

Appendix IV

SIGNIFICANT DISEASES OF CAMELIDAE

A) Viral diseases in camelids

Group I = Significant diseases

Group II = Diseases for which camelids are potential pathogen carriers

Group III= Minor or non-significant diseases

Dromedary camels

Diseases	Identification of the agent	Serological tests	Recommendations for diagnostic	Recommendations for prevention
<i>Group I</i>				
Camelpox	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.2, Page 1177	ELISA not available VNT*	Preparation of an ELISA kit by Dr Wernery in collaboration with Dr El-Harrak for validation	Vaccination
Contagious ecthyma	TEM IHC	None	Contact with Dr Albina (CIRAD) for PCR validation on Parapox strains from different animal species	
Rabies	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.13, Page 304	ELISA not available VNT*	Vaccination with cattle dose	Vaccination
<i>Group II</i>				
BT, AHS, EHD	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.5.1 (AHS), Page 823; Chapter 2.1.3 (BT and EHD), Page 158	c-ELISA	Investigation of susceptibility for virulent strains and serotypes. Investigation of duration of viraemia	
RVF	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.14, Page 323	c-ELISA VNT*	Investigation on susceptibility and duration of viraemia	
BVD	rt-PCR Virus isolation as for other ruminants OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.8, Page 698	ELISA not available VNT*	Validation of serological tests in blood and milk Investigation on susceptibility	
<i>Group III</i>				
West Nile fever	PCR and virus isolation OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.20, Page 377	c-ELISA	Investigation on susceptibility for the two strains	
Herpes	PCR, Virus isolation, Immunofluorescence OIE <i>Terrestrial Manual</i> 2008, Chapter 2.5.9 (EHV), Page 894; Chapter 2.4.13 (IBR), Page 752	ELISA not available VNT*	Investigation on susceptibility for EHV 1 and 4, and BHV 1 Validation of serological tests	

PPR, RP	PCR, virus isolation OIE <i>Terrestrial Manual</i> 2008, Chapter 2.7.11 (PPR) and 2.1.15 (RP), Pages 1036 and 334	c-ELISA	Investigation on susceptibility for virulent strains. Validation of PCR for PPR. Production of negative and positive sera for reference laboratories	
CCHF	Virus isolation** PCR	None	Validation of ruminant c-ELISA Serological survey	
FMD	PCR & Virus isolation OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.5, Page 190	NSP & c-ELISA	Remove dromedary from the OIE list of FMD susceptible animals	

*need to work in BSL3 level lab security; **need to work in BSL4 level lab security

Bactrian camels

Diseases	Identification of the agent	Serological tests	Recommendations for diagnostic	Recommendations for prevention
Group I				
Camelpox	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.2, Page 1177	ELISA not available VNT*	Preparation of an ELISA kit by Dr Wernery in collaboration with Dr El-Harrak for validation	Vaccination
Contagious ecthyma	TEM IHC	None	Contact with Dr Albina (CIRAD) for PCR validation on Parapox strains from different animal species	
Rabies	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.13, Page 304	ELISA not available VNT*	Vaccination with cattle dose	Vaccination
FMD	PCR Virus isolation OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.5, Page 190	NSP c-ELISA	Recommended test. More investigations needed (blood and milk)	Vaccination
Group II				
BT, AHS, EHD	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.5.1 (AHS), Page 823; Chapter 2.1.3 (BT and EHD), Page 158	c-ELISA	Investigation on susceptibility for virulent strains and serotypes. Investigation on duration of viraemia	
RVF	PCR and virus isolation	c-ELISA VNT*	Investigation on camel susceptibility and duration of viraemia	
BVD	rt-PCR Virus isolation as for other ruminants -OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.8, Page 698	ELISA not available VNT*	Validation of serological tests in blood and milk. Investigation on camel susceptibility	

Group III				
West Nile fever	PCR and Virus isolation OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.20, Page 377	c-ELISA	Investigation on camel susceptibility for the two strains	
Herpes	PCR, Virus isolation, Immunofluorescence OIE <i>Terrestrial Manual</i> 2008, Chapter 2.5.9 (EHV), Page 894; Chapter 2.4.13 (IBR), Page 752	ELISA not available VNT*	Investigation on susceptibility for EHV 1 and 4, and BHV 1 Validation of serological tests	
PPR, RP	PCR, virus isolation OIE <i>Terrestrial Manual</i> 2008, Chapter 2.7.11 (PPR) and 2.1.15 (RP), Pages 1036 and 334	c-ELISA	Investigation on camel susceptibility for virulent strains. Validation of PCR for PPR. Production of negative and positive sera for reference laboratories	
CCHF	Virus isolation** PCR	None	Validation of ruminant c-ELISA Serological survey	

