Introduction

The major important factors influencing egg quality are egg storage time and conditions, strain and age of hen (Williams, 1992). Haugh unit (HU), albumen index (AI) and yolk index (YI) are at maximum when eggs are laid and their values decrease with increasing storage time (Silverisides and Villenueva, 1994; Silverisides and Scott, 2001; Tilki and Inal, 2004). After ovoposition the albumen pH value is between 7.6-7.9, during storage it rises to 9.7 (Powrie, 1973; Heath, 1977; French and Tullet, 1991; Tayar, 2005; Wong et al., 1996). The pH increases during storage due to carbon dioxide loss through the porous shell (Powrie, 1973; Heath, 1977; French and Tullet, 1991; Wong et al., 1996; Tayar, 2005). In general, eggshells are breathable material; therefore they allow moisture and carbon dioxide to permeate through the shell (Wong et al., 1996). The permeation may cause physical and chemical changes in albumen and yolk and also weight loss. The pores on eggshell are sealed with polysaccharides for reducing evaporation and escape of carbon dioxide. A recent research conducted by Tayar (2005) indicated that eggs may also become sour due to excessively preventing the loss of water and CO2 during increased storage time.

It is proven that some protection methods such as egg shell coating minimize deterioration in interior egg quality (Wong et al., 1996; Bhaie et al., 2003). The edible films, which are not detrimental to human health, have a barrier property against oxygen, carbon dioxide and humidity movement from eggs (Caner et al., 1998; Krocita and Dcmulder, 1997). Some conservation methods including oil coating (Hisil and Ortes, 1997), dipping in low temperature, freezing, high temperature and drying (Tayar, 2005) and also the coating of egg shell with chitosan, whey protein and shellac (Caner 2005) are used for protection of interior egg quality.

Propolis, having strong anti-bacterial, anti-fungal and anti-viral properties (Ghisalberti, 1979; Krell, 1996; Bankova et al., 2000), is a sticky gummy resinous substance with a strange odour which is collected by worker honeybees (Apis mellifera) from the young shoots and buds of certain trees and shrubs (Greenaway et al., 1990; Schmidt, 1997). Bees also use it to cover the inside of the hive and mix it with bees wax during the building of combs to protect the colony and larvae from pathogenic microorganisms such as Bacillus subtilis, B. alvei, Proteus vulgaris and P. galangin (Ghisalberti, 1979). In addition, propolis has considerable antibiotic effects on Salmonella, Staphylococcus aureus, P. vulgaris and Escherichia coli (Powers, 1964). Due to the anti-bacterial effects propolis is used for protection of various agricultural products during storage. For example, propolis has been used with alcohol on strawberry to inhibit Boytris cinerea pers development (Torre et al., 1990). In addition, Ozdemir et al., (2005) covered mandarin with propolis in order to prevent weight loss.

Since the egg shell coating limits water losses and gas diffusion through pores, it should be useful to coat table eggs shell with propolis extracts during storage. The aim of this study was to determine the effect of propolis coating of the shell on the interior quality of eggs.

Material and Methods

This study was carried out at laboratory conditions at the Department of Animal Science at Mustafa Kemal University (Turkey) in 2006. White-shelled fresh hen eggs were used in this study. Eggs were obtained from a local table eggs producer from 54 weeks old hens. After oviposition eggs were collected and brought to laboratory for coating with various dosages of propolis extract. The following treatments were included: (I) control without any treatment, (II) coating with ethyl alcohol, coating with (III) 5%, (IV) 8% and (V) 10% propolis extract in ethyl alcohol. Treated eggs were stored for four weeks at room temperature (25°C) and interior egg quality was determined every week. Weekly sixteen eggs were used for determination of albumen height, albumen length, albumen width, yolk width and albumen pH in each group.

