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MISSION REPORT

CAMEL BREEDING, PROTECTION AND ENVIRONMENT CENTRE RESEARCH ACTIVITIES IN THE KINGDOM OF SAUDI ARABIA

UTF/SAU/021/SAU

Dr Bernard FAYE

16-29 April 2010



May 2010



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TITLE : **Mission report : Camel Breeding, Protection and Environment
Centre Research Activities in the Kingdom of Saudi Arabia**

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Mission report, April 2010, Montpellier, France

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SUMMARY :

The present mission was the third involving the monitoring of scientific activities at the Al-Jouf *Camel and Range Research Centre* in the frame of the *Camel breeding, protection and improvement Centre in the Kingdom of Saudi Arabia*" (UTFN/SAU/021/SAU).

The following tasks were achieved:

- (1) Monitoring of the present research activities in the field of camel disease, camel farming systems and camel breed description,
- (2) Monitoring the current training achieved by the local staff (3) programming further training activities at Al-Jouf Center in the field of data management.

ABSTRACT

The present mission was the third involving the monitoring of scientific activities at the Al-Jouf *Camel and Range Research Centre* in the frame of the *Camel breeding, protection and improvement Centre in the Kingdom of Saudi Arabia*" (UTFN/SAU/021/SAU).

The following tasks were achieved:

- (1) Monitoring of the present research activities in the field of camel disease, camel farming systems and camel breed description,
- (2) Monitoring the current training achieved by the local staff (3) programming further training activities at Al-Jouf Center in the field of data management.

INTRODUCTION

As usual, the conditions and context will not be repeated in my successive reports. (FAYE B., 2009. Report on camel breeding, protection and environment centre research activities in the Kingdom of Saudi Arabia. UTF/SAU/021/SAU, 16-22 oct., 2009, 37 p. and FAYE B., 2010. Mission report on camel breeding, protection and environment centre research activities in the kingdom of Saudi Arabia. UTF/SAU/021/SAU. 2-19 Feb. 2010. Rapport de mission FAO/CIRAD-ES, Montpellier, 53 p.). The main purpose of the present mission was to support the scientific achievement of the protocols decided previously under the supervision of the Chief RNER and the FAO Programme Coordinator in KSA, under the technical supervision of the the LTO and in close collaboration with the National Project Director and project staff/counterparts. According the TORs, it is also necessary to prepare a program for training on data management.

1 - FOLLOW-UP OF THE RESEARCH PROPOSALS

- **Detection of subclinical mastitis in dromedary Camel (*Camelus dromedarius*) using Somatic cell count, California Mastitis Test and udder pathogens.**

In addition to the previous report, it has been observed an increase of the number of milk samples studied, but due to shortage of kit, the analysis will be pursued in few weeks. For the moment, data on SCC and on CMT test were entered into a database under Excel table.

A short training has been achieved during the mission and a first analysis was achieved showing some results to be completed.

Some examples: The relationships between CMT results and SCC showed a clear correlation between these two parameters whatever the quarter of the udder (figure 1).

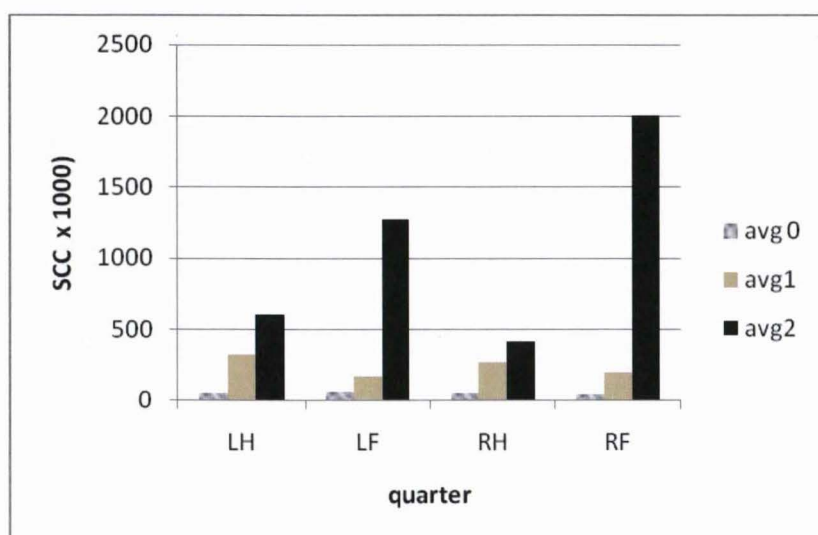


Figure 1. Relationships between Somatic cell count and CMT results in each quarter

The SCC is higher on average in front quarter compared to hind ones that is different than in cows, probably because the hind quarters in dairy camel are more protected than in cows (Figure 2).

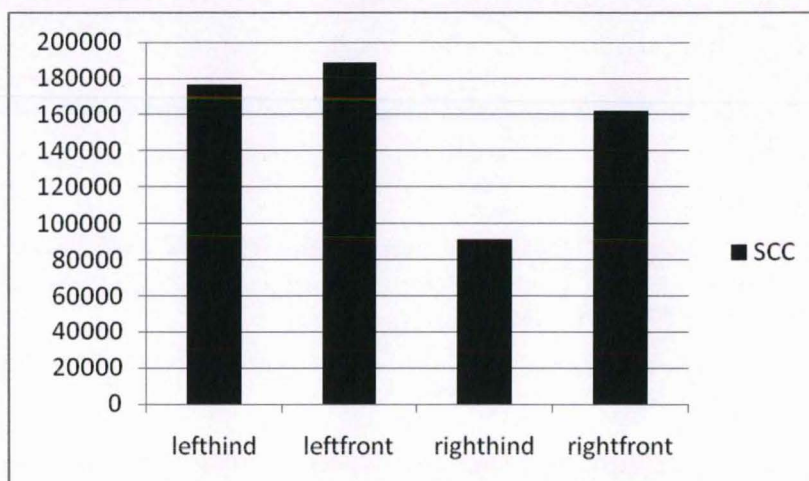


Figure 2. Mean SCC according to the quarter

By analyzing the mean SCC according to the total value of CMT (by adding the four quarters), a high correlation is observed but with a lower value than expected for CMT3. However, there is no statistical difference between CMT2, CMT3 and CMT' while the values for CMT1 and CMT0 are significantly lower (figure 3).

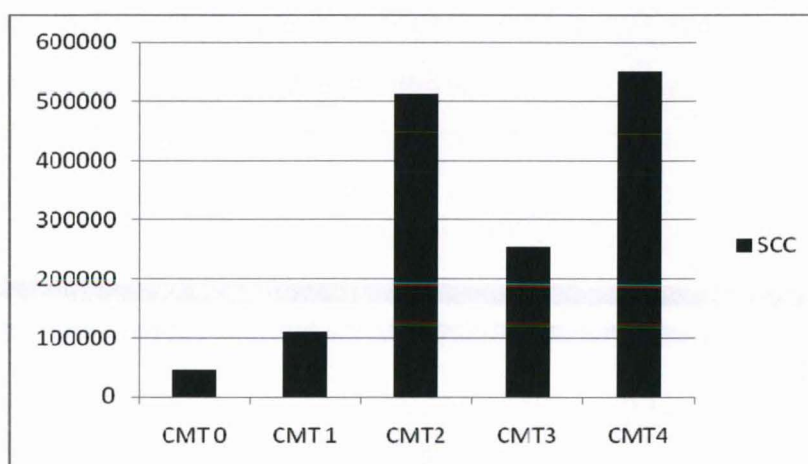


Figure 3. Relationship between total CMT values and SCC in camel milk

The contact with Dubai Dairy farm (Dr Peter NAGY) as well contacts with Al-Qassim University where similar studies are currently achieved, were not yet taken. The full analysis achieved during the present mission is proposed in annexe.

Milk Composition of camels

The protocol must be thank again in order to include more biochemical aspects but there is no biochemist in the centre. Only gross composition could be studied that is of low interest.

Effect of heat treatment on camel milk composition and some bacteriological parameters

There is a lack of human resource to achieve this protocol for the moment.

▪ Fattening performance and carcass characteristics of camels

The trial on fattening by using different diet was started in march 2010 The duration of the trial will be at least 4 months for animals between 4 to 8 months.

▪ Effect of different feeding levels on growth, sexual maturity and milk production

The trials are in progress and measurement and samplings are achieved. However, I strongly suggest integrating biochemical analysis of blood and Body condition scoring according to the score established by myself (see Faye B., Bengoumi M., Cleradin A., Tabarani A., Chilliard Y., 2001. Body condition score in dromedary camel : a tool for management of reproduction. Proc. of the International twin conf. On reproduction/production in camelids.. Al-Ain, Nov. 11-13, 2001, U.A.E. Emir. J. Agric.Sci., 13, 1-6). In addition to that, valorisation of milk data collected several years ago in the farm will be achieved. The data are entered in data table (Excell).

▪ Survey on the risk factors of the newborn diarrhea and identification of the main causal agents

Nothing is started

▪ ELISA in comparison with conventional method for detection of trypanosomosis in camel

The training of Dr IHAB ABDEL KARIM in France (UMR177-Trypanosomes at CIRAD-Montpellier) has been achieved in very good conditions. The applicant has learnt a lot of techniques and methodology. He need absolutely now to start as soon as possible the protocols on tryps.

