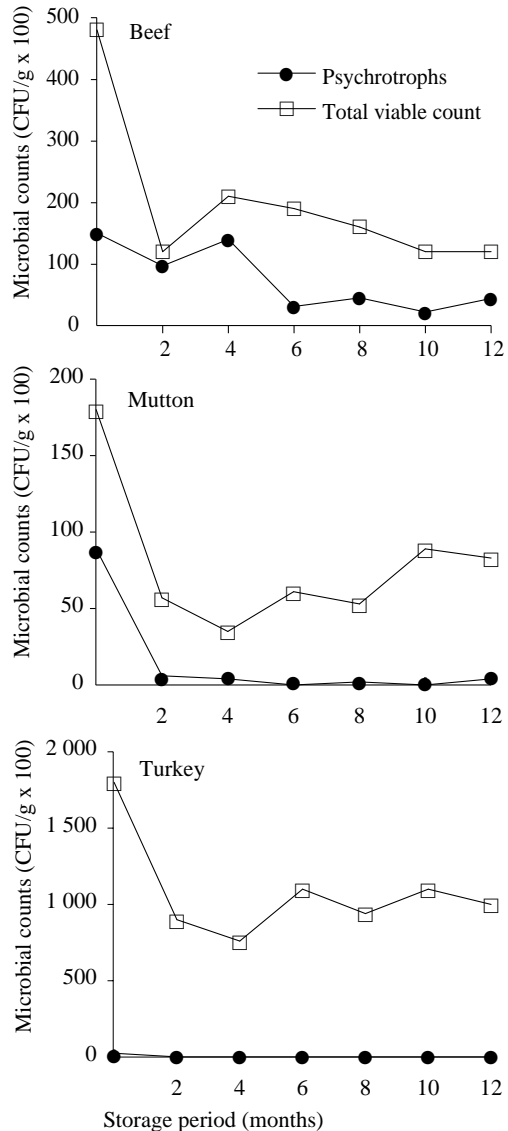


Figure 2. Microbial counts during frozen storage of restructured steak-like products from beef, mutton and turkey

sharply initially for both the mesophilic as well as the psychrotrophic counts. The counts in the three types of samples varied depending on the initial counts, which basically depend on the microbial quality of the raw materials used. The hygienic conditions of all the samples were good as salmonella and staphylococcus were not detected, and coliform and *E. coli* counts

were all quite low or not detected. Thus, it can be seen that all the samples were still microbiologically acceptable and safe after a storage period of 12 months at -20°C .

Organoleptic analysis

Results of the sensory evaluations showed that restructured steak-like products made from beef, mutton and turkey were still acceptable after 12 months of storage at -20°C . Mean values of sensory attributes of restructured steak-like products from beef, mutton and turkey are presented in *Table 5*. Mean values of the scaled hedonic rating on the beef product attributes are quite stable and invariant throughout the investigation. The numerical rating means lead to an imperative implication that the restructured steak-like beef product received moderate acceptance from the panelists.

For steak-like product from mutton, the means of hedonic rating scale indicate that the product received favourable acceptance from the panelists. The numerical ratings are stable while the variability is small. The results imply that the product was well accepted by the panelists. The numerical rating scales are stable for attributes of the steak-like product from turkey. The scores indicate that the product is highly acceptable to the panelists.

As the three products were vacuum packed and stored at -20°C , the rate of physical, chemical and microbiological changes during storage would be reduced. Furthermore, with the addition of STPP which not only helped to increase the water holding capacity of the products but also acted as an antioxidant, off-flavour due to rancidity is reduced. Akamittath et al. (1990) also found that sodium pyrophosphate were effective in inhibiting lipid oxidation in beef, pork and turkey restructured meat. A study conducted by Crackel et al. (1988) on restructured beef steaks indicated that if the TBA values fell within the range of 0.33–2.04, the correlation coefficients between sensory scores and TBA values would be generally low and non-significant.

As such, the results of this study indicate that there is a significant relationship between sensory scores and TBA as all TBA values fell within 0.33 and 2.04, as shown in *Table 4*.

Conclusion

This study showed that acceptable restructured steak-like products from low-value cuts of beef and mutton as well as meat from spent turkey can be produced. At the end of the storage period, the products were still acceptable and no off-flavour was detected if they were properly packed and stored. Thus based on the microbiological and other test results for the samples, it was found that the shelf life of the product under the packaging and storage conditions described above is at least 12 months.

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Table 5. Mean values of six sensory attributes of restructured steak-like product from beef, mutton and turkey