Preparation of propolis solution

Propolis was collected from honey bees in Hatay and extracted according to the method suggested by Krell, (1996). A 5% propolis solution was prepared by mixing 1900 ml 70% ethanol and 100 g of propolis, a 8% propolis by mixing 1840 ml 70% ethanol and 160 g of propolis, and a 10% propolis were prepared by mixing 1800 ml 70% ethanol and 200 g of propolis. Solutions were kept in a container, sealed the top and shaken twice daily for one week. Each solution was filtered separately and was kept in a clean, dark bottle at 4°C until use.

Coating of eggs with coating solutions and alcohol

Eggs were immersed in the 5, 8%, 10% propolis solution and/or alcohol by hand for 1 min, and this process was repeated once more. Eggs were then dried at ambient temperature.
**Albumen index**

Eggs were broken on a flat surface where the height of the albumen was measured, half way between yolk and edge of the inner thick albumen by using a standard tripod micrometer in mm. Albumen index (AI) was calculated as follows:

\[ AI = \frac{\text{Albumen height (mm)}}{\left[ \frac{\text{Albumen length (mm)} + \text{Albumen width (mm)}}{2} \right]} \times 100 \]

During measurement of albumen length and albumen width were used the nearest 0.1 mm a steel vernier caliper.

**Haugh unit**

Individual HU (HAUGH, 1937) score was calculated using the egg weight and albumen height (SARIÇA and ERENŞAYIN, 2004). The HU values were calculated for individual egg using the following formula:

\[ \text{HU} = 100 \log (H + 7.57 - 1.7C^{0.37}) \]

where H is the height of the thick albumen in millimetres and G is the mass of the whole egg in grams. The parameter H was estimated by tripod micrometer. Egg mass measurements were recorded to 0.001 g.

**Yolk Index**

YI was calculated as follows:

\[ YI = \frac{\text{Yolk Height (mm)}}{\text{Yolk diameter (mm)}} \times 100 \]

Yolk height was measured by tripod micrometer and yolk width was measured with digital caliper.

**pH measurement**

After albumen height (mm) had been measured, albumen was separated from yolk. The volumes (ml) of thick and thin albumen were mixed with spatula by hand before measuring pH. The pH of the albumen was measured by a pH 210 meter (Hanna Inst, Woonsocker, RI 02895).

**Data analysis**

This study evaluated the combined effect of propolis and storage time on the properties of eggs. The data were subjected to a GLM using software of SPSS 10 (1999), with treatments and storage time as main effects. When main effects were significant at P < 0.05 differences between means were tested using Duncan’s multiple range test.

**Results and Discussion**

**Albumen pH**

The determination of albumen pH in fresh egg is more important than determination of albumen height. In general, the pH of the albumen does not differ between genetic strains, but increases with storage time (SILVERSIDES and SCOTT, 2001). An increase in albumen pH causes a decrease in egg quality (SCOTT and SILVERSIDES, 2000). For assessing changes in albumen pH during storage it is necessary to measure the basic pH immediately after oviposition time. In the present experiment the basic pH was 7.81 (Table 1). Previous researchers reported the starting value of albumen pH between of 7.6-7.9 (POWRIE, 1973; FRENCH and TULLET, 1991; SILVERSIDES and SCOTT, 2001; SENKOYLU, 2001). The current study indicates that increasing storage time caused an increase in albumen pH of the egg at room temperature (p < 0.01) (Table 6). Eggs coated with 8% (Group IV) and 10% propolis (Group V) exhibited lower pH (p < 0.01) than eggs coated with 5% propolis (Group III) or alcohol (Group II) and in the control (Group I) group. According to these results, it may be assumed that eggshell coating decreased CO₂ release through the shell by acting as a barrier for CO₂. In general, coatings may force some gasses to diffuse less rapidly than others through the shell. After 2 weeks of storage, the average albumen pH in Group I reached 9.04. However, after 4 weeks the average albumen pH of Groups IV and V did not reach 9.00 (Table 1). Albumen pH of Group II reached 9.04 in the 3rd week of storage. However, this parameter reached 9.08 in the fourth week of storage. On the other hand, albumen pH at 4th week was 8.87 and 8.84 in Groups IV and V, respectively. The observed values supported previous work conducted by CANER, (2005) who found similar pH values when coating eggs with chitosan (8.83) and shellac (8.82). The pH increase in Groups I, II and III at the 4th week was also similar to findings by POWRIE, (1973), FRENCH and TULLET, (1991), SILVERSIDES and SCOTT, (2001), who reported pH values of 8.9–9.7. In general, the observed increase in albumen pH supports the conclusions of previous studies (POWRIE, 1973; HEATH, 1977; FRENCH and TULLET, 1991; WONG et al., 1996; TAYAR, 2005) that the pH increases with CO₂ loss via egg shell pores during storage time.

