Characteristics of duck eggs and the quality of duck eggs products

Eigenschaften von Enteneiern und die Qualität von Enteneiprodukten

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Introduction
Duck eggs are being commercially produced and consumed commonly in the Far East countries. In Poland the consumption of duck eggs has not been officially prohibited, however, they are often suspected to be contaminated with pathogenic microbial strains, among other of the Salmonella genus, more frequently than the hen eggs. This traditional opinion has to be revised since laying ducks are housed in confinement on deep litter and not on free range (Niewiarowicz, 1991).

In a study conducted at the Poultry Research and Development Centre in Poznań (Poland) in the years 1986–1989 no Salmonella were found on the shell of 960 duck eggs from 27 parent farms. On the other hand other bacteria detected on the surface of the duck egg shell were found close to those found on the shell of hen eggs (Wos, 1989). Similar investigations carried out at the Regional Veterinary Hygiene Station in Poznań on 1500 duck eggs from various commercial farms revealed that Salmonella were found on two duck egg shells only.

Those findings are in agreement with the results of earlier study conducted by Baker et al. (1985) on the frequency of Salmonella occurrence in duck eggs in the period 1982–1983. The authors examined the microflora on the shell and in the content of 544 duck eggs washed and non-washed, delivered from breeding farms. Only among the non-washed eggs from two farms the occurrence of S. enteritis and S. hadar was found on the surface of the egg shell. The authors concluded that the contamination of duck eggs with pathogenic microorganisms poses no problem and may be minimised by adequate hygienic conditions on the duck farm. They also suggested that cleaning and disinfection of eggs can eliminate their contamination with Salmonella.

Trongpanich and Dawson (1974) did research on bacterial counts of duck eggs from one commercial farm but did not find Salmonella. Joyce and Chaplin (1978) reported that duck eggs collected from nest boxes had lower surface contamination than floor eggs.

Since duck eggs have been found to be not contaminated more than commercial hen eggs they might be allowed for human consumption.

Characteristics of macrostructure, chemical and aminoacid composition

The weight of the Peking duck eggs is 20–30 percent higher than that of the hen eggs. In the case of eggs of the Khaki Campbell ducks the weight differences are markedly lower. Shell thickness and shell percentage content were higher in the duck eggs but shell strength, as measured by the non-destructive egg deformation was better in the hen eggs (Niewiarowicz et al., 1989a).

The egg yolk content in the whole egg and in the egg content only of both Peking and Khaki Campbell ducks is higher than of the hen egg. Both the whole egg content and the egg white in the duck egg contain around 1 percent protein more than those in the hen egg. Moreover the fat content in the duck egg is 2.5 percent higher than that in the hen egg. For this reason the water content in the duck egg is lower than that in the hen egg (Tab. 1).

The composition of the egg white proteins in the duck and hen eggs is different (Osuga and Feeney, 1977). This pertains particularly to a lower content of ovalbumin, conalbumin, lysozyme and ovoflavoprotein in the duck egg. Rhodes and Feeney (1957) reported that water added to the duck egg white makes it not opaque as it is in the case of hen egg white. Hen egg lysozyme added to the duck egg white prior to its dilution with water makes it opaque similarly as it is in the hen egg white.

The content of the exogenous and relatively exogenous amino acids in the duck and hen egg yolk is around 2 percent higher than in the egg white of those eggs. Both egg white and egg yolk in the duck egg contains circa 3 percent more those amino acids than egg yolk and white of the hen egg. Duck egg white contains by about 50 percent phenylalanine, by about 30 percent methionine and by about 24 percent threonine more than that of the hen egg.

However, the content of arginine is by about 20 percent and of isoleucine by around 23 percent lower in the duck egg white. Duck egg yolk protein contains by 22 percent methionine and by 13 percent lysine more than that of the hen egg (Niewiarowicz, 1991).