New World Camelids

Diseases	Identification of the agent	Serological tests	Recommendations for diagnostic	Recommendations for prevention
Group I				
BVD	rt-PCR Virus isolation as for other ruminants -OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.8, Page 698	ELISA not available VNT*	Validation of serological tests in blood and milk	
Contagious ecthyma	TEM IHC	None	Contact with Dr Albina (CIRAD) for PCR validation on Parapox strains from different animal species	
Rabies	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.13, Page 304	ELISA not available. VNT*	Vaccination with cattle dose	Vaccination
Herpes	PCR, Virus isolation, Immunofluorescence OIE <i>Terrestrial Manual</i> 2008, Chapter 2.5.9 (EHV), Page 894; Chapter 2.4.13 (IBR), Page 752	ELISA not available VNT*	Investigation on susceptibility for EHV 1 and 4, and BHV 1 Validation of serological tests	
Group II				
BT, AHS, EHD	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.5.1 (AHS), Page 823; Chapter 2.1.3 (BT and EHD), Page 158	c-ELISA	Investigation on susceptibility for virulent strains and serotypes Investigation on duration of viremia	
RVF	PCR and virus isolation	c-ELISA	None	

FMD	PCR Virus isolation OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.5, Page 190	NSP c-ELISA VNT*	Investigation on different susceptibility in llama and alpaca	
Equine encephalo- myelitis	PCR Virus isolation OIE <i>Terrestrial Manual</i> 2008, Chapter 2.5.5, Page 858	CF, HI, PRN	Investigation on small camelid susceptibility for virulent strains and serotypes. Investigation on duration of viraemia	
Group III				
West Nile fever and other flaviviruses	PCR and Virus isolation OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.20, Page 377	c-ELISA VNT*	Investigation on small camelid susceptibility for the two lineages	
Camelpox	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.2, Page 1177	ELISA not available VNT*	None	
PPR, RP	PCR, virus isolation OIE <i>Terrestrial Manual</i> 2008, Chapter 2.7.11 (PPR) and 2.1.15 (RP), Pages 1036 and 334	c-ELISA	None	
CCHF	Virus isolation** PCR	None	None	

b) Bacterial diseases in camelids

Group I = Significant diseases

Group II = Diseases for which camelids are potential pathogen carriers

Group III= Minor or non-significant diseases

Dromedary camels

Diseases	Identification of the agent	Serological tests	Recommendations for diagnostic	Recommendations for prevention
Group I				
Brucellosis (<i>abortus</i> and <i>melitensis</i>)	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.3, Page 624	CF, RBT, SAT	Validation of c-ELISA test for <i>B. abortus</i> and <i>B. melitensis</i> . Tests validation in milk. Specificity and sensitivity evaluation	Eradication of seropositive animals and vaccination according to the species (<i>B. abortus</i> or <i>B. melitensis</i>)
Tuberculosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.7, Page 683	RT test	Investigation should be conducted with serological test. Need of further investigation on skin test	Eradication of positive animals after validation of the tests
Johne's disease	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.11, Page 276	ELISA not available	Validation of serological tests in blood and milk.	Eradication of seropositive animals after validation of the tests
Anthrax	OIE <i>Terrestrial Manual</i> 2008 Chapter 2.1.1, Page 135	None	None	Vaccination in endemic area Need for vaccine field trial

Pyogenic diseases (Caseous lymphadenitis)	Isolation and typing of bacteria	None	Development of serological test for <i>Corynebacterium pseudotuberculosis</i>	Development of vaccines
Pasteurellosis (haemorrhagic septicemia)	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.12, Page 739	None	Controversial data on susceptibility and aetiology. Investigation on susceptibility	Not yet
Salmonellosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.9, Page 1267	None	Identification of the most prevalent biovars. Development of serological tests	Development of vaccines
Colibacillosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.11, Page 1294	None	Identification of the most pathogenic biovars. Development of serological tests	Development of vaccines
Group II				
Plague (Yersiniosis)	Isolation of bacteria	None	Development of serological test	Eradication of infected animals
Leptospirosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.9, Page 251	MAT	Identification of the most prevalent biovars. Investigation on susceptibility	Development of vaccines
Q fever	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.12, Page 292	CF ELISA not available	Validation of serological tests in blood and milk. Investigation on susceptibility	Development of vaccines
Group III				
Glanders (Melioidosis)	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.5.11, Page 919	CF	Validation of serological tests	Eradication of seropositive animals
Chlamydiosis	Isolation and identification of the agent	c-ELISA	Validation of serological tests	None