**Albumen index**

Albumen index of all treated eggs decreased with increasing storage time (Table 2). These results agree with the

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Table 1. Effect of propolis coating on albumen pH during 4 weeks of storage

<table>
<thead>
<tr>
<th>Groups</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Mean ± SE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>7.81 ± 0.04&lt;sup&gt;d&lt;/sup&gt;</td>
<td>8.91 ± 0.03&lt;sup&gt;c&lt;/sup&gt;</td>
<td>9.04 ± 0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9.07 ± 0.007&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>9.10 ± 0.01&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>II</td>
<td>7.81 ± 0.04&lt;sup&gt;d&lt;/sup&gt;</td>
<td>8.82 ± 0.02&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8.99 ± 0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9.04 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.08 ± 0.009&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>III</td>
<td>7.81 ± 0.04&lt;sup&gt;d&lt;/sup&gt;</td>
<td>8.83 ± 0.03&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8.86 ± 0.01&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8.97 ± 0.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9.04 ± 0.008&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>IV</td>
<td>7.81 ± 0.04&lt;sup&gt;d&lt;/sup&gt;</td>
<td>8.62 ± 0.04&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8.76 ± 0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>8.84 ± 0.008&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.87 ± 0.02&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>V</td>
<td>7.81 ± 0.04&lt;sup&gt;d&lt;/sup&gt;</td>
<td>8.58 ± 0.06&lt;sup&gt;c&lt;/sup&gt;</td>
<td>8.68 ± 0.01&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>8.76 ± 0.021&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>8.84 ± 0.07&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

a, b, c and d: in the table followed by different letters differ significantly (p < 0.01)
I: Control Group; II: Alcohol; III: 5% Propolis; IV: 8% Propolis; V: 10% Propolis
The decrease of Al during storage is caused by a diffusion of water from the albumen to the yolk, resulting in changes in its quality. In general, albumen height decreases with increased hen age and storage time of eggs and it is different in line of hen (Silversteds and Budgell, 2004). In the present experiment, after 4 weeks storage time albumen index reached 3.04, 3.05 and 3.19 in Groups I, II and III, respectively (p < 0.05), while albumen index in Groups IV and V reached 3.04, 3.05 and 3.19 in Groups I, II and III, respectively (p < 0.05), with higher values in Groups IV and V. This result agrees with the results of Silversteds and Budgell, (2004) that albumen height decreased from 6.05 to 3.93 and 3.75 (Table 7).

Table 2. Effect of propolis coating on value of Al during 4 weeks of storage (%)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>6.05 ± 0.31^a</td>
<td>4.20 ± 0.35^b</td>
<td>2.83 ± 0.08^c</td>
<td>0.91 ± 0.12^d</td>
<td>0.64 ± 0.06^d</td>
</tr>
<tr>
<td>II</td>
<td>6.05 ± 0.31^a</td>
<td>4.22 ± 0.26^b</td>
<td>2.67 ± 0.20^c</td>
<td>1.04 ± 0.13^d</td>
<td>0.69 ± 0.09^d</td>
</tr>
<tr>
<td>III</td>
<td>6.05 ± 0.31^a</td>
<td>4.23 ± 0.20^b</td>
<td>2.92 ± 0.30^c</td>
<td>1.32 ± 0.09^d</td>
<td>0.90 ± 0.11^d</td>
</tr>
<tr>
<td>IV</td>
<td>6.05 ± 0.31^a</td>
<td>6.00 ± 0.32^b</td>
<td>3.49 ± 0.35^b</td>
<td>2.19 ± 0.15^c</td>
<td>1.09 ± 0.06^d</td>
</tr>
<tr>
<td>V</td>
<td>6.05 ± 0.31^a</td>
<td>4.82 ± 0.24^b</td>
<td>3.65 ± 0.38^c</td>
<td>2.30 ± 0.19^d</td>
<td>1.43 ± 0.13^e</td>
</tr>
</tbody>
</table>