Hagenmaier (1975) found in the duck egg white by 60 percent methionine, by 30 percent threonine, by 25 percent tryptophan and by 45 percent sulphur amino acids more than in the hen egg. The author suggests that the duck egg may be a good source of those amino acids.
Storage stability

Rhodes et al. (1960) studying storage stability of the Khaki Campbell duck eggs confirmed the earlier findings concerning the Peking duck eggs that their storage stability was better than that of the hen eggs. The authors kept duck eggs at 37 °C for 7 days and found only slight changes in the egg white and yolk indices and yolk height in comparison with those in eggs kept under refrigeration. In the hen eggs the changes were more noticeable. Duck and hen eggs stored under refrigeration for 105 days demonstrated only marginal changes in the yolk height and Haugh unit values. The authors found no differences in the quality traits of scrambled egg prepared from those eggs after three months refrigerated storage (Tab. 2).

Weight losses during storage of eggs at 12 °C for 10 weeks were lower in the duck than in the hen eggs (Fig. 1). These differences were even larger after storage of eggs at 26 °C for 5 weeks (Niewiarowicz et al., 1989b). The pH values of albumen increased with the length of storage time (Fig. 2).

Storage stability of eggs measured by Haugh units was also better in the duck than in the hen eggs (Fig. 3). In the duck eggs kept at 12 °C the quality grade A (according to the USA Standard 110-72 Hu) was maintained for 20 days, and the grade B for 35 days. The hen eggs met the requirements of grade A for 14 days and of grade B for 21 days. During storage at the temperature of 26 °C the duck eggs maintained grade A quality for 16 days and the hen eggs only for 5 days (Niewiarowicz et al., 1989). Liquefaction of the dense egg white and weakening of vitelline membrane is occurring markedly slower in the duck than in the hen egg.

Functional properties

Foaming ability

Rhodes et al. (1960) reported lower foaming ability in the duck egg (Khaki Campbell) in comparison with hen egg white. This trait can be considerably improved by acidification of the egg white to pH 5.0–5.5. In this way the whipping time could be markedly reduced, however, it was slightly longer for the hen eggs white.

Niewiarowicz et al. (1989b) and Kijowska et al. (1989) demonstrated, that the maximal foam volume of the Peking duck eggs was smaller than that of the hen eggs (Fig. 4). To reach the maximally possible foam volume, the duck egg white has to be whipped from 3 to 5 minutes longer than that of the hen egg. On the contrary, the foam stability of the duck egg white was found better than that of the hen egg white, particularly in the case of foam made from eggs stored at 26 °C. Foam stability was better in fresh eggs and was decreasing with storage time both in the duck and hen eggs (Fig. 5).

Emulsifying capacity

It was found that the emulsifying capacity of the duck egg albumen was higher than that of the hen (Fig. 6). However, it resulted from a higher protein content in the duck egg white. In the case of liquid whole egg the emulsifying capacity was higher in the hen egg. Thermal stability of emulsion was higher for hen egg white, but for the whole egg it was found higher for the duck egg (Niewiarowicz et al., 1989c; 1990). The viscosity of white and yolk in the duck egg was two times higher than that in the hen egg.

Thermal gel formation

The coagulation temperature of duck egg (Khaki Campbell) white was found to be slightly lower than for chicken egg white (Rhodes et al., 1960). Both duck (Peking) and hen egg

Table 1. Comparison of duck and hen eggs

<table>
<thead>
<tr>
<th>Characteristics of macrostructure</th>
<th>Duck eggs compared to hen eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell thickness</td>
<td>higher</td>
</tr>
<tr>
<td>Shell strength</td>
<td>lower</td>
</tr>
<tr>
<td>Shell percentage</td>
<td>higher</td>
</tr>
<tr>
<td>White percentage</td>
<td>lower</td>
</tr>
<tr>
<td>Yolk percentage</td>
<td>higher</td>
</tr>
<tr>
<td>Water content</td>
<td>lower</td>
</tr>
<tr>
<td>Protein content</td>
<td>about 1% more</td>
</tr>
<tr>
<td>Fat content</td>
<td>about 2.5% more</td>
</tr>
<tr>
<td>White protein composition</td>
<td>different</td>
</tr>
<tr>
<td>Ovoalbumin, conalbumin, lysozyme, ovoflavoprotein</td>
<td>lower</td>
</tr>
<tr>
<td>Exogenous and relatively exogenous amino acids</td>
<td>about 3% more in white</td>
</tr>
<tr>
<td>White threonine, sulphur amino acids, arginine</td>
<td>much more</td>
</tr>
<tr>
<td>Yolk methionine, lysine</td>
<td>much less</td>
</tr>
</tbody>
</table>

