Influences of Body Condition Score and Somatic Cell on the Productivity and Economic Efficiency of the Dairy Cows with Special Highlighting on its Milk Constituents

Abstract

A total of 2874 cows belonging to six farms which responded to the request had been sent to 17 farms to participate in this study and have all needed data. Those six farms were distributed in the three provinces representing the Nile delta in Egypt: two farms located in Beheira, two farms located in Alexandria, and two farms located in Kafr El-Sheikh. Those cows were selected from different lactation order. The lactation order investigated in this study was classified as; first lactation, second lactation, third lactation, and higher than three lactations. The selected farms were similar in the production system, feeding method, and udder health management. Twenty five samples of bulk tank milk from the six farms were randomly collected every month staring from March 2015 to April 2016 totaling 1800 samples for somatic cell count (SCC) analysis. Body condition score (BCS) was determined and was classified into three groups as good (3-4), medium (2) and poor (1-5). The obtained results revealed that poor body condition score cows have significantly lower Fat% (3.10 %) when compared with the medium BCS(3.88 %) and good BCS(4.10 %). Likewise, Protein % follows the same trend as Fat %. Good and medium BCS have 3.85% and 3.51 %, respectively more than 2.95% recorded for poor BCS. In regard to the solid % among the body condition score groups, poor body condition score cows have 11.10 % lower than the percentage obtained for medium body condition score (13.23%) and good BCS(13.69%). SNF (Solid Not Fat) % precedes the same trend as solid%. In terms of the relation between SCC and average milk yield, it has been remarked that milk of cows have SCC 100-199×10^3 and 200-299× 10^3 have higher average milk yield (29.33 ± 1.31 kg and 28.50 ± 2.24 kg, respectively) when compared with the comparable cows having milk with SCC399× 10^3 and >400× 10^3. Furthermore, a negative correlation between SCC and milk return was detected however the total costs have positive correlation with SCC. In conclusion, BCS and SCC were confirmed as beneficial implement for mediating the cow farm health, milk constituents, and cow farm revenue.

Keywords: Body condition score; Somatic cell count; Milk constituents; Productive; Economic efficiency

Introduction

Body condition scores (BCS) are subjective, visual or physical assessment of the amount of metabolizable energy stored in fat and muscle on a live animal. It has been widely used as a management tool for producers to monitor and manage the nutritional, health, and fertility status of their herds [1-3]. Body condition score meets all the criteria to be considered a useful indicator trait for health and fertility status in dairy cattle. Previous studies have investigated the relationship between BCS, milk yield and milk composition [4,5]. Rennó FP et al. [6] studied the effect of BCS at calving on milk composition and found higher production of milk and its components in cows with 3.25 BCS at calving. Mushtaq A et al. [7] found that BCS had a significant effect on the milk yield and fat, protein and lactose contents in buffaloes. They also showed that the highest yield was documented to poor BCS (1.5) followed by moderate (2.5) and higher (3.5 and 3.0). Furthermore, they postulated that Protein contents amplified with increasing BCS up to 3.0 and declined with 3.5 while lactose showed a reverse trend.

SCC in milk is one of the most important indicators to evaluate the udder health of cows due to the high direct correlation with the mammary gland’s degree of infection [8,9]. Somatic cells have varying effects on milk composition [10,11], Ying C et al. [12] concluded that there were positive and negative correlations between log SCCs and protein and lactose. Diaz JR et al. [13] also described that raises in SCC augmented the protein content. Nevertheless Lauri-Navidute V et al. [14] conveyed no significant effect on milk fat content with increases in SCC. In terms of the economic impact, Gonzalo C et al. [15] and Rougers CW et al. [16] established that SCC was a measure of the incidence of mastitis, whereby one could select cows for treatment, determine the animals that should be culled, and identify healthy cows for purchasing. The aim of this study was to explore the influence of...
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BCS and SCC on the milk constituents, production and economic efficiency of the dairy cows.