a, b, c and d: in the table followed by different letters differ significantly (p < 0.01).
\( I \): Control Group; II: Alcohol; III: 5% Propolis; IV: 8% Propolis; V: 10% Propolis

\( I \): Control Group; II: Alcohol; III: 5% Propolis; IV: 8% Propolis; V: 10% Propolis

The decrease of YI during storage is caused by a diffusion of water from the albumen to the yolk, resulting in changes in its quality. In general, albumen height decreases with increased hen age and storage time of eggs and it is different in line of hen (Silversteds and Budgell, 2004). In the present experiment, after 4 weeks storage time albumen index reached 3.04, 3.05 and 3.19 in Groups I, II and III, respectively (p < 0.05), while albumen index in Groups IV and V decreased from 6.05 to 3.93 and 3.75 (Table 7).

Albumein Height

In general, albumen height decreases with increased hen age and storage time of eggs and it is different in line of hen (Silversteds and Budgell, 2004). In the present experiment albumen height differed significantly between all treatment groups (p < 0.05) with higher values in Groups IV (4.53) and V (4.56) than in Groups I (3.68), II (3.75) and III (3.92) (Table 7). Albumen height was 7.79 mm at the beginning of storage. At 4th week albumen height of Groups I, II, III, IV and V groups were 1.0, 1.05, 1.35, 1.53 and 2.13 mm, respectively (Table 3). Albumen height in eggs decreased faster in Groups I, II and III than in Groups IV and V. This result agrees with the results of Silversteds and Budgell, (2004) that albumen height decreased from 8.45 to 4.10 during 10 days storage. Results showed that the albumen height during storage time is significantly decreased.

Hauhoff units

HU is related to albumen quality and measured as a function of the inner thick albumen height and egg weight. In the formula albumen height is corrected for egg weight. According to the Institution of Turkish Standard (TSE), eggs with HU value > 79 are graded as ‘AA’ (perfect), with HU between 55 and 78 a ‘A’ (good), with HU between 31 and 54 as ‘B’ (bad) and with HU < 30 as ‘C’ (very bad) (Sarica and Erensayin, 2004). After 4 weeks, the HUs decreased in all groups and the difference of HU value between groups was statistically significant (p < 0.01) (Table 7). The HUs of Groups V and IV amounted to 54.72 and 51.81, the corresponding values of Groups III, I and II were 42.97, 34.48 and 32.90, respectively. HU values of Groups I, II and III did not differ significantly (p > 0.05), whereas, HUs of Groups IV and V were significantly different from Groups I and II (p < 0.01) (Table 7).

The decrease in HU after one week storage was higher in Groups I, II and III than in Groups IV and V. At the first week eggs of Groups I, II and III maintained grade ‘A’. The grade changed to ‘B’ and ‘C’ in the 2nd and 3rd week and in the 3rd and 4th week. Eggs of group IV were graded as ‘A’ in the first week, ‘B’ in the 2nd and 3rd week and ‘C’ in the 4th week. In contrast eggs of Group V group maintained grade ‘A’ in the first and second week, followed by ‘B’ in the 3rd week and ‘C’ in the 4th week (Table 4). Eggs of Group V remained the same grade for a longer time. This result is in agreement with Alenoni and Antunes, (2004) and Caner, (2005) studies who found a higher HU value of coated eggs than of uncoated eggs in the 4th week of storage.
of the vitellin membrane and in a liquefaction of the yolk (Scott and SilverSides, 2000; SilverSides and Scott, 2001). A fresh, good quality egg has a YI of about 0.45 (Senkoylu, 2001). The difference of YI values between treatment groups was not significant (p > 0.05). At the beginning of storage YI values agreed with those of Senkoylu (2001) who reported YI value for a fresh egg of 45%. The effect of storage time on YI was significant (p < 0.01). YI of Groups I, II and III decreased from 44.02% to 24.36, 25.08 and 28.54%, respectively, after 3 weeks of storage time, while YI of Groups IV and V decreased to 31.80 and 31.11%, respectively (Table 5).

