DEDICATION

To my father,

Mother,

Brothers,

Sisters,

Friends

And colleagues

With love and respect

Bhagiel
Acknowledgements

All praise is to Allah, Almighty for his unlimited support. Peace and blessing of Allah be to prophet and messenger and his pious companions and followers.

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ABSTRACT

The current study was carried out to investigate the quality of raw milk in highlands around Addis Ababa Ethiopia in the two collection centres: Sululta (in Amhara Region 20 kilometers north west of Addis Ababa) and Chacha (in Oromya Region 100 kilometers north east of Addis Ababa) during three different seasons (long rainy, short rainy and dry season) in farms different sizes: large farm (more or equal 10 milking cows), medium farm (between 5-10 milking cows) and small scale farms (less than 5 milking cows).

Milk samples were collected and transported in ice-boxes to the laboratory of the Ethiopian Meat and Dairy Technology Institute (EMDTI) in Debre-Zeit (45 kilometers south west of Addis Ababa) and for microbial examination, while the other tests were carried out at the farm level and compared with the conventional procedures in the laboratory.

Milk samples in the study were evaluated for chemical composition (fat, protein, solids non-fat and acidity), physical properties (specific gravity, freezing point degree and adulteration%) and microbiological examination (ten minutes resazurin test, total bacteria counts, gram negative bacteria counts, somatic cell counts and coliform bacteria count).

Chemical composition (fat, protein and SNF) of milk from Chacha area was higher in large scale farms during the long rainy season, while TA wasn’t significantly different (P<0.05) in all farms during the long rainy season.

Regarding physical properties of milk produced in the two collection centres, there was a slight increase in specific gravity values in milk
from Chacha during the short rainy season and dry season, while values were higher in milk from Sululta during all seasons as well as adulterations.

The total bacterial counts in the dry season were higher in both collection centres (Sululta and Chacha). Whereas the values of gram negative bacteria revealed highest counts in Chacha during the long rainy season and highest somatic cell counts in the same collection centre in the short rainy season. The screenings check of coliforms revealed higher counts in Sululta than Chacha collection centre.

Large scale farms revealed high protein content, SNF, acidity, specific gravity and low freezing point in all seasons, while small scale farms showed high fat content and slightly adulteration compared to other farms.

Total bacterial counts were slightly higher in milk from small scale farms, while gram negative bacteria were higher in large scale farms in long rainy season and medium scale farms during the dry season, whereas somatic cell counts were slightly higher in large scale farms in the long rainy season.

Season’s effect revealed the lowest fat, protein and SNF in the dry season in the different farm scales, while TA was not significantly different in the three seasons.

Specific gravity and freezing point were slightly higher in milk from large scale farms during all seasons, while milk from medium scale farms was more adulterated in all seasons compared to other farms.

The lowest total bacteria and higher gram negative bacteria counts was affected during long rainy season in the milk produced from large and
medium scale farms respectively, while coliforms revealed highest counts during dry season from the milk produced in the small farm scale. The results indicated that there's a significant difference (P<0.05) of total bacterial count in the interaction between the milk produced from different locations and different farm sizes and also significantly different (P<0.01) counts in the interaction between seasons×farm sizes and also in the interaction between seasons×locations×farm sizes. The milk produced from different locations during different seasons revealed the TBC (= better quality) of the milk produced from large farm scales than the milk produced from small farms scale milk which declared a lower TBC quality, whereas the milk produced during dry season revealed a better quality than that produced in short rainy and long rainy season which ranged between (7×10^6, 3×10^7 and 2×10^8) respectively. The gram negative bacteria in the raw milk obtained a significant (P<0.05) counts of the milk in the interactions of (seasons×farm sizes, locations×farm sizes and seasons×locations×farm sizes) where it was a better quality in the milk produced from large farm scales compared with that produced from medium and small farm scales which ranged between (6×10^4, 7×10^4 and 7×10^4), respectively.
بسم الله الرحمن الرحيم