Table 2. Quality changes of duck and hen eggs storage

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Species</th>
<th>Storage conditions</th>
<th>Results</th>
<th>Indices</th>
<th>Yolk height (mm)</th>
<th>Haugh units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Temperature (°C)</td>
<td>Time (days)</td>
<td>pH of white</td>
<td>White</td>
<td>Yolk</td>
</tr>
<tr>
<td>A</td>
<td>Duck</td>
<td>2</td>
<td>7</td>
<td>9.0</td>
<td>0.10</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>Hen</td>
<td>2</td>
<td>7</td>
<td>9.0</td>
<td>0.07</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>Duck</td>
<td>37</td>
<td>7</td>
<td>9.3</td>
<td>0.09</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td>Hen</td>
<td>37</td>
<td>7</td>
<td>9.4</td>
<td>0.03</td>
<td>0.17</td>
</tr>
<tr>
<td>B</td>
<td>Duck</td>
<td>2</td>
<td>105</td>
<td>9.0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Hen</td>
<td>2</td>
<td>105</td>
<td>8.9</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

(Rhodes et al., 1960)

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Fig. 1. Weight losses of duck and hen eggs stored at different temperatures (NIEWIAROWICZ et al., 1989b)

Gewichtsverluste bei Lagerung von Enten- und Hühnereiern unter verschiedenen Temperaturen

Fig. 2. Albumen pH of duck and hen eggs stored at different temperatures (NIEWIAROWICZ et al., 1989b)

Eiklar von Enten- und Hühnereiern bei verschiedenen Lagertemperaturen

Fig. 3. Haugh units of duck and hen eggs stored at different temperatures (NIEWIAROWICZ et al., 1988)

Haugh-Einheiten von Enten- und Hühnereiern bei verschiedenen Lagertemperaturen

Fig. 4. Foamability of duck and hen eggs stored at different temperatures (NIEWIAROWICZ et al., 1989b)

Schaumbildung von Enten- und Hühnereiern bei verschiedenen Lagertemperaturen
Fig. 5. Foam stability of duck and hen eggs stored at different temperatures (Niewiarowicz et al., 1989b)
Schaumfestigkeit von Enten- und Hühnereiern bei verschiedenen Lagertemperaturen

Fig. 6. Emulsifying properties of duck and hen eggs white and whole egg (Niewiarowicz et al., 1990)
Emulsionsfähigkeit von Enten- und Hühner-Eiklar und -Vollei

Fig. 7. Hardness of gels obtained from duck and hen eggs at different heating temperatures (Niewiarowicz et al., 1990)
Gelstabilität von Enten- und Hühnereiern bei verschiedenen Erhitzungstemperaturen

Fig. 8. Cohesiveness of gels obtained from duck and hen eggs at different heating temperatures (Niewiarowicz et al., 1990)
Gelhaltbarkeit von Enten- und Hühnereiern bei verschiedenen Erhitzungstemperaturen
white starts coagulating already at 62 °C but gels adequate for instrumental evaluation of mechanical properties were formed at higher temperatures. Resistant gels of duck albumen were obtained at 67.5 °C, while those of hen at 75.0 °C (KIJOWSKI; et al., 1989; NIEWIAROWICZ et al., 1990b).