Material and Methods

Study area, population, and sampling

The present study was conducted at three localities representing the delta region of Egypt. Beheira, Kafr El-Sheik, and Alexandria Provinces were the localities which randomly selected from different provinces located in the Nile delta. These localities are the major for cattle production [17]. A total of 2874 cows belonging to six farms which responded to the request had been sent to 17 farms to participate in this study and have all needed data. Those six farms were distributed in the three provinces: two farms located in Beheira, two farms located in Alexandria, and two farms located in Kafr El-Sheikh. Those cows were selected from different lactation order. The lactation order investigated in this study was classified as: first lactation, second lactation, third lactation, and higher than three lactations. The selected farms were similar in the production system, feeding method, and udder health management. Twenty five samples of bulk tank milk from the six farms were randomly collected every month staring from March 2015 to April 2016 totaling 1800 samples for SCC analysis.

Milk samples and Total somatic cell count

Some tanks were randomly selected in the cow farms for collection of the samples [18]. The hygienic measures were followed during the collection of the milk samples. The samples were collected during the morning milking in sterile 100mL bottles, which putted on ice and transferred directly to the laboratory. The sources of contamination were strictly avoided during transportation. The raw, unreserved samples were stored overnight at +4°C and analyzed on the following day. Milk was analyzed for protein and fat content on a Milkoscan 134 (Foss-Electric A134 Hillord, Denmark) [19].

Total bulk SCCs were determined by direct microscopic cell count of smears that were stained with May-Grunwald and Giemsa medium, described by Gonzalo C et al. [11]. In brief, the milk was heated to 40°C in a water bath and incubated for 15 min. before being cooled to 20°C by gentle stirring. We used the method that was recommended by the International Dairy Federation [20]. Two slides of each sample were prepared and counted. The working factor – the number by which the actual count of somatic cells by an instrument is multiplied to calculate the SCC of a sample was 1600. SCCs were categorized, and the status of the cows was determined based on the resulting classifications [21] and [18].

Body condition score: (BCS) was determined by observing the condition of tail head and loin areas and was classified into three groups as good (3-4), medium (2) and poor (1-5) according to the methods described by Nicholson MJ et al. [22].

Productive and reproductive variables: Daily milk yields, average milk yield, days in milk and total milk yield were recorded. Peak milk yield, day peak, and peak period were also considered. Calving interval was taken as a reproductive parameter for this study.

Economic parameters: Fixed, variable, and total costs were calculated according the methods indicated by El Tahawy AS et al. [23]. As well, the return parameters were calculated. The net income was calculated as the difference between the total returns and total costs. The benefit-cost analysis was estimated as the percentage of total returns to the total costs as investigated by El Tahawy AS [17]. Additionally, the ratio of the net income to the feed costs was also estimated.

Data analysis

For statistical analyses, the following were considered as sources of variation: lactation order = 1st lactation, 2nd lactation, 3rd lactation, and >3 lactation; body condition score range = poor (1-5), medium (2), and good (3-4); SCC categories=100-199×10³, 200-299×10³, 399×10³, >400×10³. Data were subjected to variance analysis and mean comparison test. The Statistical procedures were conducted by the means of PROC GLM using multivariate analysis of SAS (2010). The effects of different treatments on each variable were compared by Tukey test at 5% probability. The relationship between the productive, reproductive, and economic parameters with the body condition score and somatic cell count were conducted using Pearson correlation through PROC CORR. As well as, logarithmic functions were performed between the milk constituents and somatic cell count.

Results and Discussion

Table 1 presented the effect of the BCS and the somatic cell categories on the milk constituents. As shown, poor body condition score cows have significantly lower Fat% (3.10 %) when compared with the medium body condition score (3.88 %) and good body condition score (4.10 %). Likewise, Protein % follows the same trend as Fat %. Good and medium body condition scores have 3.85% and 3.51 %, respectively more than 2.95% recorded for poor body condition score. In previous study conducted by Mushfaq A [7], they found that BCS had a significant effect on the milk yield and fat, protein and lactose contents in buffaloes. They showed that the highest yield was documented to poor BCS (1.5) followed by moderate (2.5) and higher (3.5 and 3.0). Furthermore, they postulated that Protein contents amplified with increasing BCS up to 3.0 and declined with 3.5 while lactose showed a reverse trend.