▪ ELISA and PCR tests in the diagnosis of diseases in camels in KSA

As for the former protocol, the training of the technician at Biopharma lab (Morocco) is started. After this survey it could be expected to start collaboration on PPR within the survey on respiratory diseases as it has been suggested during the former mission. The former suggested activities are still available:

1. Achievement of a serological survey including questionnaire on animal moving (notably those crossing the borders?) with a stratified sample (mixed or pure camel herds) and using GIS if any. The serology could include PPR, Rift Valley Fever, Mycoplasma and could be achieved in Saudi Arabia in collaboration with a vet lab to be identified.
2. The collection of blood on filter paper (see procedure in annexe) in order to implement a data base for comparison with serology results. The optimal blood sampling could be 15 animals per farm with five less than 3 year olds, 5 between 3 and 5 years and 5 more than 5 years.
3. Training of a scientist in France with the sampling on filter paper (one month training at CIRAD in the reference lab)

▪ Study of selenium deficiency in Arabian camel

Blood samplless were collected during the last 3 months. Laboratory analysis of selenium will start soon.

▪ Camel genetic and Farming system survey

A first paper was published (reference: Sallal E. Mutairi, Ismail Boujenane, Abdelgader Musaad, Falah Awad-Achawari, 2010. Non-genetic factors influencing reproductive traits and calving weight in Saudi Camels. Trp. Anim. Health Prod., DOI 10.1007/s11250-010-9529-y).

The survey on phenotypes (breed description proposed by Dr BENGOUMI) is begun to be filled and a master student from CIRAD is arriving for 5 months in order to achieve the survey with Dr Hussein ABDALLAH. A first analysis of the first questionnaires (n=169) has been achieved during the mission showing the absence of links between the phenotype description by the farmers and the breed (figure 4). The method used was the Factorial analysis of multiple correspondences.

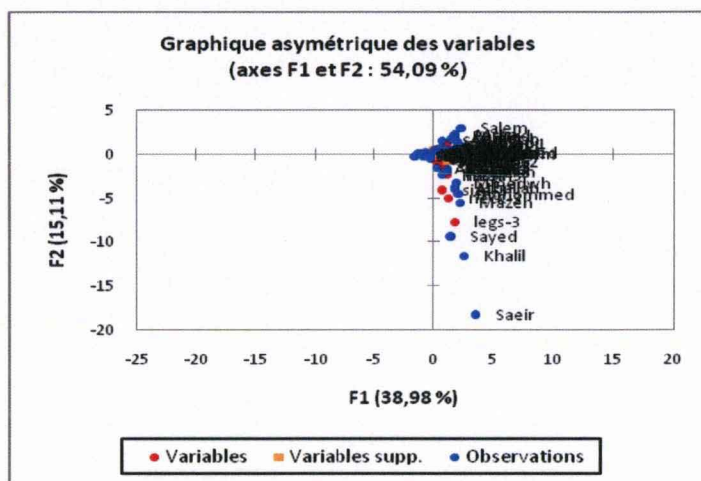


Figure 4. Projection on the factorial plan of the 169 descriptions of camels and of the variables with modalities describing the phenotypes. All the breeds (n=5) were integrated as supplementary variables.

The results showed that all the supplementary variables are projected at the centre of gravity of the factorial plan indicating the absence of links with the descriptive variables. It has been confirmed by a cluster analysis (figure 5).

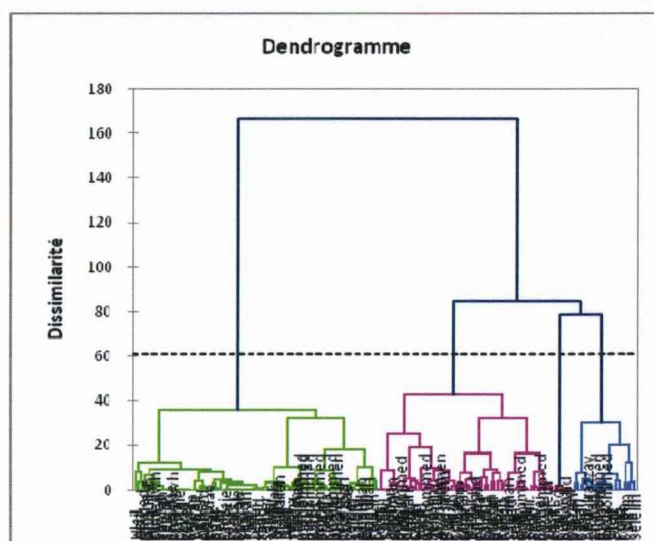


Figure 5. Classification of the 169 camels according to their phenotype description by the farmers. Four types are identified

The four identified types could be interpreted as: (1) small animals with big udder, (2) medium animals with high growth, (3) medium animals with short neck and legs, (4) Tall animals. There is no link between this four types and the main 5 breeds (figure 6).

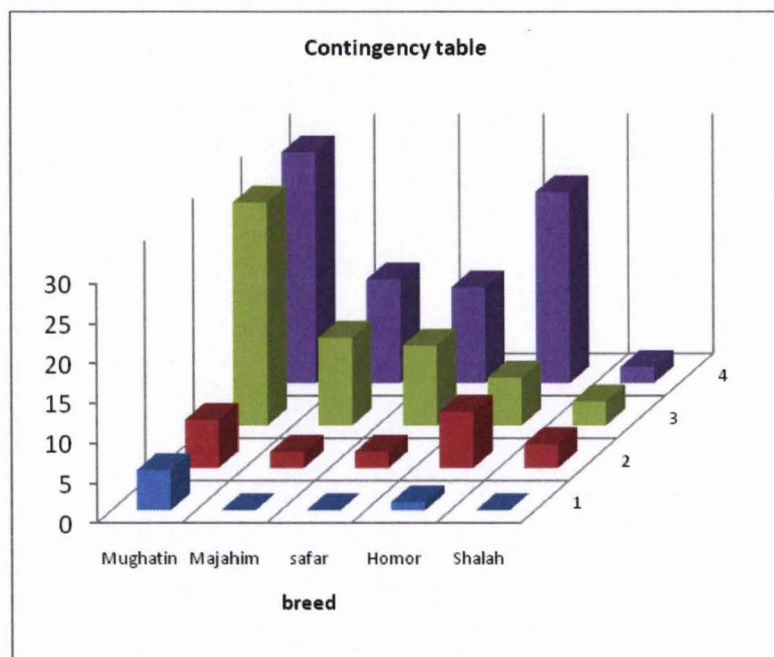


Figure 6. Distribution of the 5 camel breeds among the four phenotypes (Chi² test: $p < 0.067$)

However, by analyzing the only phenotype data separately of the physiological data (adaptation to stress, disease, starvation etc...), a significant difference between breeds is observed, contrary to phenotype description (see annex).

Thus, it has been proposed to achieve a new questionnaire (see annex 7) with the master student coming from France, in order to get reliable data on the phenotype description with measurements of the body and of the udder.

▪ Training on histology

The training of the lab technician (Saad Falah Al Sharary) in the Al-Jouf University with Prof Bashir Jarra has started. It has been proposed to start also a first study in slaughterhouse by taking samples on the animals at the abattoir and to perform histological comparisons. In the future, training in the vet lab of Al-Ain in Emirates (Pr El-Khouly) could be proposed. A project of **color Atlas on camel histology** is proposed commonly with the University at Al-Jouf. I suggested, better to achieve a book, to develop an on-line atlas (printing hard copy will be discussed later). A budget is proposed by the University but could be debatable. During my mission, a visit at the slaughterhouse was achieved at the Al-Jouf slaughterhouse, in order to prepare a sampling protocol for Mr Saad Falah.

▪ Website

The first version of the website www.cabpicksa.net is available. An English version have to be prepared (see annex).

According to the accumulation of data and the lack of know-how by the local staff, a training on data base management is highly recommended. This training could occur in next September. The content of the training is proposed in annex 2 and 3.