خلاصة الأطروحة

أجريت هذه الدراسة لمعرفة جودة اللبن الخام في المناطق المرتفعة حول مدينة أديس أبابا بإثيوبيا في مركزين لجمع الألبان سلوتا (التي تقع في إقليم الأمهرا ومركز جاجا (في إقليم الأرومو على بعد 20 كيلومتر شمال غرب أديس أبابا) ومركز جاجا (في إقليم الأمهرا على بعد 100 كيلومتر شمال شرق أديس أبابا) خلال ثلاثة مواسم (الصيف الطويل والمطر القصير والجاف) في مزارع مختلفة السعة (مزارع تحتوي على 10 ابقار حليب وآخرين مزارع متوسطة بها ما بين 5-10 ابقار حليب ومزارع صغيرة بها أقل من 5 ابقار حليب).

عينات اللبن التي جمعت من المناطق المذكورة تم ترحيلها في صناديق تحتوي على مكعبات ثلج إلى معمل اللحوم وتكنولوجيا الألبان الإثيوبي بمدينة داميري زيت (45 كيلومتر شمال غرب أديس أبابا) لإجراء الاختبارات الميكروبيولوجية بينما تجري بقية الاختبارات على مستوى المزرعة ويتثم مقارنتها عن طريق الطرق التقليدية داخل المعامل ثم إجراء اختبار عينات الدراسة كيميائيًا (نسبة الدهن، نسبة البروتين، نسبة الجوامد الصلبة غير الدهنية، نسبة الحموضة، الكثافة النوعية، نقطة الإنجذام، ونسبة المضافات للبن) وميكروبيولوجيا (اختبار إحتثال الربيزوبارين، عدد المستعمرات الكلي للباكتيريا). عدد مستعمرات البكتيريا لصبقة جرام وعدد الخلايا الميتة والكوليكوفورم.

سجل اللبن المنتج في مركز تجميع جاجا محتوي كيميائيًا (دهن، بروتين، مواد صلبة) ونظيره أعلاي خلال الموسم المطر الطويل. في حين لم تسجل نسبة الحموضة أي فروقات معنوية في كل المزارع خلال نفس الموسم، بخصوص الخواص الفيزيائية اللبن المنتج والمجمع من مركزي سلولتا وجاجا. فقد سجل اللبن المنتج والمجمع في جاجا زيادة بسيطة في الكثافة النوعية خلال الموسم المطر.
القصير وموسم الجفاف، بينما كانت القيم مربعة في مركز سلوتوا بالنسبة للخواص
الفيزيائية طوال العام.
سجل العد البكتيري أفضل النتائج خلال موسم الجفاف في كلا المركزين، بينما سجلت
قيم البكتيريا السالبة لصبغة جرام عدا أعلى خلال الموسم الممطر الطويل وكذلك عدا
أعلى للخلايا البكتيرية الميتة خلال الموسم الممطر القصير في مركز جاجا، بينما أعطي
المسح الذي أجري على تعداد الكوليفورم في موسم الجفاف قيماً في مركز تجميع
سلوتا أعلى من التي سجلت في مركز جاجا.
سجلت المزارع الكبيرة محتويات عالية من البروتين، المواد الصلبة اللاذهبية، الكثافة
النوعية محتوي قليل بالنسبة لنقطة التجمد خلال كل المواسم. في حين أظهرت
المزارع الصغيرة محتوي عالياً من الدهن والمواد المضافة للبن مقارنة بالمزارع الأخرى.
كانت أعداد البكتيريا في اللبن أكثر قليلاً في اللبن المنتج من المزارع ذات الأحجام
الصغيرة، في حين كان تعداد البكتيريا السالبة لصبغة جرام أكثر في لبن المزارع ذات
الأحجام الكبيرة خلال الفصل الممطر الطويل وكذلك المزارع المتوسطة خلال موسم
الجفاف، بينما كان تعداد الخلايا الميتة أكثر قليلاً في لبن المزارع الكبيرة خلال الموسم
الممطر الطويل.
ظهر تأثير الموسم في المحتويات الأقل للدهن، البروتين والمواد الصلبة
اللابهدنية خلال موسم الجفاف للبن في مختلف المزارع، غير أن نسبة الحموضة لا
تختلف معاً خلال المواسم الثلاثة. كانت الكثافة النوعية ونقطة التجمد أكثر قليلاً في لبن المزارع الكبيرة خلال كل
المواسم، في حين كان لبن المزارع المتوسطة أكثر غشاً بالماء في كل المواسم مقارنة
بالمزارع الأخرى.
لوحظت التعداد الأقل للعد الكلي للبكتيريا والبكتيريا السالبة لصبغة جرام خلال الموسم
الممطر الطويل للبن المنتج في المزارع الكبيرة والمتوسطة على التوالي. في حين أوضح
الكوليفورم تعداداً أكثر خلال موسم الجفاف في اللبن المنتج من المزارع ذات الحجم
الصغير.
أوضحت النتائج وجود فروقات معنوية (P<0.05) للعدد الكلي للبكتيريا في اللبن
المنتج نتيجة التداخل بين المواقع المختلفة × مختلف أحجام المزارع وكذلك وجود
فروقات معنوية (P<0.01) نتيجة للتفاعل بين المواسم × أحجام الزراع وكذلك نتيجة للتفاعل بين المواسم والمواسم × أحجام الزراع حيث أن اللبن من المواقع المختلفة خلال المواسم المختلفة اظهر تعداد أفضل للبكتيريا الكلية للبن المنتج من المزارع الكبيرة من اللبن المنتج من المزارع الصغيرة والذي اظهر ظهوراً بالنسبة للعد الكلي للبكتيريا في اللبن، بينما لبن لبن المنتج في موسم الجاف جودة أفضل من اللبن المنتج خلال موسم الأمطار القصير وموسم الأمطار الطويل والذي كان في المدى (7×10^6 - 3×10^7 - 2×10^8) على التوالي.