In regard to the solid % among the body condition score groups, poor body condition score cows have 11.10 % lower than the percentage obtained for medium BCS (13.23%) and good body condition score (13.69%). SNF% precedes the same trend as solid%. Concerning the total fat, protein, lactose, and total solid, as observed in Table 1, the poor body condition score cows were associated with lower values when compared with the medium and good body condition scores. Our obtained data are matched with those obtained; they declared that there was non effect of BCS on milk composition in multiparous cows while primiparous cows had positive correlations to the content of protein, casein,
total solids and non-fat solids. Besides, Rennó FP [24] studied the effect of BCS at calving on milk composition and found higher production of milk and its components in cows with 3.25 BCS at calving.

Table 1: BCS and SCC effects on the milk composition.

| Main Effects | Fat % | Protein % | Lactose % | Solid % | SNF % | Total fat | Total protein | Total lactose | Total solid |
|--------------|-------|-----------|-----------|---------|-------|-----------|--------------|---------------|-------------|
| **Body Condition Score** |       |           |           |         |       |           |              |               |             |
| Poor         | 3.10±0.06b | 2.95±0.13b | 3.10±0.10c | 11.10±0.22b | 7.11±0.11b | 13.87±0.68c | 11.44±0.52b | 13.15±1.90b | 44.22±0.44b |
| Medium       | 3.88±0.16a | 3.51±0.17a | 3.88±0.14b | 13.23±0.13a | 8.28±0.04a | 16.33±0.44b | 16.88±0.17a | 17.60±1.02a | 50.08±0.47a |
| Good         | 4.10±0.20a | 3.85±0.12a | 4.25±0.11a | 13.69±0.20a | 8.58±0.12a | 17.90±0.90a | 17.90±0.43a | 18.29±1.44a | 51.13±0.81a |

| Somatic Cell Count |       |           |           |         |       |           |              |               |             |
| 100-199000       | 4.23±0.11a | 3.65±0.21a | 4.65±0.22a | 13.25±0.45a | 9.10±0.22a | 17.87±1.18a | 17.12±1.45a | 18.40±1.80a | 51.33±2.47a |
| 200-299000       | 3.95±0.14a | 3.41±0.11ab | 4.40±0.17ab | 13.10±0.09a | 8.33±0.51ab | 16.12±1.44a | 16.20±1.03a | 18.00±1.90a | 50.65±1.69a |
| 300-399000       | 3.10±0.06b | 3.20±0.10ab | 4.00±0.13ab | 12.68±0.89ab | 7.19±0.67b | 14.21±0.90b | 12.88±0.87b | 15.22±1.12b | 43.11±1.58b |
| >400000          | 2.99±0.16b | 3.00±0.20b | 3.89±0.12b | 12.10±0.61b | 7.01±0.50b | 12.80±0.67b | 10.11±0.50c | 13.93±0.88c | 41.58±1.71b |

Means within the same column carrying different superscript are significantly different at P<0.05

In terms of the effect of somatic cell categories in the milk constituents, it has been remarked that Fat % was gradually decreased with the increase of somatic cell count. Somatic cell count of 100-199 x 10^3 have 4.23% and somatic cell count of 200-299 x 10^3 have 3.95% compared to 3.10% and 2.99% for 300-399 x 10^3 and >400 x 10^3, respectively. As well as, protein, lactose, solid, and SNF percentages decreased with increasing somatic cell count.

In the same manner, total fat, protein, lactose, and solid were all significantly decreased with increasing of somatic cell count. For instance, total lactose of the cow milk having somatic cell count of 300-399 x 10^3 and >400 x 10^3 have 12.88 kg and 10.11 kg, respectively when compared with those of somatic cell count 200-299 x 10^3 (18 kg) and 100-199 x 10^3 (14.21 kg). Our results are in consistent with the results obtained by El Tahawy AS et al. [18] who concluded that fat% declined with increasing of SCC. Furthermore they remarked that milk protein content steadily diminished from 3.82% to 2.06% with increasing SCC. As well as they recorded that lactose, solid and SNF percentages decreased considerably with elevated SCC.