2 - ACHIEVEMENT OF THE PROPOSAL

Proposal	Leader	Timeframe	Progress	Observation
Survey on camel farming system, practices and breed description	Hussein Ridaa Abdallah	November 2009- December 2010	The surveys are on going, 170 questionnaires were achieved. First data treatment	Collaboration with MSc student from CIRAD (Rachid Mahmoudi) for data analysis arriving in april for 4 months
Study of selenium, copper and zinc deficiency in pregnant females and their new born camels	Osama Mahmoud Alhamna	January- December 2010	Protocol written, contacts taken with lab for analysis Sampling still continue	Lab analyses will be externalized.
Validation of CMT for camel subclinical mastitis using Somatic Cell Count and microbial count in the milk	Saeed Kamal Salih	November 2009 - July 2010	Protocol written, lab equipment purchased, 32 samples analyzed and first data treatment achieved	First publication could be done before June
Survey on the incidence of clinical trypanosomosis in Al-Jouf region	Ihab Abdel Karim	March 2010 - December 2010	Training in France achieved	Waiting for a new protocol and training of the other staff
Survey on the risk factors of the newborn diarrhoea and identification of the main causal agents	Mustafa Ibrahim Zeidan	January- December 2010	Protocol written, list of lab equipment established, waiting for reagents sampling not started	Still, the situation of Dr Zeidan is quite debatable but some efforts could be done by entering in the collective dynamic.
Identification of the main causal agents of the camel respiratory	Gamri Hashim Al Ramada	Marsh- December 2010	Protocol written, training on lab analysis in Biopharma (Morocco) almost achieved	It is still important to include Gamri in the PPR survey
The Effect of different heat treatments (T^0 /time) on camel milk composition and bacteriological parameters	Abdel Gadir Musaad	May - December 2010	No advance	Collaboration with Dr O. M. Khalil from the Al-Jouf University but not available still now
Effect of different feeding levels on growth, sexual maturity and milk production	Abdel Gadir Musaad	November 2009- December 2010	Experiment started in November 2009 Started detected ovary improvement by Ultrasound and measurements of the male organs. For milk production, experimental trial is starting with the sharing camels into four different groups receiving four different diets with different protein contents and energy	Collaboration and supervision by Dr M.A-Sayadi, University, King Abdulaziz, Riyadh. Study working on
Fattening performance and carcass characteristics of camels	Falah Awad-Acharari	July- December 2010	Trial started	Collaboration and supervision by Dr I. Boujenane, IAV Hassan II, Morocco. Study is on progress

Genetic characterization of camel breeds and breeding programmes	Abdel Gadir Musaad Falah Awad-Acharari	April 2009-December 2010	Two publications already achieved and published	- Work in achievement
Therapeutic effect of camel milk against diabetes	Abdel Gadir Musaad	June 2009-December 2010	List of lab equipment established. Protocol proposed to the University	Collaboration with Dr O.M. Khalil from the Al-Jouf University and the LTO
Milk productivity	Abdel Gadir Musaad	Started in March 2010	Data available. Data management and analysis training is necessary. Data entered in Excel table for the last four years	Supervised by B. Faye

3 - RECOMMENDATIONS

I recall and upscale the former recommendations

In the field of capacity building

- The first expected trainings (lab analysis especially) being achieved, the beneficiaries have to transfer their new know-how to their colleagues of the centre and prepare a protocol for the survey
- To organize a training on data base management for field survey and data monitoring with specific software (one mission for CIRAD expert proposed for September 2010)- see TOR proposal in annex?
- To start a survey on PPR and respiratory diseases after writing protocol.
- To improve the English level of the staff
- To participate to the camel disease workshop in June

In the field of partnerships:

- To reinforce collaboration with Al-Jouf University around the common project on Alas histology after discussing the convenient budget
- To encourage the motivated staff to be registered at the University for master degree course (under national or international supervision).
- To strengthen the links with international partners working on camel sciences by establishing contacts at least by email.
- To participate for national and international events on camel (the participation to the next ISOCARD 2012 is encouraged and to an international meeting in Saudi Arabia proposed in the former report). Also camel meeting in Vienna and in Khartoum in October 2010

In the field of research facilities:

- To improve access to the library and generally to international journals (subscription du Journal of Camelid Sciences, Journal of Camel Practice and Research at least) by the purchase of the proposed books in the former report.
- To engage training and implementation on data management and treatment as mentioned above.

- To take the convenient contacts for using the acquired material and lab analysis
- To purchase urgently the necessary reagents in the field of camel disease diagnosis.
- To purchase a statistical software for data treatment (for example XLstat ©)

In the field of communication

- A cycle of one-day seminars for Vets, Vet Assistants and farmers is started in 2010 (camel diseases and production) and in 2011 (camel farming management) according to the former proposal. Those seminars could be organized by the whole staff of the centre. Organization of two advanced training courses for the cadres for the MOA on Camel diseases (June 2010) and Camel Production (October 2010).
- It is suggested to engage an operational support for the library management and in a first step, to designate a responsible for documentation and improve the quality of the library, first by purchasing some basic books on camel sciences (see proposals in February). A training of the responsible for documentation is proposed (use of electronic library, bibliographical database inquiry, camel publication monitoring). This training could be organized at CIRAD and includes staff from other centers supervised by FAO.
- To buy Endnote© software in order to manage bibliographical data on camel and to implement a database on all references on camel. This database is available at CIRAD and could be provided to the center free but it needs Endnote © license for all the staff (see www.EndNote.com). The distributor for Arabic version is in Egypt: **Alex centre for Multimedia & libraries (ACML)** 181-183 Ahmed Shawky Street, Roushdy, Alexandria, Egypt www.acml-egypt.com; info@acml-egypt.com; Phone: +2 03 5411741; Fax: +2 03 5411742.
- To encourage the maintenance of the CRRC website and to develop an on-line book on camel histology

CONCLUSION

There is a certain dynamic that should be sustained to involve all the staff. It is necessary to push the members of the centre, but they have to be also encouraged when they take initiatives. I insist on the necessity to train them in the field of data management and data analysis. But they have to feel themselves engaged in the progress of knowledge and activities.

ACKNOWLEDGEMENTS

Thanks to all the staff both in FAO national office at Riyadh and in the Camel Center for their support in order to achieve the activities of the project.

ANNEXES

- ANNEXE 1 - Calendar of the mission**
- ANNEXE 2 - Training proposal for data management**
- ANNEXE 3 - TOR for data management training**
- ANNEXE 4 - Part of the present website**
- ANNEXE 5 - Statistical report on CMT and SCC analysis**
- ANNEXE 6 - Statistical report on phenotype survey**
- ANNEXE 7 - Questionnaire on camel phenotype description**

ANNEXE 1

Calendar of the mission

Calendar and encountered personalities

Friday 16th April

- Departure from Cairo
- Arrival at Riyadh

Saturday 17th April

- Meeting with FAO officer at Riyadh (Abdullah OIHABI)
- Departure to Al-Jouf

Sunday 18th April

- Meeting with the different scientists of the centre
- Discussion on the protocols
- Preparation of the first one-day seminar
- Data treatment of genetic survey with Dr HUSSAIN

Monday 19th April

- Visiting the experiments in the camel farm at Al-Jouf
- Data treatment of mastitis data (Dr SAID)

Tuesday 20th April

- Writing project document
- Discussion on master training

Wednesday 21th April

- Preparation of statistical reports
- Discussion on phenotype questionnaire

Thursday 22th April

- Statistical report on phenotype analysis

Friday 23th April

- Writing report

Saturday 24th April

- Visit of the University of Al-Jouf (Dr BASHIR JARRA and BELGUTH HATEM)
- Meeting with Dr AL-FADDA (Al-Jouf Veterinary administration)
- Preparation of powerpoint for the first one-day seminar on infectious diseases on camel

Sunday 25th April

- One-day seminar on infectious multifactorial diseases in camel (mastitis, calf diarrhea, respiratory disease)

Monday 26th April

- Visit to the slaughterhouse at Sakaka
- Meeting with the Dean of Al-Jouf University
- Preparation of training period for EPSED students
- Invitation in the Prince MANSOUR's farm
- Meeting with Dr SALLAL
- Visit again the slaughterhouse with SAAD FALAH and DR SAID

Tuesday 27th April

- Departure for Riyadh
 - Discussion with Mr Brahim DJAOUED HARZALLAH (EPSED master student) before his arrival to Al-Jouf
 - Finalization of the phenotype questionnaire
 - Meeting by telephone with Karim MAHMOUDI (second EPSED master)
 - Report writing

Wednesday 28th April

- End of report writing
- Restitution of the report to FAO officer

Thursday 29th April

- Departure for Montpellier

ANNEXE 2

Training proposal for data management

Training proposal

Training Microsoft Access

16 - 30 September 2010 - Al-Jouf
Camel Breeding Protection and Environment Center

Context

In the Research Center at Al-Jouf, Several surveys and data collection are achieving including :

- (i) Survey on camel farming system,
- (ii) Survey on breed characteristics,
- (iii) Survey on camel diseases (including a future survey on PPR and respiratory diseases and a survey on trypanosomosis),
- (iv) Database on lab analysis in the frame of camel diseases survey.

Those data have a common part (same animals and/or same camel farms, including the camel farm of the Centre).

These several surveys and data collection generate many data file (often in different format).

A data management system like Microsoft Access allows to centralize information and to provide more flexibility in their consulting and valuation.

We offer training aimed Microsoft Access master the concepts of databases and manipulation software.

The work is done step by step, each learner performs the manipulation and must perform exercises. It is possible to work directly on data belonging to the learners for the practical learning part.

Duration

Travel Montpellier to Al-Jouf	Thursday 16 September, Friday 17 September
Courses	Saturday 18 September to Wednesday 29 September
Travail Al-Jouf to Montpellier	Wednesday 29 September, Thursday 30 September
Total of days	15

Contact Persons

Xavier JUANES Specialist of data base management @ xavier.juanes@cirad.fr
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Component

1. Starting Microsoft Access

Create Database, Navigation Pane, Database tools, Ribbon and tool bar,

2. Table and object

Concept, Fields, Data Properties, Data entry, Filter/Sorting, Relationship, Replace data, Design view

3. Form

Form Wizard, field object, button, controls, sub-form, Data Entry, Properties, Design view, Templates

4. Query

Query Wizard, Design view, Syntax SQL, Operations, Action Queries, Parameters

5. Report

Report Wizard, field object, format, Section properties, Design view, Templates, Graphics, Charts, Sub-Report

6. Macro

Design, using in forms

7. Manage Data base

Compact, Import data, Export data, Split database

Admission

This course is open to veterinarians, agronomists, engineers or academics who wish to enhance their skills.