Gels from duck eggs were more firm than those of hen eggs at the same temperature and heating time (Fig. 7). Gels from albumen of duck eggs reached maximum hardness at temperature 80 °C, and from albumen of hen eggs at temperature 85 °C (NIEWIAROWICZ et al., 1990b). Gels from duck eggs white showed better cohesiveness than gels from hen eggs (Fig. 8). Duck egg gels formed from albumen and whole eggs were characterized by higher water binding than hen egg gels in temperatures from 75 °C to 85 °C (Fig. 9).

**Utilization of duck eggs as human food**

*Boiled, scrambled, poached and fried eggs*

Fresh duck and chicken eggs were compared as soft boiled, hard boiled, scrambled, poached and fried. These comparisons were made by laboratory workers and families of the University staff (RHODES et al., 1960). The characteristics which were considered favourable to duck eggs (Khaki Campbell) were (Tab. 3):

- greater stability to deterioration,
- less pronounced chalaza,
- reduced darkening around the yolks of boiled eggs,
- the reduced sulphur odour,
- the lack of yellow colour in the white.

Only slight or no differences were found in the flavour of the duck and of the hen eggs regardless of how they were prepared. Several individuals did report slightly less flavour for the duck eggs, but no one objected to the flavour. Little or no difference was observed in the colour of the yolks of the duck and hen eggs.

Duck eggs had a “firmer” egg white, which was easily noted when eggs were prepared by methods other than scrambling. This firmness was objectionable to some individuals who stated that the whites were “tough”. Other characteristics which were considered to be somewhat unfavourable to duck eggs were:

- tougher shell membrane,
- large chalaziferous layer around the yolk (making separation difficult),
- lower coagulation temperature of the white, which may hinder the cooking of the yolk,
- less pleasing shell appearance.

The sensory evaluation of the hard-boiled Peking duck and “Astra S” hen eggs revealed no flavour differences between both kinds of products. The hard-boiled duck eggs demonstrated appreciably whiter colour of the egg white than that of the hen eggs. The latter ones exhibited a grey-green-yellow tint of the white caused by its higher riboflavin content (NIEWIAROWICZ et al., 1989c).

**Pickled eggs**

An increasing interest has been shown by the food industry in the use of hard-boiled eggs for the production of various food products, e.g. a part of the hen eggs is being prepared as pickled eggs. In the professional literature numerous reports may be found on the pickling conditions and changes during the pickling procedure of the hen eggs. PIKUL and CEGIELSKA-RADZIEJSKA (1993) described pickling conditions and made quality evaluation of pickled Pekin duck eggs. A parallel study was conducted on the pickled “Astra S” hen eggs and comparative quality evaluation of both duck and hen pickled eggs was made (PIKUL and CEGIELSKA-RADZIEJSKA, 1992). No differences were observed in the preparation of fresh duck and hen eggs prior to pickling except 5 minutes longer cooking time of the duck eggs. The initial pH value of the acetic pickling solution has to be dependent on the pH value of whites and yolk of eggs to be pickled. The rate of pH reduction in the egg white and yolk during the pickling period was similar in the duck and hen eggs (Fig. 10).

After one week pickling time the eggs were ready to eat and marketing. The concentration of the table salt in the pickling liquid and in the egg white was the same (1.3–1.4 perc.

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**Table 3. Properties of duck eggs**

<table>
<thead>
<tr>
<th>Character</th>
<th>Duck eggs compared to hen eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stability on storage</td>
<td>much greater</td>
</tr>
<tr>
<td>Chalaza</td>
<td>less evident</td>
</tr>
<tr>
<td>Darkening around yolks in boiled</td>
<td>much less</td>
</tr>
<tr>
<td>eggs</td>
<td>much less</td>
</tr>
<tr>
<td>Sulfur odor in boiled eggs or pouched eggs</td>
<td>colorless</td>
</tr>
<tr>
<td>Color of uncooked white</td>
<td>same</td>
</tr>
<tr>
<td>Color of yolk</td>
<td>same</td>
</tr>
<tr>
<td>Flavor of cooked material</td>
<td>more</td>
</tr>
<tr>
<td>Firmness of cooked white</td>
<td>tougher</td>
</tr>
<tr>
<td>Shell membrane</td>
<td>lower</td>
</tr>
<tr>
<td>Coagulation temperature of white</td>
<td>less pleasing</td>
</tr>
</tbody>
</table>