Data obtainable in Table 2 showed that dairy cows of good and medium body condition scores have significantly longer days in milk (344.70 ± 10.16 and 320.70 ± 13.19 days; P<0.05) when compared of those of poor body condition score (289.40 ± 12.22). Conversely, days of dry period in the poor condition cows were higher than the medium and good body condition cows. Days of dry period for poor condition cows were recorded as 10.14±2.5±22 days while days of dry period for medium and good body condition cows were 7.51±4.18 and 6.73±3.79 days, respectively. In regard to the total milk yield, cows of poor condition score were associated with lower total milk yield (8258.28±125.22 kg; P<0.05) than the comparable medium (10334.98±115.60 kg) and good (11987.33±130.5 kg) body condition scores. In accordance with our results, [7] indicated that the milk yield was negatively correlated with BCS. Moreover, studies conducted by Jílek F [13] clarified those cows with moderate BCS in the first month of lactation showed the highest milk yield during the first 5 months of lactation. Roche IR et al. [25] described that optimum calving BCS for milk production was roughly 3.5 in the 5-point scale. Nevertheless, there was slight rise in milk yield beyond a BCS of 3.0.

The effect of lactation order on the days in milk, days of dry period and total milk yield was presented in Table 2. The results demonstrated that cows in their first lactation and higher than those of second lactation showed the highest milk yield during the first 5 months of lactation. Concerning the days of dry period, cows in the first and third lactation have days in milk longer than those of second lactation and third lactation. Nevertheless, there was slight rise in milk yield beyond a BCS of 3.0.

In terms of the effect of somatic cell count, it has been noticed that cows of somatic cell count ranged (100-199 x 10^3) and those ranged (200-299 x 10^3) have longer days in milk than those ranged (300-399 x 10^3) and (400 x 10^3). However, days of dry period for cows recorded somatic cell count ranged (300-399 x 10^3) and (400 x 10^3) were higher than those of somatic cell count ranged (100-199 x 10^3) and those ranged (200-299 x 10^3), respectively. Milk production reasonably decreases with SCC increasing in milk.
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from individual cows. This was shown in Table 1 a higher level of milk production was detected for the cows their SCC ranged (100-199×10³; 12652.11 ± 105.34 kg) and those ranged (200-299×10³; 12145.19 ± 143.80kg) when compared with total mil yield of cows of somatic cell count ranged (300-399×10³; 10115.27 ± 125.88 kg) and those (>400×10³; 10103.30 ± 111.28 kg). The results of the milk production under the effect of SCC were in the same line of the results obtained by Pritchard DE [26,27] and El Tahawy AS [18] they declared that milk yield of cows under investigation significantly decreased with increasing of SCC. The later one found the monthly milk yield decreased from 429 kg/cow to 329 kg/cow as a result of SCC increment.

Average daily milk yield for good body condition score cattle was significantly higher (28.78 ± 1.78 kg; P<0.05) than those cattle of medium and body condition scores, Table 3. However, calving interval of cattle have poor body condition score was indicated greater (446.20 ± 10.97 d; p<0.05) than cattle of medium and good body condition scores (380.30 ± 17.16b and 360.20 ± 11.20 d, respectively). The peak milk yield for cattle having good body condition score was significantly higher than the yield for cattle of poor and medium body condition score.

Table 2: Productive parameters for different body condition scores of dairy cattle affected by different categories of somatic cell count.