This course may be followed by candidates not belonging to these categories, but can demonstrate sufficient professional experience.

A good knowledge of Windows environment XP Microsoft ® and data manipulation (Excel, statistic software) is required.

The training is conducted in English.

The number of participants is limited to 10.

Materials

A room equipped with a video projector and a whiteboard are needed.

A computer with Microsoft Access must be available for each learner or group of 2 students.

Course materials will be provided to each learner.

Cost

Total of days	15
Cost including travel	10.000 USD

ANNEXE 3

TOR for data management training

TOR for Data management training

Terms of Reference

International expert: Data base management in camel livestock

Duty station: Al Jouf
Duration: 2 weeks
EOD: September 30th 2010

Description of duties:

Under the overall supervision of the Chief RNER and the FAO Programme Coordinator in KSA, under the technical supervision of the related technical division and in close collaboration with the National Project Director and staff/counterparts of the UTF/SAU/021/SAU project, the expert will be responsible for:

1. Prepare a programme with a precise schedule for the training course covering documentation, preparation of data base management for camel farming survey and disease control
2. Conduct the training both on theoretical and mainly practical aspect for 10 participants from the Centre and other Regional research centers for two weeks - starting 16th September 2010 to 29th September 2010 using the facilities in the Camel and Range Research Centre.
3. Conduct the training on software LASER for setting up a camel farm monitoring
4. Built the architecture of the data base including all the current surveys achieved in the Center
5. Assess the understanding of the training course by the trainees
6. Support the individual demand in data base management
7. Write a report on the training course and give conclusions and recommendations

ANNEXE 4

Part of the present website



English

1.



المجلس العلمي

المختبرات

ألبوم صور



• موقع المشروع

تم إنشاء مشروع تربية وحماية وتحسين الإبل في المملكة بمركز أبحاث الإبل والمراعي بالجوف.

• وصف مختصر للمشروع

يهدف المشروع إلى إنشاء وتأسيس مركز بإعطي المسميات العالمية وذلك بتوفير البنية التحتية والتجهيزات بالمعدات العلمية المتطورة والقوى العاملة المتخصصة في المجالات المختلفة، وذلك لتحسين سلالات الإبل وإنتاجها وصحتها وحمايتها من الأمراض للحفاظ على الإرث الوطني الاجتماعي بالإضافة لسد الفجوة في المعلومات والبيانات المتعلقة بتطوير مبدل انتاج وحماية الإبل وتنسيق ودعم تأسيس الهيكل البحثي للرفع من كفاءات ومهارات الكوادر الوطنية. كما سيعنى المركز بتعزيز مجمل القدرات في مناحي الخدمات البيطرية المتطورة، وتوسيع أطر التعاون في المجالات البحثية والإرشادية مع كافة مراكز الأبحاث ذات الصلة داخل المملكة وخارجها على المستويين الإقليمي والعالمي لتحقيق ودعم الأمن الغذائي وتطوير الاقتصاد الاجتماعي لقطاع كبير من السكان اللذين يعتمدون على الإبل في



ANNEXE 5

Statistical report on CMT and SCC analysis

Statistical report on CMT/SCC analysis (data of Dr SAEED)

STATISTICAL REPORT ON CMT/SCC ANALYSIS

1. The raw data

Two types of data are available: the SCC per quarter (left hind, left front, right hind and right front) (table 1) and the CMT results per quarter (table 2)

Table 1. SCC results by quarter in camel

SCC			
Lh	Lf	Rh	Rf
294000		145000	38000
10000	10000	10000	10000
10000	10000	10000	28000
10000	10000	12000	10000
11000	15000	21000	69000

Table 2. CMT results per quarter in camel

LH	LF	RH	RF	total
0	1	0	1	2
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

A dataset gathering the 2 sets of data was built by corresponding animal. In addition of that, the mean SCC for one animal was calculated as well as the sum of CMT (sum of the four quarters) and the average of CMT (although this concept could be widely debatable). Finally we got the final datatable (table 3).

Table 3. Final dataset on SCC and CMT values per animal

Lh	Lf	Rh	Rf	Mean SCC	LH	LF	RH	RF	total	Mean CMT
294000		145000	38000	550833	0	1	0	1	2	0,5
10000	10000	10000	10000	10000	0	0	0	0	0	0
10000	10000	10000	28000	14500	0	0	0	0	0	0
10000	10000	12000	10000	10500	0	0	0	0	0	0
11000	15000	21000	69000	29000	0	0	0	0	0	0

2. Description of the data

- **Average SCC per quarter:** The SCC values are higher in the left quarters but the differences are not significant (table 4 and figure 1).. The variance analysis applied on logSCC (in order to normalize the values) showed no difference ($P=0.548$)

Table 4. Mean and standard-deviation of the SCC values according to the quarter

lefthind	leftfront	righthind	rightfront	
176227,273	188818,182	90818,1818	161826,087	187612,319
203579,094	359896,233	118465,145	410989,344	219893,919

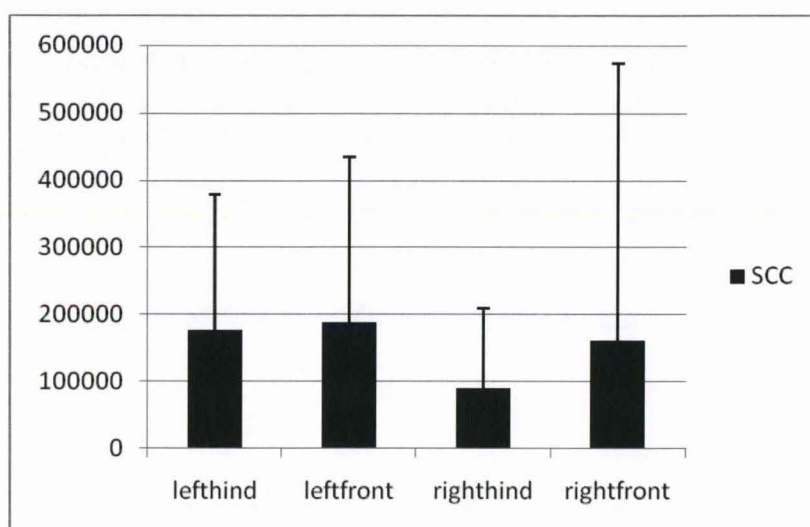


Figure 1. Mean and S.D. of the SCC values according to the quarter

The mean SCC value in camel is $187,612 \pm 219,893$. The missing data were discarded from the calculation. The extremes-values are 10,000 (limit of detection) and 2 000,000 cells.

• CMT distribution per quarter

The high CMT values are more often encountered on the left quarters: 35% of Lh quarter are affected by CMT value 1 or 2, and 26% for Lf, vs 13% and 22% for Rh and Rf respectively.

• Relationships between SCC and CMT

A first analysis takes into account the mean SCC value according to the quarter and to the CMT value, 0, 1 or 2. As it is expected, the SCC values increase significantly when CMT score is increasing especially when the value is 2 (table 5)

Table 5. Mean SCC values according to the quarter and CMT score

	LH	LF	RH	RF
CMT0	52,4	57,8	55	44,9
CMT1	324	173,5	268	201
CMT2	600	1268	417	2000

The highest averages are observed in the front quarters (Figure 2), that is different usually than in cow. Probably the anatomy of camel with a narrow basin could explain a better protection of the hind quarters?

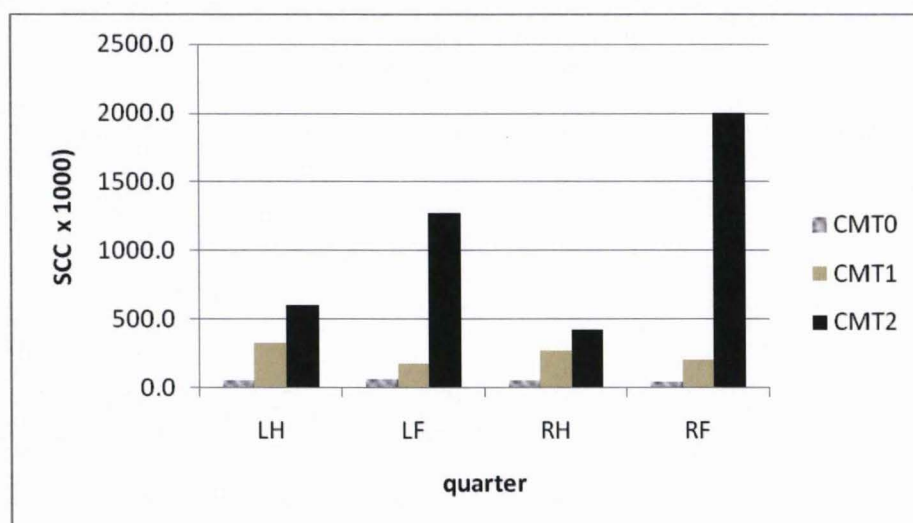


Figure 2. SCC values according the quarter and CMT scoring (0, 1 or 2)

By adding the CMT scores for each animal, we get a significant increase of SCC values with the increasing score. However, the relation does not appear linear (Figure 3). The SCC value for CMT4 is significantly different of SCC values for CMT09 and CMT1 but not with SCC values for CMT2 and 3 (variance analysis on logSCC). The total model is highly significant ($p < 0.0001$) (Table 6)