### Conclusions

Albumen height and albumen pH values are important properties for quality determination of table eggs. These properties decrease during storage time by gas release via pores. The coating of egg shell with propolis at 25°C (room temperature) was an effective method for increasing egg shelf life. After 4 weeks storage time albumen pH of control eggs and eggs coated with alcohol and with 5% propolis were above 9.0, while those of eggs from groups coated with 8 and 10% propolis were under the 9. The effects of different concentrations of propolis treatments on albumen height were important at the 4th week. During storage albumen height and albumen index values of eggs coated with higher concentrations of propolis were higher than of eggs coated with lower concentrations of propolis. Eggs coated with 10% propolis maintained grade ‘A’ one week (until the end of second week) longer than the eggs of the other treatment groups. After 3rd week, eggs of control, alcohol and 5% propolis coated groups maintained grade ‘C’, while eggs of 8 and 10% propolis coated groups remained in grade ‘B’. During table egg storage at room temperature, the coating of egg shell with propolis as a nature product decreased CO2 loss of albumen and reduced the changes of interior egg quality. Using of propolis will effectively improve the shelf life length of table eggs. Espe-

### Table 4. Grade of eggs based on the HU during 4 weeks of storage

<table>
<thead>
<tr>
<th>Treatments</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>AA</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>II</td>
<td>AA</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>III</td>
<td>AA</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>IV</td>
<td>AA</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>V</td>
<td>AA</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>

I: Control Group; II: Alcohol; III: 5% Propolis; IV: 8% Propolis; V: 10% Propolis

The grade A.B or C is given an egg based upon interior quality not size. AA grade > 79; A ranges from 55 to 78; B ranges from 31 to 54; C ranges from < 30.

### Table 5. Effect of propolis coating on YI during 4 weeks of storage (%)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>44.02 ± 1.42a</td>
<td>37.24 ± 0.64b</td>
<td>32.74 ± 0.48c</td>
<td>24.36 ± 0.68d</td>
<td>23.14 ± 0.61d</td>
</tr>
<tr>
<td>II</td>
<td>44.02 ± 1.42a</td>
<td>35.26 ± 1.13b</td>
<td>33.10 ± 0.46c</td>
<td>25.08 ± 0.62d</td>
<td>22.79 ± 1.01d</td>
</tr>
<tr>
<td>III</td>
<td>44.02 ± 1.42a</td>
<td>36.15 ± 0.79b</td>
<td>33.26 ± 0.79c</td>
<td>28.54 ± 0.50d</td>
<td>22.06 ± 0.50d</td>
</tr>
<tr>
<td>IV</td>
<td>44.02 ± 1.42c</td>
<td>37.69 ± 0.69b</td>
<td>31.38 ± 0.80c</td>
<td>31.80 ± 1.06d</td>
<td>23.57 ± 0.79d</td>
</tr>
<tr>
<td>V</td>
<td>44.02 ± 1.42c</td>
<td>39.91 ± 0.47b</td>
<td>32.88 ± 0.52c</td>
<td>31.11 ± 0.52d</td>
<td>23.54 ± 0.30c</td>
</tr>
</tbody>
</table>

a, b, c and d: in the table followed by different letters differ significantly (p < 0.01).