| Main Effects            | Days in Milk | Days Dry | Total Milk Yield |
|-------------------------|--------------|----------|------------------|
| **Body Condition Score**|              |          |                  |
| Poor                    | 289.40± 12.22b | 101.22± 5.22a | 8258.28± 125.22c |
| Medium                  | 320.70± 13.19a | 75.11± 4.18b  | 10334.98± 115.60b |
| Good                    | 344.70± 10.16a | 61.78± 3.79b  | 11987.33± 130.54a |
| **Lactation Order**     |              |          |                  |
| 1                       | 324.35± 14.23b | 78.91± 1.32a  | 11487.37± 108.12a |
| 2                       | 341.70± 18.78a | 66.10± 2.52b  | 11052.90± 120.99b |
| 3                       | 311.37± 16.05b | 79.10± 2.11a  | 10650.50± 118.33c |
| >3                      | 331.70± 18.19a | 65.30± 2.70b  | 10112.45± 182.46d |
| **Somatic Cell Count**  |              |          |                  |
| 100-199000              | 352.87± 8.19a | 64.28± 3.14b  | 12652.11± 105.34a |
| 200-299000              | 349.22± 8.19a | 62.19± 2.11b  | 12145.19± 143.80b |
| 300-399000              | 308.22± 8.19b | 93.06± 3.30a  | 10115.27± 125.88c |
| >400000                 | 268.55± 8.19c | 98.57± 2.60a  | 10103.30± 111.28c |

Means within the same column carrying different superscript are significantly different at P<0.05.

Table 3: productive and reproductive parameters for different body condition scores of dairy cattle affected by different categories of somatic cell count.

| Main Effects            | Average Daily Milk | Calving Interval | Day Peak | Peak Milk Yield | Peak Period |
|-------------------------|--------------------|------------------|----------|-----------------|-------------|
| **Body Condition Score**|                    |                  |          |                 |             |
| Poor                    | 19.90± 1.24b       | 446.20± 10.97a   | 80± 1.16c | 21.32± 1.28b    | 5.20± 1.8c  |
| Medium                  | 20.20± 1.16b       | 380.30± 17.16b   | 112± 0.94a| 25.18± 1.90b    | 10.12± 1.99b|
| Good                    | 28.78± 1.78a       | 360.20± 11.20b   | 96± 1.22b | 34.12± 1.60a    | 17.20± 1.39a|
| **Lactation Order**     |                    |                  |          |                 |             |
| 1                       | 24.48± 0.31b       | 368.22± 13.98c   | 120± 1.24a| 27.32± 1.33b    | 12.30± 0.64c|
| 2                       | 27.21± 1.24a       | 405.06± 10.22b   | 76± 1.16d | 35.88± 2.13a    | 18.11± 1.74a|
| 3                       | 22.36± 1.01c       | 436.12± 14.27a   | 105± 1.78c| 26.10± 2.89b    | 9.78± 1.80b |
| >3                      | 23.10± 0.94c       | 410.74± 20.18ab  | 113± 1.55b| 27.22± 2.11b    | 15.02± 1.67a|
| **Somatic Cell Count**  |                    |                  |          |                 |             |
| 100-199000              | 29.33± 1.31a       | 355.50± 12.42c   | 76± 0.80d | 34.27± 3.08a    | 16.42± 1.58a|
| 200-299000              | 28.50± 2.24a       | 380.22± 14.26b   | 100± 1.36c| 33.16± 2.47a    | 12.14± 1.64b|
| 300-399000              | 20.06± 1.31b       | 450.16± 21.13a   | 120± 1.80b| 25.13± 2.50b    | 7.28± 1.44c |
| >400000                 | 19.97± 2.24b       | 468.39± 18.11a   | 130± 1.12a| 24.23± 2.60b    | 8.20± 1.88c |

Means within the same column carrying different letters are significantly different P<0.05.
In terms of the relation between somatic cell count and average milk yield, it has been remarked that milk of cows have somatic cell count 100-199×10³ and 200-299×10³ have higher average milk yield (29.33 ± 1.31 kg and 28.50 ± 2.24 kg, respectively) when compared with the comparable cows having milk with somatic cell count 399×10³ and >400×10³. Conversely, cows which have milk of somatic cell count 399×10³ and >400×10³ noted greater calving interval (450.16 ± 21.13 d and 468.39 ± 18.11 d, respectively) than those of somatic cell count 100-199×10³ and 200-299×10³, Table 3. Similar results matched with our data obtained by Kvapilik [28] who point out that with the increase in SCC, Calving interval prolonged by 33 days and the insemination index elevated from 2.87 to 3.28.