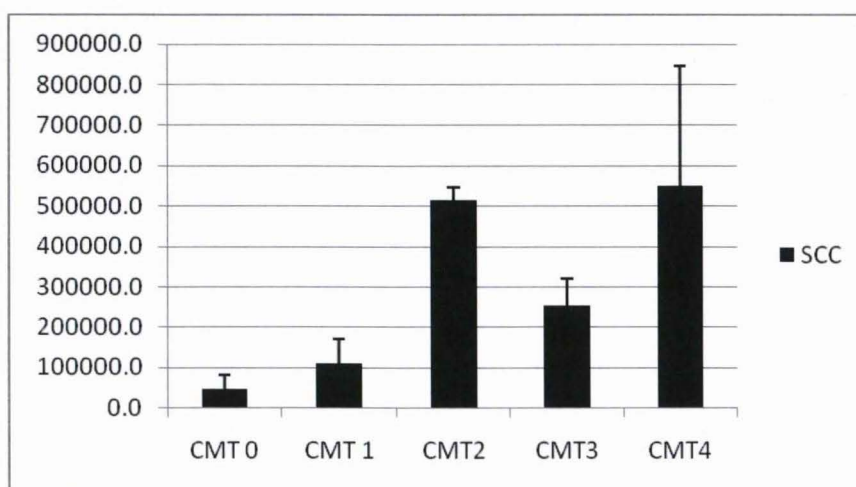


Figure 3. Mean and S.D of SCC values according to the total CMT score for one animal

	Mean	SD
CMT 0	46025,0 ^a	36870,0
CMT 1	111291,7 ^a	59473,2
CMT2	513916,7 ^b	33248,2
CMT3	253375,0 ^b	66291,3
CMT4	550833,3 ^b	294896,2

Table 6. Mean and SCC values according to the total CMT score for one animal (the different letters mean significant difference at $p < 0.001$).

These relationships are confirmed by the use of Spearman correlation which is highly significant ($r = 0.848$; $P < 0.0001$) (table 7).

Variables	Mean SCC	Mean CMT
meanSCC	1	0,848
meanCMT	0,848	1

Table 7. Correlation matrix between SCC values and total CMT score

ANNEXE 6

Statistical report on phenotype survey

Statistical report on camel phenotype analysis

1. The raw Data

Name	breed	color	hair	size	head	ears	neck	legs	mam	mlk	grow	race	rep	mor	deh	star	dis	mast	abor
Rashed	1	1	3	1	1	2	1	1	3	2	1	3	3	3	2	3	3	3	2
khalad	1	1	2	2	2	2	1	1	1	1	2	3	1	3	1	2	2	2	2
hussin	1	1	2	2	2	3	1	2	2	2	3	3	2	3	1	1	3	3	3
massalem	1	1	2	1	2	2	1	1	3	2	2	3	2	2	2	3	3	3	3
mahamed	1	1	2	2	2	3	1	2	2	2	3	3	2	3	1	1	3	3	3
Sayed	1	1	2	2	2	3	1	1	1	2	2	3	2	3	2	1	2	3	3
Bashir	1	1	2	1	2	2	1	1	3	2	2	3	2	3	2	2	3	3	3

The originate table included 164 rows (farmers) after discarding 5 corresponding to rare described breed. Two types of variables are collected in this table:

- Phenotype data describing the different animals according to the perception of the owner: color, length of hair, size, length of the head, type of ears, length of the neck and of the legs, type of udder
- Physiological characteristics: milk production, growth performance, ability to race, reproduction performance, young mortality, adaptation to dehydration and starvation, resistance to disease, to mastitis and to abortion.

After a general analysis giving no convenient results, it was decided to treat the 2 sets of data separately. As the whole we got 2 tables of 164 animals belonging to 86 camel farmers.

2. Statistical strategy

The objective of the data analysis is to identify homogenous groups of animals (by their phenotype or their physiological characteristics) and to compare these types with the breed affectation. So, the following methods are used:

- Multiple correspondence analysis with the breed as supplementary variable in order to identify the link between the variables
- A hierarchical ascending classification of the animals in order to identify types of phenotype and types of physiological profile
- A confrontation of these types with the camel breeds affectation with a chi-square test to quantify the links between types and breed
- A confrontation of the types of phenotype and of physiological profiles in order to express the eventual link between them.

3. Analysis of camel phenotypes

After discarding 3 breeds rarely represented, 5 breeds only were retained:

1	white	Al-maghatat
2	black	Al-majahim
3	dark brown	sofor
4	dark yellow	homor
7	red	shaleh

Only phenotypes variables were taken in account. The data table was as follow (table 1):

Name	breed	color	nbbreed	hair	size	head	ears	neck	legs	mam
Rashed	1	1	17	3	1	1	2	1	1	3
khalad	1	1	35	2	2	2	2	1	1	1
hussin	1	1	52	2	2	2	3	1	2	2
massalem	1	1	50	2	1	2	2	1	1	3
mahammed	1	1	39	2	2	2	3	1	2	2
Sayed	1	1	70	2	2	2	3	1	1	1
Bashir	1	1	10	2	1	2	2	1	1	3

Table 1: Phenotype data set describing the camel according to their anatomical characteristics.

The breed being defined by their color, only breed belonging was taken in account in the further analysis. The number of animals of the same breed belonging to each farmer (variable nbbreed) was not taken in account in the analysis.

The multivariate analysis of this table give a predominance of the two first factors expressing 82% of the variance (figure 1):

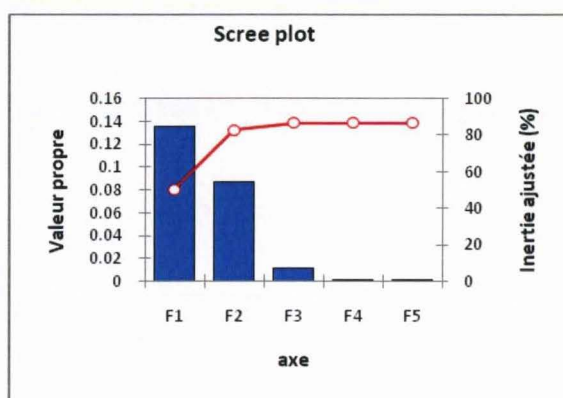


Figure 1. Variance explained by the first factors of the MCA
The two main axes could be interpreted as follow (table 2)

	F1	F2
hair-1	4,715	1,671
hair-2	-3,375	-0,031
hair-3	-0,081	-1,517
size-1	8,245	1,814
size-2	-8,093	1,349
size-3	0,140	-10,243
head-1	7,168	2,349
head-2	-7,411	0,868
head-3	1,257	-9,370
ears-1	8,190	1,336
ears-2	-7,748	1,652
ears-3	0,633	-4,701
neck-1	10,804	2,475
neck-2	-11,158	-0,460
neck-3	1,549	-9,175
legs-1	10,437	1,658
legs-2	-10,613	0,038
legs-3	1,194	-10,853
mam-1	6,302	1,808
mam-2	-8,259	1,678
mam-3	3,915	-4,813
breed-1	-0,142	-1,162
breed-2	0,120	1,086
breed-3	0,911	1,470
breed-4	-1,240	-0,695
breed-7	1,056	-0,234

Table 2. Test-values of the modalities to the two first factors

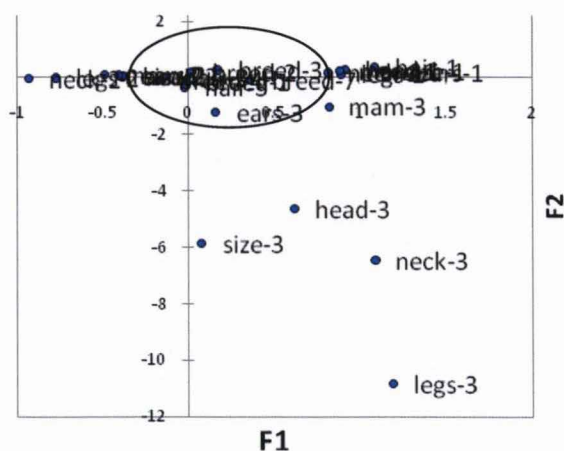


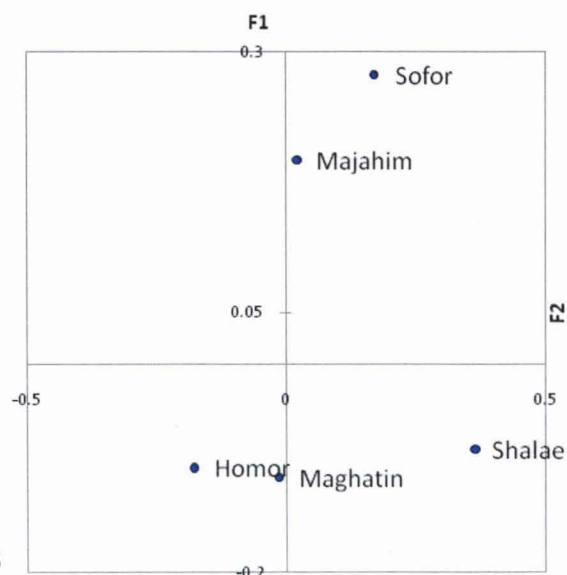
Figure 3. Projection of the camel breed on the first factorial plan (1,2)

F1 expressed the opposition between camels having in one side long hair, tall size, big head, long ears, long neck, long legs, big udder to animals with all medium characteristics for all parameters.