Storage period (months)	Cohesiveness	Flavour	Texture	Juiciness	Tenderness	Overall acceptability
Beef						
0	6.50 ± 0.27	6.30 ± 0.34	5.60 ± 0.31	5.50 ± 0.56	5.10 ± 0.55	5.60 ± 0.37
1	6.50 ± 0.40	6.80 ± 0.42	5.70 ± 0.50	5.90 ± 0.41	5.60 ± 0.45	6.10 ± 0.46
2	5.80 ± 0.55	5.70 ± 0.40	4.90 ± 0.38	4.50 ± 0.40	4.90 ± 0.43	4.80 ± 0.44
3	6.50 ± 0.17	6.50 ± 0.27	5.70 ± 0.26	5.80 ± 0.20	5.70 ± 0.30	6.00 ± 0.15
4	5.70 ± 0.30	6.30 ± 0.15	5.40 ± 0.31	5.50 ± 0.27	5.00 ± 0.30	5.80 ± 0.36
5	6.90 ± 0.35	6.70 ± 0.30	6.20 ± 0.29	6.00 ± 0.21	5.80 ± 0.29	6.30 ± 0.37
6	6.70 ± 0.30	6.70 ± 0.21	6.10 ± 0.35	5.70 ± 0.26	5.70 ± 0.21	6.40 ± 0.27
7	6.40 ± 0.27	6.40 ± 0.31	6.10 ± 0.38	5.90 ± 0.28	6.00 ± 0.52	6.10 ± 0.43
8	6.60 ± 0.17	6.00 ± 0.49	5.50 ± 0.43	5.40 ± 0.60	5.70 ± 0.52	5.80 ± 0.47
9	6.90 ± 0.28	6.60 ± 0.22	5.90 ± 0.43	5.90 ± 0.43	5.80 ± 0.42	5.90 ± 0.35
10	6.80 ± 0.25	6.20 ± 0.36	5.90 ± 0.43	5.90 ± 0.31	6.20 ± 0.36	6.40 ± 0.22
11	6.30 ± 0.34	6.30 ± 0.21	5.80 ± 0.42	6.00 ± 0.33	5.80 ± 0.42	6.20 ± 0.29
12	6.20 ± 0.33	6.60 ± 0.34	5.80 ± 0.36	5.60 ± 0.37	5.50 ± 0.34	6.00 ± 0.26
Mutton						
0	7.00 ± 0.26	6.90 ± 0.23	7.50 ± 0.17	6.90 ± 0.23	7.20 ± 0.25	7.10 ± 0.18
1	6.90 ± 0.23	7.20 ± 0.18	7.10 ± 0.13	6.40 ± 0.22	7.20 ± 0.20	7.10 ± 0.18
2	6.80 ± 0.13	6.80 ± 0.20	7.00 ± 0.15	6.30 ± 0.21	6.80 ± 0.21	6.80 ± 0.20
3	6.70 ± 0.33	6.50 ± 0.34	6.80 ± 0.25	6.00 ± 0.39	6.60 ± 0.40	6.40 ± 0.40
4	6.50 ± 0.17	6.70 ± 0.15	7.00 ± 0.26	6.60 ± 0.37	7.10 ± 0.28	6.90 ± 0.23
5	6.70 ± 0.30	7.00 ± 0.21	6.90 ± 0.23	6.60 ± 0.27	6.80 ± 0.25	7.00 ± 0.21
6	6.90 ± 0.18	7.00 ± 0.15	6.70 ± 0.15	6.30 ± 0.40	6.70 ± 0.26	6.80 ± 0.25
7	6.90 ± 0.18	6.90 ± 0.28	6.80 ± 0.25	6.40 ± 0.31	6.70 ± 0.40	6.50 ± 0.16
8	6.80 ± 0.25	7.00 ± 0.26	6.85 ± 0.21	6.70 ± 0.21	6.95 ± 0.28	6.95 ± 0.24
9	7.10 ± 0.10	6.80 ± 0.20	6.80 ± 0.13	5.70 ± 0.37	6.60 ± 0.16	6.50 ± 0.17
10	6.80 ± 0.29	6.70 ± 0.37	6.70 ± 0.33	6.20 ± 0.33	6.50 ± 0.34	6.50 ± 0.37
11	7.20 ± 0.25	6.70 ± 0.33	7.00 ± 0.26	6.70 ± 0.42	7.20 ± 0.25	7.05 ± 0.16
12	6.60 ± 0.31	6.50 ± 0.37	6.60 ± 0.31	6.20 ± 0.33	6.60 ± 0.31	6.60 ± 0.27
Turkey						
0	6.90 ± 0.23	7.30 ± 0.21	6.90 ± 0.28	6.50 ± 0.37	7.30 ± 0.26	7.00 ± 0.26
1	7.20 ± 0.20	7.20 ± 0.39	7.30 ± 0.26	7.40 ± 0.22	7.50 ± 0.43	7.40 ± 0.22
2	6.90 ± 0.23	7.10 ± 0.38	7.00 ± 0.21	6.80 ± 0.23	7.10 ± 0.38	7.20 ± 0.20
3	7.20 ± 0.20	7.20 ± 0.39	7.30 ± 0.21	6.70 ± 0.26	7.30 ± 0.15	7.00 ± 0.26
4	6.90 ± 0.28	6.70 ± 0.37	7.10 ± 0.28	6.50 ± 0.31	7.10 ± 0.28	7.00 ± 0.21
5	6.90 ± 0.18	7.20 ± 0.25	7.00 ± 0.21	7.00 ± 0.21	7.20 ± 0.20	7.30 ± 0.21
6	7.00 ± 0.21	7.40 ± 0.16	7.40 ± 0.16	6.90 ± 0.23	7.10 ± 0.18	7.30 ± 0.15
7	7.10 ± 0.31	7.40 ± 0.22	7.30 ± 0.26	6.80 ± 0.25	7.10 ± 0.35	7.25 ± 0.25
8	7.10 ± 0.23	7.00 ± 0.15	7.10 ± 0.18	6.60 ± 0.16	6.90 ± 0.23	7.00 ± 0.15
9	6.90 ± 0.23	6.70 ± 0.26	7.20 ± 0.20	6.70 ± 0.26	7.10 ± 0.23	7.10 ± 0.18
10	7.20 ± 0.20	6.90 ± 0.18	6.80 ± 0.42	6.80 ± 0.25	7.20 ± 0.20	6.90 ± 0.18
11	6.70 ± 0.21	7.00 ± 0.21	7.20 ± 0.20	6.80 ± 0.33	7.00 ± 0.21	7.00 ± 0.21
12	7.30 ± 0.15	7.10 ± 0.28	7.30 ± 0.21	7.30 ± 0.21	7.50 ± 0.17	7.25 ± 0.23

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