Bactrian camels

Diseases	Identification of the agent	Serological tests	Recommendations for diagnostic	Recommendations for prevention
Group I				
Brucellosis (<i>abortus</i> and <i>melitensis</i>)	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.3, Page 624	CF, RBT, SAT	Validation of c-ELISA test for <i>B. abortus</i> and <i>B. melitensis</i> . Tests validation in milk. Specificity and sensitivity evaluation	Eradication of seropositive animals and vaccination according to the species (<i>B. abortus</i> or <i>B. melitensis</i>)
Tuberculosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.7, Page 683	RT test	Investigation should be conducted with serological test. Need of further investigation on skin test	Eradication of positive animals after validation of the tests
Johne's disease	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.11, Page 276	ELISA not available	Validation of serological tests in blood and milk	Eradication of seropositive animals after validation of the tests

Anthrax	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.1, Page 135	None	None	Vaccination in endemic area Need for vaccine field trial
Pyogenic diseases (Caseous lymphadenitis)	Isolation and typing of bacteria	None	Development of serological test for <i>Corynebacterium pseudotuberculosis</i>	Development of vaccines
Pasteurellosis (haemorrhagic septicemia)	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.12, Page 739	None	Controversial data on susceptibility and aetiology Investigation on susceptibility	Not yet
Salmonellosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.9, Page 1267	None	Identification of the most prevalent biovars. Development of serological tests	Development of vaccines
Colibacillosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.11, Page 1294	None	Identification of the most pathogenic biovars. Development of serological tests	Development of vaccines
Group II				
Plague (Yersiniosis)	Isolation of bacteria	None	Development of serological test	Eradication of infected animals
Leptospirosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.9, Page 251	MAT	Identification of the most prevalent biovars. Investigation on susceptibility	Development of vaccines
Q fever	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.12, Page 292	CF ELISA not available	Validation of serological tests in blood and milk. Investigation on susceptibility	Development of vaccines
Group III				
Glanders (Meloidosis)	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.5.11, Page 919	CF	Validation of serological tests	Eradication of seropositive animals
Chlamydiosis	Isolation and identification of the agent	c-ELISA	Validation of serological tests	None

New World Camelids

Diseases	Identification of the agent	Serological tests	Recommendations for diagnostic	Recommendations for prevention
Group I				
Brucellosis <i>abortus</i> and <i>melitensis</i>	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.3, Page 624	CF, RBT, SAT	Validation of c-ELISA test for <i>B. abortus</i> and <i>B. melitensis</i> . Tests validation in milk. Specificity and sensitivity evaluation	Control for exported animals
Tuberculosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.7, Page 683	RT test	Investigation should be conducted with serological test. Need of further investigation on skin test	Eradication of positive animals after validation of the tests

Johne's disease	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.11, Page 276	ELISA not available	Validation of serological tests in blood and milk	Eradication of seropositive animals after validation of the tests
Anthrax	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.1, Page 135	None	None	Vaccination in endemic area Need for vaccine field trial
Pyogenic diseases (internal abscesses)	Isolation and typing of bacteria	None	Development of serological test for <i>Corynebacterium pseudotuberculosis</i>	Development of vaccines
Enterotoxaemia	Isolation and typing of bacteria	None	ELISA and PCR tests available for toxinotyping. Application to determine dominant types	Development of toxoid bacteria vaccines
Salmonellosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.9, Page 1267	None	Identification of the most prevalent biovars Development of serological tests	Development of vaccines
Colibacillosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.11, Page 1294	None	Identification of the most pathogenic biovars. Development of serological tests	Development of vaccines
Group II				
Leptospirosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.9, Page 251	MAT	Identification of the most prevalent biovars, Investigation on susceptibility	Development of vaccines
Q fever	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.12, Page 292	CF ELISA not available	Validation of serological tests in blood and milk. Investigation on susceptibility	Development of vaccines
Group III				
Pasteurellosis (haemorrhagic septicemia)	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.12, Page 739	None	Controversial data on susceptibility and aetiology. Investigation on susceptibility	Not yet
Chlamydiosis	Isolation and identification of the agent	c-ELISA	Validation of serological tests	Not yet