Concerning the variable and total costs incurred under the effect of the explored parameters, Table 4 revealed that feed costs of the good and medium body condition scores were meaningfully higher (19069.17± 148.36 EGP and 19122.23± 122.45 EGP; P<0.05) when compared with the feed costs of those having poor body condition score (17487.23± 180.35 EGP). Nevertheless, the costs of veterinary management were calculated greater for cows having poor body condition score (212.15± 15.18 EGP) comparable to those of medium (176.20± 10.55 EGP) and good body condition score (170.44± 15.87 EGP). The variable and total costs of the medium and good body condition score cows have higher values when compared with the poor ones.

Table 4: Costs parameters for different body condition scores of dairy cattle affected by different categories of somatic cell count.

| Main effects                      | Fixed Costs | Feed Costs | Veterinary Management Costs | Variable Costs | Total Costs |
|-----------------------------------|-------------|------------|-----------------------------|----------------|-------------|
| **Body Condition Score**          |             |            |                             |                |             |
| Poor                              | 215.12± 12.24a | 17487.23± 180.35b | 212.15± 15.18a | 17699.38± 125.18b | 17914.50± 125.18b |
| Medium                            | 215.12± 12.24a | 19122.23± 122.44a | 176.20± 10.55b | 19298.43± 112.78a | 19513.55± 112.78a |
| Good                              | 215.12± 12.24a | 19069.17± 148.36a | 170.44± 15.87b | 19239.61± 122.43a | 19454.73± 122.43a |
| **Lactation Order**               |             |            |                             |                |             |
| 1                                 | 215.12± 12.24a | 17445.18± 174.18a | 189.25± 9.24a | 17634.43± 120.89b | 17849.55± 120.89b |
| 2                                 | 215.12± 12.24a | 18987.10± 118.70a | 248.50± 15.10a | 18235.60± 115.91a | 18450.72± 115.91a |
| 3                                 | 215.12± 12.24a | 18810.15± 133.10a | 260.47± 18.30a | 18070.62± 124.45a | 18285.74± 124.45a |
| >3                                | 215.12± 12.24a | 18984.47± 124.85a | 178.11± 10.36b | 18162.58± 130.17a | 18377.70± 130.17a |
| **Somatic Cell Count**            |             |            |                             |                |             |
| 100-199×10³                       | 215.12± 12.24a | 17668.47± 152.14b | 156.12± 10.78c | 17824.59± 115.18a | 17709.91± 115.18a |
| 200-299×10³                       | 215.12± 12.24a | 17101.36± 128.61b | 142.24± 14.43c | 17243.60± 121.78a | 17458.72± 121.78a |
| 300-399×10³                       | 215.12± 12.24a | 19647.42± 134.11a | 252.42± 13.55b | 19899.94± 125.41a | 20114.69± 125.41a |
| >400×10³                          | 215.12± 12.24a | 19487.91± 114.27a | 281.15± 10.16a | 19769.06± 131.42a | 19984.18± 131.42a |

Means within the same column carrying different letters are significantly different P<0.05.

The variable and total costs varied across the different lactation order. The second lactation and over than three lactation have greater total variable (18235.60± 115.910 EGP, 18070.62± 124.45 EGP, and a 1816258± 130.17 EGP) when compared with those of medium and poor body condition score (18450.74± 132.43 EGP, 18285.74± 124.45 EGP, and 1816258± 130.17 EGP) respectively. The higher average milk yield (29.33 ± 1.31 kg and 28.50 ± 2.24 kg, respectively) when compared with those of body condition score 100-199×10³ and 200-299×10³ noted greater calving interval (450.16 ± 21.13 d and 468.39 ± 18.11 d, respectively) than those of somatic cell count 100-199×10³ and 200-299×10³, Table 3. Similar results matched with our data obtained by Kvapilik [28] who point out that with the increase in SCC, Calving interval prolonged by 33 days and the insemination index elevated from 2.87 to 3.28.