F2 expressed the presence of animals with small size, small head and ears, small neck and legs, then small udder (figure 2).

All the breeds are not well represented on these 2 factors and the variability was very low (figure2 and 3).

Figure 2. Factorial plan (1,2) representing the phenotype variables. The breeds are represented within the circle and are all close to the centre of gravity.



The classification of the camel gave a dendrogramme expressing four types of camels (figure 4)

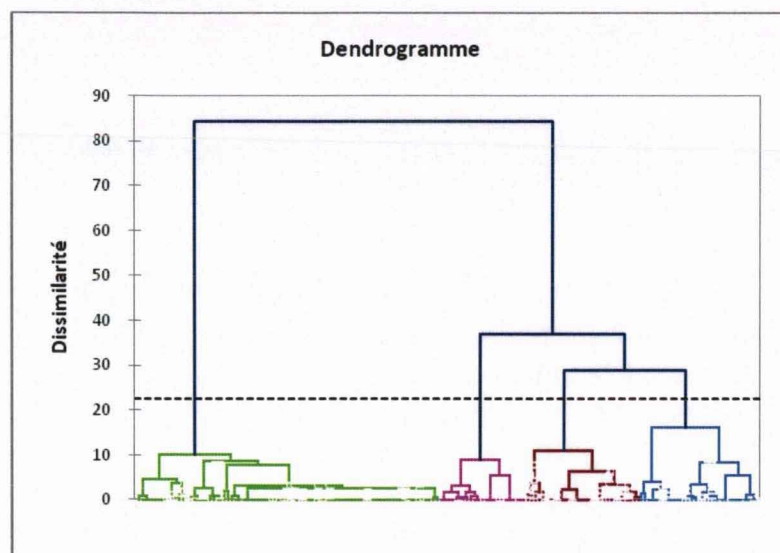


Figure 4. Typology of phenotypes showing 4 types of animals

The 4 types could be described as follow (table 3):

Phenotype 1: short hair, tall size, big head, medium ears long neck and legs, small udder

Phenotype 2: Medium parameters except long neck and legs

Phenotype 3: all parameters medium

Phenotype 4: all parameters more or less long

Phenotype	hair	size	head	ears	neck	legs	mam
1	2,217	1,000	1,261	1,696	1,000	1,000	2,565
2	1,933	2,033	1,767	2,367	1,033	1,200	1,633
3	2,125	1,975	1,925	2,013	1,988	1,975	1,988
4	1,677	1,581	1,645	1,129	1,032	1,194	1,355

Table 3. Description of the 4 phenotypes according to the classification (long parameters close to 1, short ones close to 3)

The cross table phenotypes x breed (table 4) shows a weak interaction between them ($\chi^2 = 21$ for 12 ddl; $p < 0.05$).

	phenotype1	phenotype2	phenotype3	phenotype4
Al-maghater	14	16	32	6
Al-majahim	2	3	14	7
sofor	1	2	12	9
homor	3	7	19	9
shaleh	3	2	3	0

Table 4. Cross-table phenotype x breed

The phenotype 1 was represented by all the breeds except Sofor

All breeds are presented in phenotypes 2 and 3 and Sofor is predominant in phenotype 4 (table 5)

	phenotype1	phenotype2	phenotype3	phenotype4	Total
Al-maghater	20,6	23,5	47,1	8,8	100
Al-majahim	7,7	11,5	53,8	26,9	100
sofor	4,2	8,3	50,0	37,5	100
homor	7,9	18,4	50,0	23,7	100
shaleh	37,5	25,0	37,5	0,0	100
Total	14,0	18,3	48,8	18,9	100

Table 5. Percentage of each breed among the phenotypes: in green the significant lower values, in yellow, the significant higher values.

In conclusion: the different breeds are not clearly discriminated by their phenotypes perceived by the farmers according to the available data.

4. Analysis of camel physiological characteristics

Similar analysis was achieved on the followed data set (table 6).

Name	breed	milkQ	growth	racabi	repeff	youmor	addeh	adstar	sendi	senma	senabor
Rashed	1	2	1	3	3	3	2	3	3	3	2
khalad	1	1	2	3	1	3	1	2	2	2	2
hussin	1	2	3	3	2	3	1	1	3	3	3
massalem	1	2	2	3	2	2	2	3	3	3	3
mahammed	1	2	3	3	2	3	1	1	3	3	3
Sayed	1	2	2	3	2	3	2	1	2	3	3
Bashir	1	2	2	3	2	3	2	2	3	3	3

Table 6. Physiological data set describing the camel according to their physiological characteristics.

The multivariate analysis of this table give a predominance of the two first factors expressing 61% of the variance (figure 1):

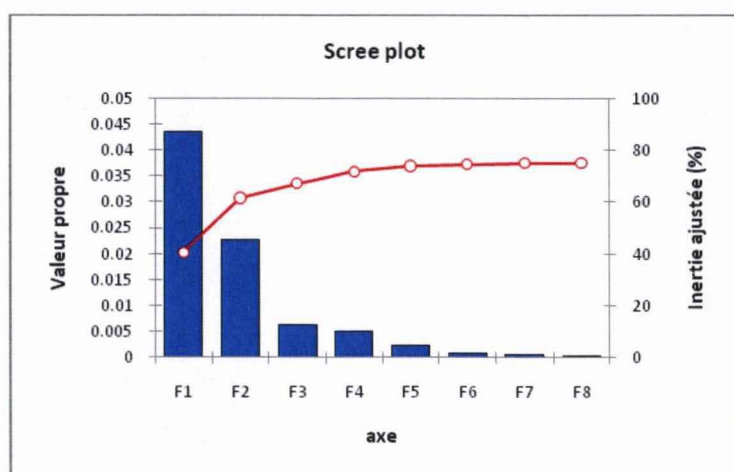


Figure 5. Variance explained by the first factors of the MCA

The two main axes could be interpreted as follow (table 7)

F1 expressed the opposition between camels having in one side high milk yield, high growth, good ability to race, high reproduction performance, to resistance to dehydration and starvation, but also high sensitivity to disease, mastitis and abortion, and the other side all medium parameters, except the low sensitivity to disease, mastitis and abortion. The first factor oppose mainly Shaleh to all other.

F2 expressed the presence of animals with low milk yield, medium growth, racing ability, reproductive performance, low young mortality in opposition to camels with high growth, low racing ability, low reproductive performance, low resistance to starvation and dehydration and medium sensitivity to abortion (figure 6). This last profile is mainly linked to Maghater breed (figure 7).

	F1	F2
milkQ-1	3,013	1,787
milkQ-2	-4,537	-2,979
milkQ-3	2,816	2,108
growth-1	5,091	-5,740
growth-2	-6,733	5,182
growth-3	3,548	0,472
racabi-1	4,072	0,952
racabi-2	-6,518	4,163
racabi-3	3,284	-4,694
repeff-1	5,520	-0,249
repeff-2	-5,386	5,330
repeff-3	-0,099	-9,409
youmor-1	1,540	-0,240
youmor-2	-1,192	-2,851
youmor-3	0,310	2,718
addeh-1	8,316	0,925
addeh-2	-8,275	1,062
addeh-3	0,036	-5,747
adstar-1	7,429	1,402
adstar-2	-7,069	3,821
adstar-3	-0,564	-10,004
sendi-1	7,509	2,830
sendi-2	0,635	2,234
sendi-3	-4,051	-3,503
senma-1	7,905	1,599
senma-2	1,465	0,226
senma-3	-6,569	-1,270
senabor-1	7,745	2,601
senabor-2	0,475	-7,486
senabor-3	-5,378	4,430
breed-1	-1,276	-2,850
breed-2	-0,070	1,423
breed-3	0,526	0,252
breed-4	-0,872	1,017
breed-7	3,882	1,699

