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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

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±1.31kg and 28.50±2.24kg, 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

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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 glands 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-Naviciute 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 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 sample.[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, unpreserved 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 15min. 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.[21,18]

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 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=100-199×10^3, 200-299×10^3, 399×10^3, >400×10^3. Data were subjected to variance analyses 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 Mushtaq 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.

In terms of the effect of somatic cell categories in the milk constituents, it has been remarked that Fat% was gradually decrease with the increase of somatic cell count. Somatic cell count of 100-199×10^3 have 4.23% and somatic cell count of 200-299×10^3 have 3.95% compared to 3.10% and 2.99% for 300-399×$10^3$and >400×10^3, 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 300-399×10^3 and >400×10^3 have 12.88kg and 10.11kg, respectively when compared with those of somatic cell 200-299×10^3 (18kg) and 100-199×10^3(18.40kg). 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 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±13.19days; 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 101.22±5.22days while days of dry period for medium and good body condition cows were 75.11±4.18 and 61.78±3.79days, respectively. In regard to the total milk yield, cows of poor condition score were associated with lower total milk yield (8258.28±125.22kg; P<0.05) than the comparable medium (10334.98±115.60kg) and good (11987.33±130.5kg) 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 5months of lactation. Roche JR et al.[25] described that optimum calving BCS for milk production was roughly 3.5 in the 5point scale. Nevertheless, there was slight rise in milk yield beyond a BCS of 3.0.

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±0.08b	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

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

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 three lactations (>3) have days in milk longer than those of second and third lactation. Concerning the days of dry period, cows in the first and third lactation have longer days than those in the second lactation or those of more than three lactations. Total milk yield in the first and second lactation was associated with greater milk yield (11487.37±108.12 and 11052.90±120.99kg; P<0.05) when compared with those in the second lactation (10650.50±118.33kg) and those of >3 lactations (10112.45±182.46kg).

In terms of the effect of somatic cell count, it has been noticed that cows of somatic cell count ranged (100-199×10^3) and those ranged (200-299×10^3) have longer days in milk than those ranged (300-399×10^3) and (>400×10^3). However, days of dry period for cows recorded somatic cell count ranged (300-399×10^3) and (>400×10^3)

were higher than those of somatic cell count ranged (100-199×10^3) and those ranged (200-299×10^3), respectively. Milk production reasonably decreases with SCC increasing in milk 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±105.34kg) 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±125.88kg) and those (>400×103; 10103.30±111.28kg). 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 429kg/cow to 329kg/cow as a result of SCC increment.

Average daily milk yield for good body condition score cattle was significantly higher (28.78±1.78kg; 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 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±1.18c
	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 100-199×10^3 and 200-299×10^3 have higher average milk yield (29.33±1.31kg and 28.50±2.24kg, respectively) when compared with the comparable cows having milk with somatic cell count 399×10^3 and >400×10^3. Conversely, cows which have milk of somatic cell count 399×10^3 and >400×10^3 noted greater calving interval (450.16±21.13d and 468.39±18.11d, respectively) than those of somatic cell count 100-199×10^3 and 200-299×10^3, Table 3. Similar results matched with our data obtained by Kvapilik J[28] who point out that with the increase in SCC, Calving interval prolonged by 33days 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±148.36EGP and 19122.23±122.24EGP; P<0.05) when compared with the feed costs of those having poor body condition score (17487.23±180.35EGP). Nevertheless, the costs of veterinary management were calculated greater for cows having poor body condition score (212.15±15.18EGP) comparable to those of medium (176.20±10.55EGP) and good body condition score (170.44±15.87EGP). The variable and total costs of the medium and good body condition score cows have higher values when compared with the poor ones.

The variable and total costs varied across the different lactation order. The second, third lactation and over than three lactation have greater total variable (18235.60±115.910EGP, 18070.62±124.45EGP, and a 1816258±130.17EGP, respectively) and total costs (18450.72±115.910EGP, 18285.74±124.45EGP, and 18377.70±130.17EGP, respectively) when compared of cows in the first lactation (17634.43±120.89EGP and 17849.55±120.89EGP). Regarding the variation of the variable and total costs among the different category of somatic cell count, cows which have milk of somatic cell count 399×10^3 and >400×10^3 indicated greater variable costs (19899.84±125.41EGP and 19769.06±131.42EGP, respectively) than those of somatic cell count 100-199×10^3 and 200-299×10^3 (17824.59±115.18EGP and 17243.60±121.78EGP). The same trend was detected for the total costs. Our results are in agreement with Kvapilik J[28] who described the losses incurred with increasing of SCC. They stated that these losses were in the form of costs of treating cows, higher labor requirement, and high culling rate. Moreover, they indicated that the veterinary management was calculated between 4 and 40%.