(RHODES et al., 1960)
cent) but in the egg yolk it was 1.6 times lower regardless of the kind of egg. During pickling and subsequent storage of eggs the dry matter in the egg white increased and in the yolk decreased. The trend of these changes was similar in the duck and hen eggs, however, the absolute values were higher in the duck eggs. Weight losses during pickling and storage of eggs were lower in the duck eggs and after 24 h, 4 weeks and 8 weeks were 0.8, 1.6 and 1.2 percent less than in the hen eggs, respectively (Fig. 11).

A considerable increase of egg white firmness occurs during pickling which is more pronounced in the duck eggs (Fig. 12). This has been confirmed by instrumental and sensory evaluation, and in the latter around 35 percent of the individuals regarded the pickled duck egg white as too firm. However, the texture of pickled duck egg white can be very convenient taking into account the possibility of thin slicing or cubing the eggs with the sharp edges maintained.

The taste and aroma of the pickled eggs is slightly sour, typical for that kind of product, and the same in the pickled duck and hen eggs without the flavour characteristic for freshly boiled eggs. The snow-white colour of the pickled egg white, is identical in the duck and hen eggs despite the fact that the colour of the duck egg white just after cooking is "whiter" (Tab. 4). There are no differences in the yolk colour between the pickled duck and hen eggs (PIKUL and CEGIELSKA-RADZIEJWSKA, 1992, 1993).

Archiv für Geflügelkunde 2/1998
After two months storage of the pickled eggs the total bacteria count is dependent on the initial microbial level and associated with the growth of halophiles. Salmonella, Staphylococci and anaerobic sporeforming bacilli were not found both in the cooked as well as in the pickled duck and hen eggs (Tab. 5).

**Mayonnaise**

Niewiarowicz et al. (1988; 1990a) assessed the usefulness of the duck eggs for mayonnaise production. Model mayonnaises were prepared according to the recipe of Froming et al. (1986): with egg yolk, liquid whole egg or egg white of the duck and hen eggs. The other ingredients were: vinegar, salt, sugar, mustard and rapeseed oil. The experimental results indicated, the highest mayonnaise viscosity in the following order resulting from the main ingredient: egg yolk; liquid whole egg; egg white (Tab. 6). The viscosity of mayonnaise made from duck egg yolk was by 38% percent higher than that of the hen egg yolk. On the other hand the viscosity of mayonnaise of the duck whole egg was by 25 percent lower than that of the hen whole egg. No viscosity differences were found between mayonnaise made from duck and hen egg white (Tab. 7).

The evaluation of mayonnaise stability after 5 days storage at 20°C measured by the degree of emulsion breaking showed a higher stability of emulsion made from the hen egg yolk (Fig. 13). The study demonstrated the possibility of mayonnaise manufacture from liquid whole egg and from duck and hen egg white. By the use of stabilising additives, a low-cholesterol or non-cholesterol mayonnaise can be produced from both duck and hen eggs.

**Confectionary products**

Duck egg yolk (Khaki Campbell) were found to be essentially equivalent to hen egg yolks when used in making sponge cakes. However the whipping characteristics of the duck egg white were found to be very poor compared to hen egg white (Rhodes et al., 1960).

The above findings were confirmed in the study on the use of Peking duck egg in the manufacture of sponge cake (Niewiarowicz et al., 1989). The liquid whole duck egg with sugar added was whipped 5 minutes longer to obtain the volume
similar to that from the liquid whole hen egg. During whipping, the liquid egg was heated to 55°C. Sensory evaluation of the sponge cake demonstrated that its texture (sponginess) in the duck egg cake was slightly less acceptable than that of the hen egg cake. The cake height was 6.0 cm of the former and 6.3 cm of the latter. The colour was white-yellow in the duck egg cake and golden-yellow in the hen egg cake. The taste and aroma of both kinds of sponge-cake were similar and evaluated as good.