Table 7. Test-values of the modalities to the two first factors

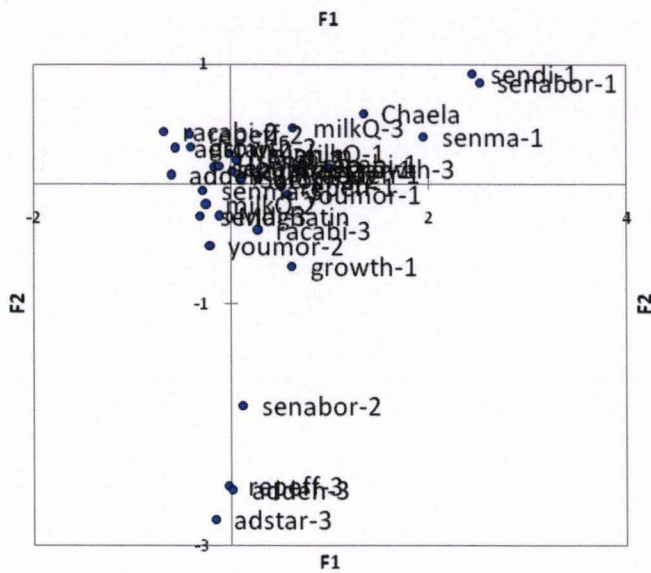
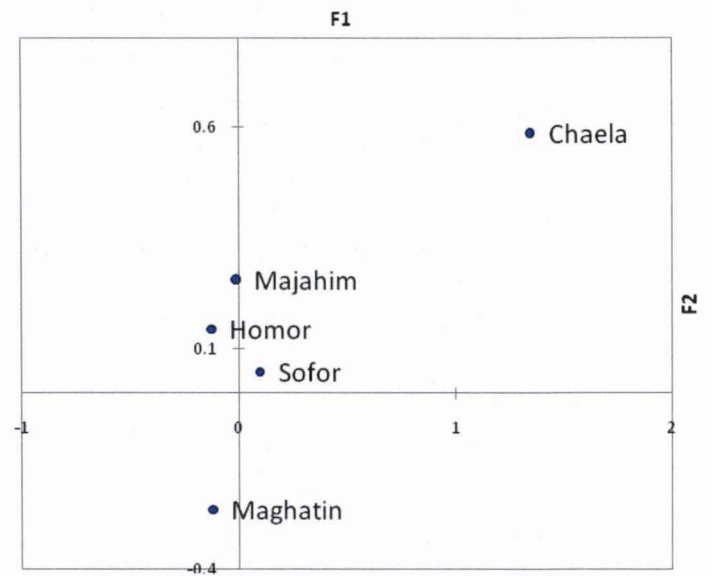


Figure 6. Factorial plan (1,2) representing the physiological variables. The breeds are relatively closed to the centre of gravity except the breed Shaela.

Figure 7. Projection of the camel breed on the first factorial plan (1,2)



The most different breeds are Chaela and Maghater which are in opposite mainly on facteur 2.

The classification of the camel gave a dendrogramme expressing four types of camels (figure 8)

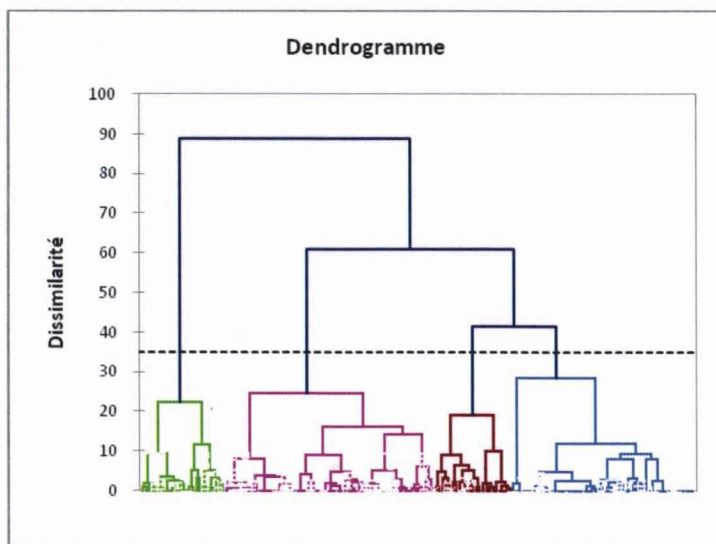


Figure 8. Typology of physiology showing 4 types of animals

The 4 types could be described as follow (table 8):

Physiol 1: medium in all parameters but low mastitis sensitivity

Physiol 2: Low adaptation and sensitivity to diseases

Physiol 3: high race ability, young mortality, sensitivity to disease and abortion

Physiol 4: low growth, race ability, reproduction performance, medium young mortality and high sensitivity to abortion.

Classe	milkQ	growth	racabi	repeff	youmor	addeh	adstar	sendi	senma	senabor
1	2,037	1,907	2,111	2,037	2,833	2,019	2,185	2,574	2,907	2,889
2	1,840	1,800	2,320	1,680	2,800	1,120	1,200	1,800	1,440	2,000
3	1,790	1,742	2,871	1,419	2,903	1,484	1,403	2,677	2,887	2,984
4	1,783	1,522	1,348	1,435	2,130	1,435	1,478	2,304	2,870	2,957

Table 8. Description of the 4 phenotypes according to the classification of physiological data. The values in yellow are significantly the lowest and in brown the highest for each column

The cross table physiological profile x breed (table 9) shows a medium interaction between them ($\chi^2 = 21$ for 12 ddl; $p < 0.003$).

	Classe-1	Classe-2	Classe-3	Classe-4
Al-maghater	23	8	30	7
Al-majahim	7	3	12	4
sofor	2	4	14	4
homor	20	6	6	6
shaleh	2	4	0	2

Table 9. Cross-table physiological class x breed

The type 1 was represented mainly by Homor, the type 2 by Shaele and the type 3 by Sofor. All breeds are presented in type 4 (table 10)

	Classe-1	Classe-2	Classe-3	Classe-4	Total
Al-maghater	33,824	11,765	44,118	10,294	100
Al-majahim	26,923	11,538	46,154	15,385	100
sofor	8,333	16,667	58,333	16,667	100
homor	52,632	15,789	15,789	15,789	100
shaleh	25,000	50,000	0,000	25,000	100
Total	32,927	15,244	37,805	14,024	100

Table 10. Percentage of each breed among the physiological types: in yellow the significant lower values, in brown, the significant higher values.

Conclusion: Only 3 breeds (Sofor, Homor and Shaleh) could be described by a physiological profile. Homor is medium in all parameters but have low sensitivity to mastitis. Sofor is considered having good race ability but high sensitivity to disease, abortion and young mortality. Shaleh is not well adapted to starvation and dehydration but is resistant to disease. Mughatin and Majahim could not be properly described by the current data.

5. Correlations between phenotypes and physiological types

Now, the question is to know if there is a link between the both typology, i.e. if there is a relationship between the phenotype and the physiological profile. For that, a contingency table was built.

The phenotype 3 is mainly represented in the first physiological profile, the phenotype 2 in third physiological profile and phenotype 4 in the physiological profile 4 (table 11).

	ClasPhys-1	ClasPhys-2	ClasPhys-3	ClasPhys-4	Total
phenotyp1	47,826	17,391	21,739	13,043	100
phenotyp2	10,000	13,333	66,667	10,000	100
phenotyp3	45,000	15,000	33,750	6,250	100
phenotyp4	12,903	16,129	32,258	38,710	100
Total	32,927	15,244	37,805	14,024	100

$$\text{Chi}^2 = 16.9; p < 0.001$$

Table 11. Percentage of each physiological profile within phenotypes (in yellow the significant lower values, in green, the significant higher values).

The contingency table could be represented with 3D diagram (figure 9).

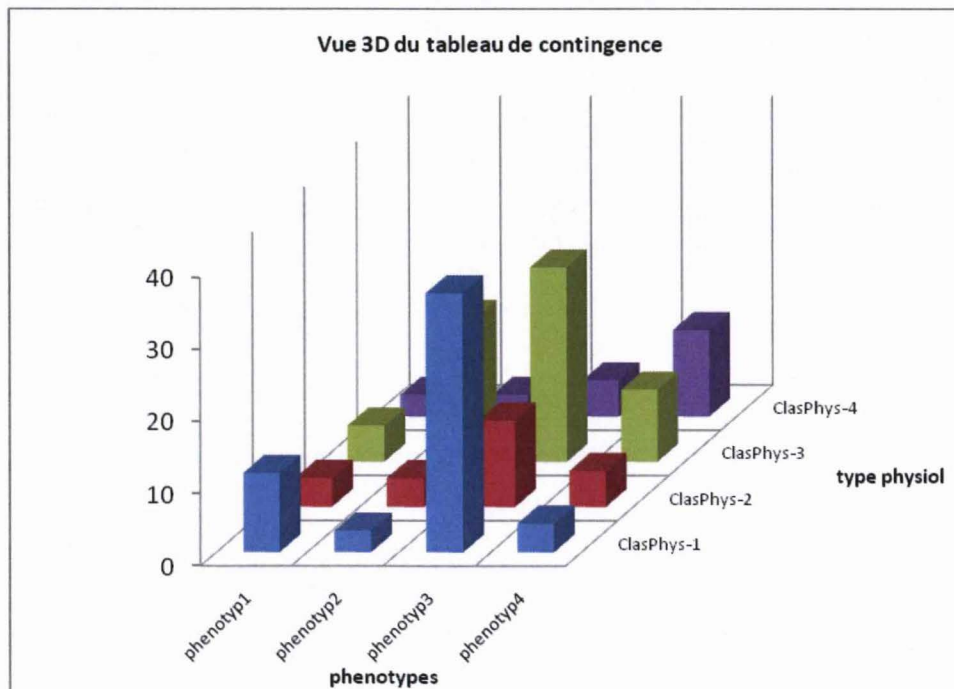


Figure 9. Three-D representation of the contingency table (phenotypes x physiological profiles)

The significant Chi-square indicated a link between the two types. The question is now: what is the distribution of the breed among the different cells of the contingency table?

For this it is created a new variable physiol/phenotype having 16 modalities: 11 = physiol1/pheno1; 12 = physiol1/pheno2; and so on. The different breeds are distributed as follow (table 12).

