

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 \times farm sizes and also in the interaction between seasons \times locations \times 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 \times farm sizes, locations \times farm sizes and seasons \times locations \times 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 اديس ابابا بأثيوبيا في مركزين لتجميع الالبان سلوتا (التي تقع في إقليم الامهرا على بعد 20 كيلومتر شمال غرب اديس ابابا) ومركز جاجا (في إقليم الارومو على بعد 100 كيلومتر شمال شرق اديس ابابا) خلال ثلاثة مواسم (الممطر الطويل والممطر القصير والجاف) في مزارع مختلفة السعة (مزارع تحتوي على 10 ابقار حلوب واكثر ومزارع متوسطة بها ما بين 5-10 ابقار حلوب ومزارع صغيرة بها اقل من 5 ابقار حلوب). عينات اللبن التي جمعت من المناطق المذكورة تم ترحيلها في صناديق تحتوي على مكعبات ثلج إلي معمل اللحوم وتكنولوجيا الالبان الاثيوبي بمدينة دبيرى زيت (45 كيلومتر شمال غرب اديس ابابا) لإجراء الاختبارات الميكروبيولوجية بينما تجري بقية الاختبارات على مستوى المزرعة ويتم مقارنتها عن طريق الطرق التقليدية داخل المعمل ثم إجراء اختبار عينات الدراسة كيميائياً (نسبة الدهن % نسبة البروتين % نسبة الجوامد الصلبة غير الدهنية % ونسبة الحموضة)، فيزيائياً (الكثافة النوعية % نقطة الإنجماد ونسبة المضاف للبن) وميكروبيولوجياً (إختبار إختزال الريبوزاربين، عدد المستعمرات الكلي للباكتريا وعدد مستعمرات الباكثيريا لصبغة جرام و عدد الخلايا الميتة والكوليوفورم).

سجل اللبن المنتج في مركز تجميع جاجا محتوى كيميائياً (دهن، بروتين و مواد صلبة لا دهنية أعلى خلال الموسم الممطر الطويل، في حين لم تسجل نسبة الحموضة أي فروقات معنوية في كل المزارع خلال نفس الموسم. بخصوص الخواص الفيزيائية للبن المنتج والمجمع من مركزي سلوتا وجاجا، فقد سجل اللبن المنتج والمجمع في جاجا زيادة بسيطة في الكثافة النوعية خلال الموسم الممطر

القصير وموسم الجفاف ، بينما كانت ال قيم مرتفعة في مركز سلولتا بالنسبة للخواص الفيزيائية طوال العام .

سجل العد البكتيري أفضل النتائج خلال موسم الجفاف في كلا المركزين ، بينما سجلت قيم البكتريا السالبة لصبغة جرام عدداً أعلى خلال الموسم الممطر الطويل وكذلك عدداً أعلى للخلايا البكتيرية الميتة خلال الموسم الممطر القصير في مركز جاجا ، بينما أعطي المسح الذي أجري علي تعداد الكوليفورم في موسم الجفاف قيماً في مركز تجميع سلولتا أعلى من التي سجلت في مركز جاجا .

سجلت المزارع الكبيرة محتويات عالية من البروتين ، المواد الصلبة اللادھنية ، الكثافة النوعية ومحتوي قليل بالنسبة لذقطة التجمد خلال كل المواسم ، في حين أظهرت المزارع الصغيرة محتوى عالياً من الدهن والماء المضاف للبن م مقارنة بالمزارع الأخرى . كانت أعداد البكتريا في اللبن أكثر قليلاً في اللبن المنتج من المزارع ذات الأحجام الصغيرة ، في حين كان تعداد البكتريا 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 والجوامد الصلبة اللادھنية خلال موسم الجفاف للبن في مختلف المزارع ، غير أن نسبة الحموضة لا تختلف معنوياً خلال المواسم الثلاثة .

كانت الكثافة النوعية وذقطة التجمد أكثر قليلاً في لبن المزارع الكبيرة خلال كل المواسم ، في حين كان لبن المزارع المتوسطة أكثر غشاً بالماء في كل المواسم م مقارنة بالمزارع الأخرى .

لوحظ التعداد الأقل للعد الكلي للبكتريا والبكتريا السالبة لصبغة جرام خلال الموسم الممطر الطويل للبن المنتج في المزارع الكبيرة والمتوسطة علي التوالي . في حين أوضح الكوليفورم تعداداً أكثر خلال موسم الجفاف في اللبن المنتج من المزارع ذات الحجم الصغير .

أوضحت النتائج وجود فروقات معنوي (P<0.05) للعدد الكلي للبكتريا في اللبن

المنتج نتيجة التداخل بين المواقع المختلفة *مختلف احجام المزارع وكذلك وجود

فروقات معنوية ($P < 0.01$) نتيجة للتداخل بين المواسم \times احجام الزارع وكذلك نتيجة للتداخل بين المواسم والمواقع \times احجام المزارع ' حيث ان اللبن من المواقع المختلفة خلال المواسم المختلفة اظهر تعداد افضل للبكتيريا الكلية للبن المنتج من المزارع الكبيرة من اللبن المنتج من المزارع

الصغيرة والذي اظهر جودة بالنسبة للعد الكلي للبكتيريا في اللبن , بينما لبن اللبن المنتج في موسم الجفاف جودة افضل من اللبن المنتج خلال موسم الامطار القصير وموسم الامطار الطويل والذي كان في المدى ($7 \times 10^6 \cdot 3 \cdot 10^7 \times 2 \cdot 10^8$) على التوالي . اعطى تعداد خلايا البكتيريا السالبة لصبغة جرام فروقات معنوية ($P < 0.05$) للبن المنتج نتيجة للتداخل (الموسم \times احجام المزارع - المواقع \times احجام المزارع - المواسم \times المواقع \times احجام المزارع) حيث اعطت افضل جودة بالنسبة للبن المنتج من مزارع كبيرة مقارنة باللبن المنتج من مزارع متوسطة ومزارع صغيرة والذي اعطى ($6 \times 10^4 \cdot 7 \cdot 10^4 \times 7 \cdot 10^4$) 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