The whipping properties and the angel-cake-baking characteristics were greatly improved by acidification of the duck egg white (Rhodes et al., 1960; Niewiarowicz et al., 1989). The whipping time was greatly reduced by acidification but was still longer then for the hen egg white.

Angel cakes prepared with duck egg white using the above modification compared favourable in taste and texture to those prepared with hen egg white and had only slightly less volume. No differences were noticed in the taste and aroma of the angel-cake prepared with the duck and hen egg white of various degree of acidification.

The cakes made with duck egg whites were noticeable whiter than those made with hen egg white because of the almost complete absence of riboflavin in the duck egg white. This characteristic is desirable since the consumer expects a white colour in the angel-cake. The experimental results indicate that the duck egg white may be used for the manufacture of angel-cake of slightly less sponginess and greater hardness but a whiter colour.

**Poultry meat products with eggs added**

**Cooked sausages**

The earlier study (Niewiarowicz et al., 1989d) on the use of hen eggs in the production of comminuted cooked sausages with added mechanically deboned poultry meat (MDPM) at the level of 12 percent demonstrated that the maximum amount of added egg white or liquid whole egg in the raw material may be at the level of 20 and 15 percent, respectively. Higher amount of eggs affects unfavourably the sensory properties of the finished product. With the increasing content of hen egg white or liquid whole egg the only characteristic which changes is an increase of colour brightness "L" and a decrease of the "a" value, compared with the sausage without added egg.

Niewiarowicz et al. (1989c) used liquid whole egg and egg white of the Peking ducks in the production of cooked poultry meat sausage. To obtain a product of similar chemical composition (52–55 percent water; 11–12 percent protein and 29–32 percent fat), in the case of added liquid whole egg, the percentage of porcine fat and spent hen meat had to be reduced and that of the added water increased. The measurements by instrumental methods revealed a 20 percent higher hardness and elasticity in the sausages with added duck egg white, compared with those with added hen egg white. The observed differences were smaller in the sausages with added liquid whole egg. Sausages having added egg white only demonstrated higher hardness than those with added liquid whole egg, regardless of the kind of eggs used.

The hardness of sausages increased with the storage time from 24 to 72 h (Fig. 14). No increase of colour brightness "L" was found in the sausages with added duck egg, compared with those with added hen egg (Fig. 15). No differences were also noticed in the "a" and "b" values between the sausages produced with added whites or liquid whole duck and hen egg. Sensory evaluation of sausage colour, hardness, juiciness, taste and aroma and overall acceptability after 24 and 72 h storage under refrigerated conditions demonstrated lower scores only in the case of juiciness of sausages with added duck liquid whole egg. However, the overall acceptability of sausages containing certain amount of duck eggs was evaluated slightly higher than that of sausages with added hen eggs (Fig. 15).

Taking into account the results of the instrumental and particularly of the sensory evaluation it has to be concluded that duck eggs – as egg white or liquid whole egg – may successfully be used instead of the hen eggs, in the manufacture on comminuted poultry meat sausages.

![Table 4. Comparison of pickled duck and hen eggs quality](https://example.com/table4)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Duck eggs compared to hen eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenderness</td>
<td>less acceptable</td>
</tr>
<tr>
<td>Texture</td>
<td>slightly less acceptable</td>
</tr>
<tr>
<td>Taste and aroma</td>
<td>same</td>
</tr>
<tr>
<td>Snow-white colour of albumin</td>
<td>same</td>
</tr>
<tr>
<td>Colour of yolk</td>
<td>same</td>
</tr>
</tbody>
</table>

(Niewiarowicz et al. 1992; 1993)

![Table 5. Total bacterial count and halophilic plate count of hard cooked and pickled duck and hen eggs***](https://example.com/table5)