In terms of the return parameters influenced by the body condition score and the categories of somatic cell count (Table 5), it has been noticed that total returns and net income of good body condition scores achieved higher values than the medium and poor body condition score. The total returns for the good body condition score was 35961.99± 115.18 EGP and for medium and poor body condition score was 31004.94± 133.74 EGP and 24774.84± 143.48 EGP, respectively. The net income follows the same direction as the total returns. The benefit-cost analysis showed that good body condition score have higher value (184.84 ± 118.43 %; P<0.05) when compared with those of medium (158.88± 11.78 %) and poor body condition score (138.29± 110.18 %). Additionally, the ratio of the net income to the feed costs for good body condition score was obtained as 0.86 compared to the poor body condition score of 0.39.

In regard to the variation of the return parameters among the somatic cell categories, cows which have milk of somatic cell count 200-299×10³, 399×10³ and >400×10³ indicated lesser total returns (36435.57± 151.50, 30345.81± 162.28 EGP and

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30309.90± 158.25 EGP, respectively) than those of somatic cell count 100-199×10³ (37956.33 ± 131.14 EGP). As well, the net returns of the cow milk have somatic cell count 100-199×10³ (37956.33 ± 131.14 EGP). As well, the net returns of cow milk having somatic cell count 200-299×10³, 399×10³ and >400×10³, respectively. These findings are in agreement with El Tahawy AS [18] who found that the milk return was significantly decreased from 905.19 EGP for SCC of 1000-99×10¹¹ to 694.61 EGP for < 400×10³.

Table 6 depicts the Pearson correlation between the various dependent parameters under the effect of the body condition score and various categories of somatic cell count. It has been showed that SCC has negative correlation with the BCS and all milk constituents and the return parameters. However, SCC has positive correlation with the total costs. In regard to the relationship between the BCS and the investigated parameters, the table demonstrated that BCS has positive correlation with the milk constituents and the return and costs parameters. The previous reports conducted by Mushtaq A [7] stated that correlation analysis of the data exhibited that BCS was significantly and positively correlated with fat and protein contents while negatively with milk yield. Additionally, they indicated that BCS correlated positively with fat and protein and negatively with lactose contents.

On other studies, BCS and milk yield are in a negative correlation Veerkamp RF [29] and high yielding dairy cows generally have a lower BCS [5]. Cows that are genetically inclined to lose more BCS in early lactation tend to have higher yields of milk, fat and protein [4]. Furthermore, El Tahawy AS [18] reported an inverse correlation between SCC and daily milk yield; fat, protein, lactose, total solid and SNF percentages; and total fat, protein, solid, lactose and milk return levels.

Table 7 showed the logarithmic regression between somatic cell count, body condition score, and the milk constituents. When SCC increased by 1%, the Fat%, protein%, Lactose%, solid% and SNF% were decreased by 0.28, 0.99, 0.30, 0.14, 0.72 %.

Table 5: Return parameters for different body condition scores of dairy cattle affected by different categories of somatic cell count.

Table 7: Regression analysis between milk constituents, SCC, and profitability measures.

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Influences of Body Condition Score and Somatic Cell on the Productivity and Economic Efficiency of the Dairy Cows with Special Highlighting on its Milk Constituents

Log (total protein) = 0.40 - 0.01 log (SCC)  
Log (total solid) = 0.17 - 0.64 log (SCC)  
Log (SNF %) = 0.96 - 0.72 log (SCC)

Log (total costs) = 0.12 + 0.18 log (SCC)  
Log (total milk yield) = 0.69 - 0.80 log (SCC)  
Log (total fat) = 0.33 - 0.89 log (SCC)  
Log (total lactose) = 0.11 - 0.08 log (SCC)

Conclusion
This study explored the effect of body condition score and somatic cell count on the productivity and economic efficiency of the dairy cows with highlighting of its influence on the milk composition. Our results revealed that SCC had a negative effect on the milk constituents. In conclusion, BCS and SCC have lower values for the milk composition parameters when compared with medium and good body condition score. In terms of the economic efficiency, increasing of the SCC level than normal level was associated with higher total costs and lowers in return and net income. Moreover, the benefit-costs analysis showed lesser values when the SCC increases. In conclusion, BCS and SCC are beneficial tools for evaluating the dairy farms productivity, economic efficiency, and milk constituents.

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Conflict of Interest
The authors certify that they there are no conflict of interest/s.

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