I: Control Group; II: Alcohol; III: 5% Propolis; IV: 8% Propolis; V: 10% Propolis

### Table 6. Mean weekly changes of initial egg quality for all treatments

<table>
<thead>
<tr>
<th>Properties</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>F</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumen PH</td>
<td>7.81 ± 0.04c</td>
<td>8.75 ± 0.02d</td>
<td>8.87 ± 0.02c</td>
<td>8.94 ± 0.02b</td>
<td>8.98 ± 0.02a</td>
<td>783</td>
<td>**</td>
</tr>
<tr>
<td>Yolk Index (%)</td>
<td>44.02 ± 1.42a</td>
<td>36.65 ± 0.34b</td>
<td>32.67 ± 0.28b</td>
<td>28.18 ± 0.47d</td>
<td>23.02 ± 0.31e</td>
<td>598</td>
<td>**</td>
</tr>
<tr>
<td>Albumen-index (%)</td>
<td>6.05 ± 0.31a</td>
<td>4.69 ± 0.14b</td>
<td>3.11 ± 0.13c</td>
<td>1.55 ± 0.09d</td>
<td>0.95 ± 0.05e</td>
<td>403</td>
<td>**</td>
</tr>
<tr>
<td>Albumen Height (mm)</td>
<td>7.79 ± 0.34a</td>
<td>4.78 ± 0.11b</td>
<td>3.88 ± 0.14c</td>
<td>2.11 ± 0.10d</td>
<td>1.41 ± 0.07e</td>
<td>628</td>
<td>**</td>
</tr>
<tr>
<td>Haugh Unit</td>
<td>85.78 ± 2.15a</td>
<td>62.14 ± 1.19d</td>
<td>50.59 ± 2.08b</td>
<td>13.37 ± 3.62b</td>
<td>4.05 ± 4.47a</td>
<td>189</td>
<td>**</td>
</tr>
</tbody>
</table>

**: very important; * important and NS: Not significant
coating with 10% propolis had a more favourable effect on interior egg quality than the other coating treatments and has to be studied in more details.

**Summary**

Effects of various concentrations of propolis for egg coating (5%, 8% and 10% of propolis in ethanol) on the interior quality of fresh eggs were evaluated during 4 weeks of storage. During storage, albumen height decreased whereas albumen pH increased. The albumen pH of the uncoated eggs (control; Group I), and the eggs coated with alcohol (Group II) and 5% propolis (Group III) was significantly higher (P < 0.05) than the albumen pH of eggs coated with 8% (Group IV) and 10% propolis (Group V). On the other hand, at 4 weeks storage eggs of Groups IV and V had a higher albumen index than the rest of the groups. The HU value of eggs of Groups IV and V were significantly higher than for eggs of Groups I, II and III. Coating with 10% propolis (Group V) resulted in the maintenance of grade ‘A’ for 2 weeks longer than for the other groups. Propolis did not affect yolk-index (YI) value (p > 0.05). In conclusion, coating of eggs with 10% propolis extract improved interior egg quality during storage.

**Key words**

Layer, eggs, propolis, Haugh unit, albumen pH, albumen index

**Zusammenfassung**

**Einfluss der Beschichtung der Eischale mit Propolis auf die innere Eiqualität**

In der vorliegenden Untersuchung wurde der Einfluss der Beschichtung von frischen Eiern mit Propolis (5, 8 und 10% Propolis in Athanol) auf die innere Eiqualität während einer vierwöchigen Lagerung untersucht. Während der Lagerung nahmen die Eiklarhöhe ab und der pH-Wert des Eiklars zu. Der pH-Wert des Eiklars war bei Eiern ohne Beschichtung (Kontrolle; Gruppe I) und bei Eiern mit einer Beschichtung mit Alkohol (Gruppe II) sowie mit 5% Propolis (Gruppe III) signifikant höher (P < 0.05) als bei Eiern mit einer 8%igen (Gruppe IV) und 10%igen (Gruppe V) Beschichtung. Nach 4 Wochen Lagerung wiesen die Eier der Behandlungen IV und V einen höheren Eiklar-Index auf als die Eier der übrigen Behandlungsgruppen. Entsprechend waren die Haugh-Einheiten der Gruppen IV und V höher als die der anderen Gruppen. Die Beschichtung mit 10% Propolis verlängerte die Einstufung der Eier in Gütekla- 55-84.

**References**


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