<table>
<thead>
<tr>
<th>Bacterial variety</th>
<th>Kind of eggs</th>
<th>After cooking</th>
<th>Storage time (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Total bacterial count</td>
<td>Duck</td>
<td>$2 \times 10^4$</td>
<td>$3 \times 10^4$</td>
</tr>
<tr>
<td></td>
<td>Hen</td>
<td>$5 \times 10^3$</td>
<td>$7 \times 10^4$</td>
</tr>
<tr>
<td>Halophilic plate count</td>
<td>Duck</td>
<td>nd(</td>
<td>*)</td>
</tr>
<tr>
<td></td>
<td>Hen</td>
<td>nd</td>
<td>$2 \times 10^2$</td>
</tr>
</tbody>
</table>

*) bacterial count is expressed per 1 g of egg
***) nd – none detected

(Niewiarowicz et al., 1992)

![Table 6. Viscosity of macroscopic parts of duck and hen eggs](https://example.com/table6)

<table>
<thead>
<tr>
<th>Kind of eggs</th>
<th>Egg white</th>
<th>Yolk</th>
<th>Whole egg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duck</td>
<td>9.6</td>
<td>1497.7</td>
<td>14.5</td>
</tr>
<tr>
<td>Hen</td>
<td>4.3</td>
<td>692.0</td>
<td>8.8</td>
</tr>
</tbody>
</table>

(Niewiarowicz et al., 1992)

![Table 7. Viscosity of mayonnaise prepared from duck and hen white, yolk and whole egg](https://example.com/table7)

<table>
<thead>
<tr>
<th>Kind of eggs</th>
<th>Egg white</th>
<th>Yolk</th>
<th>Whole egg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duck</td>
<td>42.4</td>
<td>4063.6</td>
<td>625.2</td>
</tr>
<tr>
<td>Hen</td>
<td>44.7</td>
<td>2948.1</td>
<td>807.6</td>
</tr>
</tbody>
</table>

(Niewiarowicz et al., 1989)
Fig. 14. Hardness and cohesiveness of poultry sausage with duck or hen eggs added after 24 and 72 h of storage (Niewiarowicz et al., 1989c)
Härte und Kompaktheit von Geflügelwurst mit Enten- oder Hühner­eiern, beigegeben nach 24 und 72 Std. Lagerung

Fig. 15. Colour brightness and overall acceptability of poultry cooked sausages with duck or hen eggs added, after 24 and 72 h of storage (Niewiarowicz et al., 1989c)
Färbung und Akzeptabilität von Geflügelwürsten mit Enten- oder Hühnereiern, zugegeben nach 24 und 72 Std. Lagerung

Fig. 16. Hardness of minced meat balls with duck or hen eggs added, after 24 and 72 h of storage (Niewiarowicz et al., 1989c)
Härte von Fleischbällen mit Enten- oder Hühnereiern, zugegeben nach 24 und 72 Std. Lagerung

Fig. 17. Overall acceptability of minced meat balls with duck or hen eggs added, after 24 and 72 h of storage (Niewiarowicz 1989c)
Akzeptabilität von Fleischbällen mit Enten- oder Hühnereiern, zuge­geben nach 24 und 72 Std. Lagerung

Archiv für Geflügelkunde 2/1998
Deep-fat-fried or cooked minced meat balls

In the traditional recipe of this products the amount of hen egg – as egg white or liquid whole egg – is at about 5 percent. Experiments on increasing the content of hen eggs in the deep-fat-fried meat balls demonstrated that by replacing 50 percent broiler thigh meat with the mechanically deboned poultry meat it was possible to add up to 30 percent of egg white and up to 20 percent liquid whole egg without negative effects to the quality of the finished product (Niewiarowicz et al., 1988).

Niewiarowicz et al. (1989c) proposed later a recipe of deep-fat-fried or cooked meat balls with 20 percent content of duck egg white and liquid whole egg. The chemical composition of the finished product was as follows: water 67–72 percent, proteins 15–17 percent and fat 6–9 percent.