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±146.54EGP and for medium and poor body condition score was 31004.94±133.74EGP and 24774.84±143.48EGP, 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±117.78%) 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 200-299×10^3, 399×10^3 and >400×10^3 indicated lesser total returns (36435.57±151.50, 30345.81±162.28EGP and 30309.90±158.25EGP, respectively) than those of somatic cell count 100-199×10^3 (37956.33±131.14EGP). As well, the net returns of the cow milk have somatic cell count of 100-199×10^3 were greater than those of cow milk having somatic cell count 200-299×10^3, 399×10^3 and >400×10^3, respectively. These findings are in agreement with El Tahawy AS[18] who found that the milk return was significantly decreased from 905.19EGP for SCC of 1000-99×10^3 to 694.61EGP for <400×10^3.

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 csosts
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±122.24a	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±174.18b	189.25±9.24b	17634.43±120.89b	17849.55±120.89b
	2	215.12±12.24a	18987.10±118.70a	248.50±15.10a	18235.60±115.910a	18450.72±115.910a
	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	1816258±130.17a	18377.70±130.17a
Somatic Cell Count	100-199000	215.12±12.24a	17668.47±152.14b	156.12±10.78c	17824.59±115.18b	17039.71±115.18b
	200-299000	215.12±12.24a	17101.36±128.61b	142.24±14.43c	17243.60±121.78b	17458.72±121.78b
	300-399000	215.12±12.24a	19647.42±134.11a	252.42±13.55b	19899.84±125.41a	19114.696±125.41a
	>400000	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

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

Main effects		Total returns	Net income	Benefit-cost analysis(%)	Net income/Feed costs
Body Condition Score	Poor	24774.84±143.48c	6860.34±134.98c	138.29±110.18c	0.39±0.001b
	Medium	31004.94±133.74b	11491.39±162.58b	158.88±117.78b	0.60±0.08a
	Good	35961.99±146.54a	16507.62±155.43a	184.84±118.43a	0.86±0.02a
Lactation Order	1	34462.11±141.58a	16612.56±178.29a	193.06±133.89a	0.95±0.01a
	2	33158.70±155.99b	14707.98±155.10b	179.71±120.910b	0.77±0.03b
	3	31951.50±148.33c	13666.03±140.40c	174.73±121.45b	0.72±0.01b
	>3	30337.35±162.46d	11959.65±167.17d	165.07±141.17b	0.62±0.02c
Somatic Cell Count	100-199000	37956.33±131.14a	20916.62±174.55a	222.75±115.18a	1.18±152.14a
	200-299000	36435.57±151.50b	18976.85±166.22b	208.69±121.78a	1.10±128.61a
	300-399000	30345.81±162.28c	11231.11±143.96c	158.75±125.41b	0.57±134.11b
	>400000	30309.90±158.25c	10325.72±167.41d	151.66±131.42b	0.52±114.27b

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

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 constitutes 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%. Additionally, the milk yield, return was decrease by 0.80 and 0.87%, respectively. However, total costs were increased by 0.18% as SCC increased by 1%. These outcomes are in consistent with the previous work done by El Tahawy AS[18] who revealed that with increasing of SCC by 1% led to decline in the percentages of fat, protein, lactose, solid, SNF, and moreover decrease in the milk yield and return.[30,31]

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

Dependent Variable	Function	R-2	F
Fat%	Log (Fat %) = 1.01-0.28 log (SCC) T 23.54* 33.89*	0.56	128.82**
Protein %	Log (Protein %) = 0.51-0.99 log (SCC) T 40.11* 23.15*	0.61	103.352**
Lactose %	Log (lactose %) = 1.01-0.30 log (SCC) T 23.54* 33.89*	0.71	111.23**
Solid %	Log (Solid %) = 0.59-0.14 log (SCC) T 36.04* 29.10*	0.59	96.40*
SNF %	Log (SNF %) = 0.96-0.72 log (SCC) T 50.11* 23.50*	0.69	137.89**
Total fat	Log (total fat) = 0.33-0.89 log (SCC) T 27.36* 40.15*	0.55	81.45*
Total Protein	Log (total protein) = 0.40-0.01 log (SCC) T 74.40* 63.89*	0.23	34.15
Total Lactose	Log (total lactose) = .11-0.08 log (SCC) T 41.74* 38.09*	0.19	27.89
Total Solid	Log (total solid) = 0.17-0.64 log (SCC) T 50.54* 51.89*	0.63	99.45*
Total Milk Yield	Log (total milk yield) =0.69-0.80 log (SCC) T 40.50* 70.11*	0.74	140.82**
Total Return	Log (total return) = 0.62-0.87 log (SCC) T 23.54* 33.89*	0.57	70.42*
Net Income	Log (net income) = 0.61-0.34 log (SCC) T 63.54* 40.89*	0.41	63.84*
Total Costs	Log (total costs) = 0.12+0.18 log (SCC) T 53.14* 61.10*	0.5	90.78*

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 addition, poor body condition score 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 author declares that there is no conflict of interest.

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