اعطى تعداد خلايا البكتيريا السالبة لصبغة جرام فروقات معنوية (P<0.05) للبن المنتج نتيجة للتفاعل (الموسم × أحجام المزارع - المواسم × مواقع المزارع - الجو × مواقع المزارع) حيث اعطت أفضل جودة بالنسبة للبن المنتج من مزارع كبيرة مقارنة باللبن المنتج من مزارع متوسطة ومزارع صغيرة والذي اعطى (6×10^4 - 7×10^4 - 7×10^4) على التوالي.
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**Acronyms and abbreviations**
BSI : British Standards Institute
CC : Coliform Count
CSA : Central Statistics Agency
HPA : Health Protection Agency
IDF : International Dairy Federation
SNF : Solids- Non- Fat
SNV : Netherlands Development Organization
ILRI : International Livestock Research Institute
TBC : Total Bacterial Counts
SCC : Somatic Cell Counts
PCA : Plate Count Agar
EMDTI : Ethiopian Meat and Dairy Technology Institute
QA : Quality Assurance
EQSA : Ethiopian Quality and Standards Authority
FDA : Food and Drug Administration
HACCP : Hazard Analysis Critical Control Point
MoARD : Ministry of Agriculture and Rural Development (Ethiopia)
NRC : National Research Council
SPC : Standard Plate Count
TSS : Total Soluble Solids
BOAM : Business Organizations and Their Access to Markets
LRS : long rainy season
SRS : short rainy season
DS : Dry Season
IAR : Institute of Agricultural Research
CMT : California Mastitis Test
DMCC : Direct Microscopic Somatic Cell Counts
ASARECA : Association for Strengthening Agricultural Research in East and Central Africa
COMESA : Common Market for Eastern and Southern Africa
EAC : East African Community
SDP : Smallholder Dairy Project
FAO : Food and Agriculture Organization
SSA : Sub Saharan Africa