Instrumental examination revealed slightly higher hardness of meat balls with duck egg white than that with hen egg white. Product hardness was increasing with the refrigerated storage time from 24 to 72 h, regardless of the kind of eggs used. Similarly as in the case of sausages, a higher hardness was noticed in the meat balls with egg white than in those with liquid whole egg. The hardness of the deep-fat-fried meat balls was found higher than in those cooked in water (Fig. 16).

Sensory evaluation indicated that meat balls with added egg white obtained slightly higher scores than those with added liquid whole egg. No quality differences were found between the deep-fat fried meat balls and those cooked in water, both having duck or hen eggs added. Only the juiciness of the deep-fat fried meat balls obtained lower scores than that of the meat balls cooked in water. The results of sensory analysis of meat balls after 24 h refrigerated storage were close to the optimal values regardless of the kind of eggs used for their manufacture. Irrespective of the kind of egg (duck or hen) or its components (egg white or liquid whole egg) added, the quality of the meat balls was worsening with the extension of the refrigerated storage time. The undesirable changes of quality occurred at a slower rate in the deep-fat fried meat balls than those in the meat balls cooked in water (Fig. 17).

The experimental changes indicates that duck eggs may be used instead of hen eggs in the amounts up to 20 percent in the production of poultry meat balls, deep-fat fried or cooked in water.

Meat patties

In the manufacture of poultry meat patties usually some amount of hen eggs – as liquid whole egg, white or yolk – is being used as emulsifier of fats. Experiments on the optimum composition of meat patties containing various amounts of liquid whole egg or egg white, mechanically deboned poultry meat demonstrated that 20 to 30 percent of liquid whole hen egg or hen egg white may be used in the recipe without negative consequences to the finished product. When a high content of mechanically deboned poultry meat is in the recipe than the added ingredient of the liquid whole egg or egg white has to be reduced. The use of hen egg white only caused increased yield of the meat patties after thermal processing (Niewiarowicz et al., 1988).

Niewiarowicz et al. (1989c) proposed the usage of in the meat patties recipe around 30 percent of liquid whole duck egg or duck egg white and mechanically deboned poultry meat at the level up to 16 percent. The basic chemical composition of poultry meat patties with added liquid whole duck egg or duck egg white was as follows: water 56–58 percent; protein 11–12 percent and fat 23–25 percent.

No significant differences were found in the hardness, elasticity and cohesiveness of meat patties with 30 percent duck or hen eggs added, however, after 72 h refrigerated storage the highest hardness was noticed in the meat patties containing duck egg white. After that storage period the hardness of the product increases and the springiness decreases, being particularly appreciable in the meat patties with added duck egg white (Fig. 18).

All kinds of meat patties obtained very high scores during sensory evaluation, particularly after 72 h refrigerated storage (Fig. 19). No distinct quality differences were found in poultry meat patties with added liquid whole egg or egg white of

![Graph showing hardness and springiness of poultry meat patties with duck or hen eggs added.](image)

![Graph showing overall acceptability of poultry meat patties with duck or hen eggs added.](image)
ducks and hens. The findings indicate that the duck eggs may be an alternative ingredient in the recipe of meat patties, being used in it in the quantity of 30 percent.

Summary

In this review paper the possibility of duck egg utilization for human consumption is presented. Microbiological contamination, characteristics of macrostructure, chemical composition and storage life of duck eggs are reviewed. The functional properties, i.e. foaming ability, emulsifying and gel forming capacity of the duck and hen eggs are compared. The possibility of practical use of duck eggs as food is outlined. Ducks eggs cooked and pickled and other food products with duck egg added, e.g. mayonnaise, sponge cake, angel cake, and poultry meat products of considerable content of duck eggs, such as cooked sausages, fried minced meat balls and meat patties are characterized.

Zusammenfassung


Stichworte

Ente, Huhn, Ei, Zusammensetzung, Qualität, Funktionelle Eigenschaften, Produkte

References


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Archiv für Geflügelkunde 2/1998