	11	12	13	14	21	22	23	24	31	32	33	34	41	42	43	44	Total
maghater	11,8	0,0	22,1	0,0	0,0	2,9	5,9	2,9	7,4	19,1	17,6	0,0	1,5	1,5	1,5	5,9	100
majahim	3,8	0,0	19,2	3,8	0,0	0,0	7,7	3,8	0,0	7,7	19,2	19,2	3,8	3,8	7,7	0,0	100
sofor	0,0	0,0	8,3	0,0	4,2	0,0	4,2	8,3	0,0	8,3	37,5	12,5	0,0	0,0	0,0	16,7	100
homor	2,6	7,9	34,2	7,9	2,6	2,6	10,5	0,0	0,0	7,9	2,6	5,3	2,6	0,0	2,6	10,5	100
shaleh	12,5	0,0	12,5	0,0	25,0	12,5	12,5	0,0	0,0	0,0	0,0	0,0	0,0	12,5	12,5	0,0	100
Total	6,7	1,8	22,0	2,4	2,4	2,4	7,3	3,0	3,0	12,2	16,5	6,1	1,8	1,8	3,0	7,3	100

Table 12. Distribution (in % of row) of the different breeds among the physiol/phenol types (Chi² = 79; p < 0.0001)

Finally, it has been observed that:

1. Maghater is significantly mostly represented in cells physiol3/phenotypes 1 and 2 (27%). So Maghater has medium phenotypes characters with some individus with long neck and legs, has high race ability, high young mortality, is sensitive to disease and abortion.
2. Majahim is significantly represented in the cell physiol3/pheno4 (19%). So Majahim as all phenotypes characters more or less long, low growth, has race ability, good reproduction performance, medium young mortality and high sensitivity to abortion.
3. Sofor is differentiated from Majahim not by physiological profile but by phenotype (3), i.e medium characters (37,5%)
4. Homor has physiological profile 1 and phenotype 2, i.e. medium parameters with low mastitis sensitivity, medium phenotype characters except long neck and legs (8% only anyway)
5. Chalaie has physiological profile 2 and phenotype 1 (25%), i.e short hair, tall size, big head, medium ears long neck and legs, small udder, then low adaptation and sensitivity to diseases.

However, the within breed variability is very high especially on phenotype description.

ANNEXE 7

Questionnaire on camel phenotype description

QUESTIONNAIRE ON CAMEL PHENOTYPE DESCRIPTION IN KSA

Date/...../ 2010

Province

Interviewed : 1. ☐ Owner

2. ☐ Foreman

3. ☐ Shepherd

4. ☐ Other

The objective of this questionnaire is to describe the camel phenotypes in KSA by considering the camel breed description and some measurements.

1- Information on the breeder

Name :

Tel number:

Tribe:

Location:

2- Description of the herd

4. How many camel do you have in your herd? |_|_|_|_| camel

3. Herd breed description

5. Breed composition of the herd:

Breed name	nb
Malah/Majahim	
Waddah/Mughatir	
Homor	
Shaelah	
Safra	

4. Phenotype description: one /animal

Ask to the farmer to choose the most representative camel for one breed. Choose a male and a female.

Description of the head:

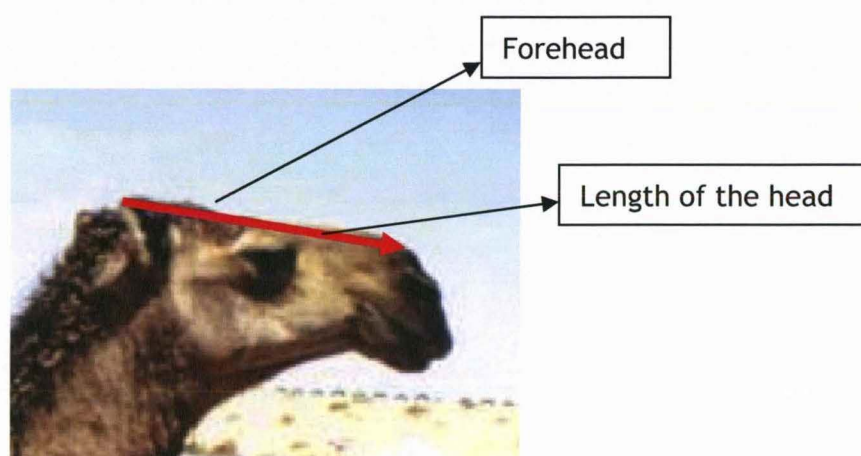
Length (from occipital to the nose): |_|_|_| cm

Forehead: no |_| slight |_| marked |_|

Ears round |_| pointed |_|

With long hair |_| With short hair |_|

Color of Eyes:



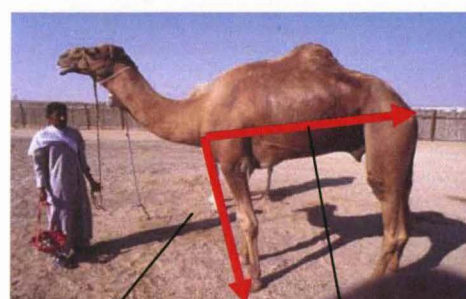
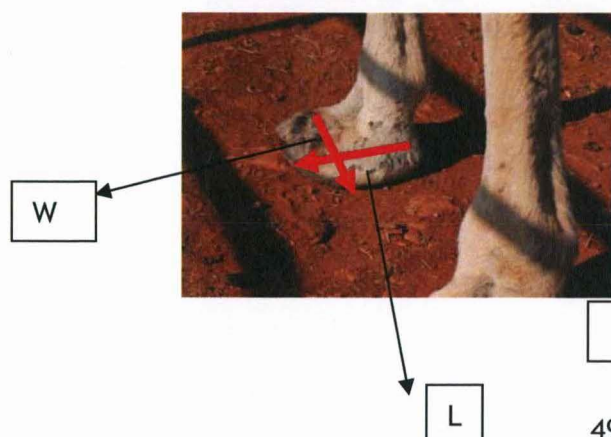
Description of the legs and foot:

Foot: Large |_| narrow |_|

Legs (measuring the ratio LL/LB) to distinguish long, medium or short legs

Foot: if the wide (W) is bigger than the length (L), the foot is large. If not he is narrow

Leg: measure the ratio LL/LB

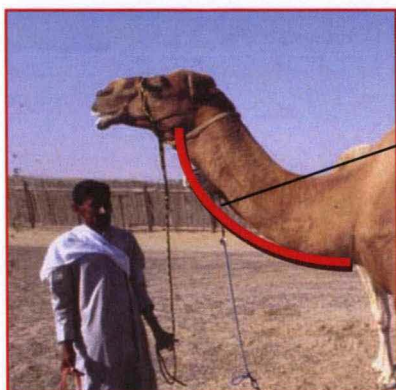


LL= from shoulder point to foot and LB= from shoulder point to ischium point

Description of the neck:

Neck: thin |_| thick |_|

Length in cm:



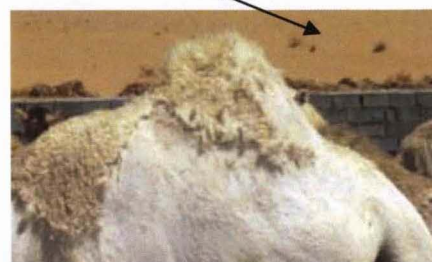
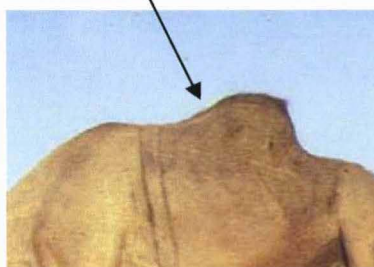
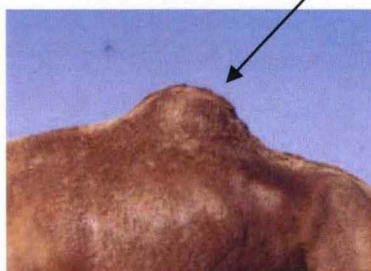
LN =length of the neck

LN: from shoulder point to throat

Description of the hump:

Shape of the hump: round |_| pointed |_|

Symetric |_| asymmetric hind |_| asymmetric front |_|



Place of the hump:

In front of the back |_ |
In middle of the back |_ |
At the hind of the back |_ |

Mammary gland (for female):

Length of the teat (Front-Left): |_ |_ | cm

Length of the udder (from front attach on abdomen to hind attach to basin): |_ |_ | cm

Shape of the udder:

Front teats > hind teats |_ |

Front teats = hind teats |_ |

Front teats < hind teats |_ |

Coat

Color of the coat:

White	
yellow	
black	
brown	
Dark brown	
red	
other	

Hair

Presence of long hair:

- On the shoulder |_ |
- On the hump |_ |
- On the head |_ |
- On the neck |_ |
- On all the body (in summer) |_ |

Sexual of the male

Shape of the testicular out of the mating time:

- No well visible |_ |
- Well visible |_ |
- Out and well developed |_ |

Width of the penis case: narrow |_| large |_|

Length of the penis case short |_| long |_|



Penis case width

Penis case length

- Age of the animal for male: |_|_|
- Number of parities for female: |_|_|

Other body measurements



Height (H) |_|_|_| cm

Girth circumference (GC) |_|_|_|cm

Thigh circumference (TC) |_|_|_|cm

Neck circumference (NC) |_|_|_|cm