c) Parasitic diseases in camelids

Group I = Significant diseases

Group II = Diseases for which camelids are potential pathogen carriers

Group III = Minor or non-significant diseases

Dromedary camels

Diseases	Identification of the agent	Serological tests	Recommendations for diagnostic	Recommendations for prevention
Group I				
Trypanosomosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.8, Page 352	CATT, Indirect ELISA, c-ELISA (Neither ELISA is commercially available)	Preparation of an ELISA kit by Dr Wernery in collaboration with Dr El-Harrak and Dr Bengoumi for validation. Validation of c-ELISA from Morocco	Systematic control for trade. Treatment of positive animal (for example melarsomine)
Mange (<i>Sarcoptes scabiei</i>)	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.8, Page 1255	c-ELISA	Identification of the parasite for differential diagnosis from other skin diseases (psoroptes, ringworm, etc.)	Quarantine and good drug for treatment Development of vaccine
Hydatidosis Echinococcosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.4, Page 175	ELISA	Validation of ELISA	Treatment of the dogs. Development of vaccine
Ticks	Agent identification	None	Identification of the parasite	Development of vaccine
Cephalopinosis	Agent identification	None	Identification of the parasite	Research for new treatment
Group III				
Myasis	Agent identification	None	Identification of the parasite	Avermectines
Screw-worm	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.10, Page 261	None	Identification of the parasite	Avermectines
Coccidiosis	Agent identification	None	Identification of the parasite. Development of serological tests and PCR	Research for new treatment and development of vaccine
Toxoplasmosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.10, Page 1284	SAT ELISA	Investigation on susceptibility	None

Bactrian camels

Diseases	Identification of the agent	Serological tests	Recommendations for diagnostic	Recommendations for prevention
Group I				
Trypanosomosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.8, Page 352	CATT, Indirect ELISA, c-ELISA (neither ELISA is commercially available)	Preparation of an ELISA kit by Dr Wernery in collaboration with Dr El-Harrak and Prof. Bengoumi for validation. Validation of c-ELISA from Morocco	Systematic control for trade Treatment of positive animal (for example melarsomine)

Mange (<i>Sarcoptes scabiei</i>)	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.8, Page 1255	c-ELISA	Identification of the parasite for differential diagnosis from other skin diseases (psoroptes, ringworm, etc.)	Quarantine and good drug for treatment. Development of vaccine
Hydatidosis Echinococcosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.4, Page 175	ELISA	Validation of ELISA	Treatment of the dogs. Development of vaccine
Ticks	Agent identification	None	Identification of the parasite	Development of vaccine
Group III				
Coccidiosis	Agent identification	None	Identification of the parasite. Development of serological tests and PCR	Research for new treatment and development of vaccine
Cephalopinosi	Agent identification	None	Identification of the parasite	Research for new treatment

New World Camelids

Diseases	Identification of the agent	Serological tests	Recommendations for diagnostic	Recommendations for prevention
Group I				
Mange (<i>Sarcoptes scabiei</i>)	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.9.8, Page 1255	c-ELISA	Identification of the parasite for differential diagnosis from other skin diseases (psoroptes, ringworm, etc.)	Quarantine and good drug for treatment. Development of vaccine
Hydatidosis Echinococcosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.1.4, Page 175	ELISA	Validation of ELISA	Treatment of the dogs. Development of vaccine
Ticks	Agent identification	None	Identification of the parasite	Development of vaccine
Sarcocystosis	None	ELISA	Validation of ELISA	Development of vaccine
Coccidiosis	Agent identification	None	Identification of the parasite. Development of serological tests and PCR	Research for new treatment and development of vaccine
Group III				
Trypanosomosis	OIE <i>Terrestrial Manual</i> 2008, Chapter 2.4.8, Page 352	CATT, Indirect ELISA, ELISA (neither ELISA is commercially available)	Preparation of an ELISA kit by Dr Wernery in collaboration with Dr El-Harrak and Prof. Bengoumi for validation. Validation of c-ELISA from Morocco	Systematic control for trade. Treatment of positive animal (for example melarsomine)
Neosporosis	PCR IF	ELISA	Investigation on susceptibility	Evaluation of available vaccine

List of Abbreviations:

AHS:	African horse sickness
BT:	Bluetongue
BVD:	Bovine viral diarrhoea
CCHF:	Crimean–Congo haemorrhagic fever
c-ELISA:	Competitive enzyme-linked immunosorbent assay
CF:	Complement fixation
CIRAD:	Centre de Coopération Internationale pour la Recherche Agronomique en Développement
EHD:	Epizootic haemorrhagic disease
FMD:	Foot and mouth disease
HI:	Haemagglutination inhibition
IHC:	Immunohistochemistry
MAT:	Microscopic agglutination test
NSP:	Nonstructural protein
OIE:	World Organisation for Animal Health
PPR:	Peste des petits ruminants
PRN:	Plaque reduction neutralisation
RBT:	Rose-Bengal test
rt-PCR:	Real-time polymerase chain reaction
RP:	Rinderpest
RT:	Rapid test
RVF:	Rift Valley fever
SAT:	Sero-agglutination test
TEM:	Transmission electron microscopy
<i>Terrestrial Manual</i>	<i>Manual of Diagnostic Tests and Vaccines for Terrestrial Animals</i>
VNT:	Virus neutralisation test
