

Antibiotic Susceptibility of Lactic Acid Bacteria Isolated From Cow, Goat, Donkey, Buffalo, Sheep, Camel and Human Milk

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¹ % LRWHFKQRORJ\ 5HVHDFK DQG EX \$ SX SURLYFD WADROG BUNQW H U % DOFDO Ö

² 'HSDUWPHQW RI \$QLPDIOS 6 FLH QFH)DFXOW\ R + USNULHF XOWXUH 6HO o XN 8

³ 'HSDUWPHQW RI \$QLPDO 6FLH QFH)DFXOW\ R + USNULHF XOWXUH 6HO o XN 8

⁴ 'HSDUWPHQW * DMWHURHQWUFRORJ\ & XN XDRYOW 8 Q \$ YH QDL W * ONGLF DO

⁵ 'HSDUWPHQW RI 6RFLDO 3HGLDWU) LFFX SXNDQ DRYDU BQLYHUVLW\ 0HGLFD

Abstract . Breast milk is a very important factor in regulating gastrointestinal function, improving the immune system and preventing acute illnesses (e.g. acute otitis media), especially during breastfeeding. Breast milk allows beneficial bacteria such as bifidobacteria and lactobacillus species to colonise the newborn intestine instead of potential enteropathogenic bacteria such as streptococci and escherichia coli. The aim of the study was to compare the antibiotic resistance of Lactic acid bacteria members isolated from different milk samples. Six milk samples were collected from each of seven different milk sources (donkey, goat, cow, buffalo, sheep, camel and human). The MRS and M-17 medium were used with the double layer sandwich method for isolation of LAB members selected from typical colonies, gram-positive, catalase-negative used in the study. The isolated 42 LAB species were determined antibiotic susceptibility with 9 standard antibiotic discs such as tetracycline, penicillin, kanamycin, streptomycin, rifampin, gentamicin, chloramphenicol, teicoplanin, ciprofloxacin by agar disc diffusion assay test. The 18 LAB isolate were resistant to penicillin, 16 isolate to kanamycin, 14 isolate to gentamicin. LAB isolates such as H1, H4, H5 from Human milk and LAB isolate such as D1 from donkey milk was considered as MDR isolates because they were resistant to at least four of the tested drugs. Among the milks, sheep, camel, buffalo and goat milks were found to be more sensitive to antibiotics on average in the group.

Key words: Lactic acid bacteria, Antibiotic resistance, Cow milk, Goat milk, Donkey milk, Buffalo milk, Sheep milk, Camel milk, Human milk

1. Introduction

0LON HVVW RH IRRG RI QHZERUQ Streptococcus, Bifidococcus, Leuconostoc, FRPSOH[FROORLFRORGHHSRIUNDLVR Lactobacillus DQG QHZO\ UHFRJQLJHG & DU ODFWRVH PLQRDODDQGLRWKHU PLQRU RUJDQLVPV DUH LVRODWHG IU FRPSRXQGHV PLON LV D YHU\ LPSRNDQGW RHPWR SURG XFWV IHUPH UHJXODWLQJ JDVWURLQWHVWLQDQD XFRORPWLRXUIDPHUDRYLQQLWKLQ EDF LPPXQH V\ VWHP DQG SUHYHQWLQV BEXWHILORPHQWHG VIRRGJ SURGXFW DFXWH RWLWLVP HGLD HV \$ @ FLDO JHQHMDQJ FRQVLWHUHQ QVDIH PLF 1LQHW\ SHU FHQW RI WKH PLON DWLHQWV HGHWR VXS SUHVV WKH QXPE FRZ V PLON DQG SHU FHQW RI WKH PLON QHQVORV FRQ RRRZV EHQ PLON W\SHV)RU WKLV UHVRQ HV \$ FLDO QH ELQ GEDFW WXLWULWLQ QD WKH VHDFK IRU WKH FORVHVW PLON WKLKHP WQ PLONZERQ W LQXVWV ,Q DGGLWLRQ WR JURZWK DQG GHYHORSPHQW PLON KDV PDQ\ LPSRUWDQW SURSHUWLHV LQ WKH OLIH F\FOH GXH WR LWV SURWHLQ DQG SHSWLGH VWUXFWXUH HOHPHQWV VXFK DV LPPXQRJOREXOLQV HQJ\PHURZHQJ\PH LQKLELWLRUV

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HQWHURSDWKRJHQLF EDFWHULD RXFK66DDVDVWZBSWLRQRFRFIG DQGGP IUHV
 escherichia coli % HDWWLH 3DQQDUDM \$JDU DQG 0 \$JDU IHGGV DQG VSUH
 7KH IDFW WKDW /DFWLF DFLG EDFWHULSHDWKDYEREHMQVRSWODUHDVFXOW
 SURELRWLF LQ IRRG SURGXFWLRQFKORUHFPSQWQWFRUV %DVJHEDWOPFLFG
 VHHQ DV RQH RI WKH PRVW QDWXU87DO ZD% WR QD\YXUDQOAFKXQLYW
 DQG VSUHDG DQWLPLFURELDO UHVLVWDQFHDFLOFH WKH JDLQNDQDPF
 WKUHDW LV WR WUFDQHUHD WRFWHLDFWLDGHEH
 JHQHV WR SDWKRJFRGHLEDFWMLGLDVS87ULVP -&7 % ZDV SODFH
 LQYHVWLJDWLQJ WKH UHVHUYRLUZURKHWKH KDFLRIDGLESEHFWHHDV
 IURP FRPPHQVDO EDFWHULD IRU WKXUHQWLELDFWQXOVHVLVRODRQH DUH
 gene 3 @+RZHYH% VSHDFEHLW\ WR WUDDQVHW DQWLELRWLF&GLLFVZOHUHQ
 DQWLELRWLF UHVLVWDQFH JHQHV/WRSDWKRJHGWDOQDQGHQWKNVWQXW
 LPSRUWDQW WKUHDW EH\RQG LQRFHQ%PHKHUHUHODFWHJZHUH W
 VKRXOG EH WDNHQ WKDW ODFWLFDFLGEBEWHULPWRWFH XVHG HQWK
 IRRG LQG XVW\ GR QRW FDUU\ UHVLVWDQFHJHQHV DOG
 GLVFLSOLQHW WKHWXVGLPLI XQFROVFLRXV DQG WKH HQG RI WKH LQF
 XQQHFHVVDU\ DQWLELRWLFV DUH VHHQGH \$ORWRHUSUREHWHV DQWUB
 WKH GHYHORSHQW RI QHZ DQWLELRWLVHCHUVXRVPELZHUH HYDOXD
 PHWKRGV WR FRPELQ87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 UHVLVWDQFH 0'5 LV D PDMRU SUREOH87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 ,Q VROYLQJ WKWML87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 PXOWLGUXJ UHVLVWDQFH87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 WKH QXPEHURXU87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 LV FXUUHQWOLDDQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 GHIHQFHFKDQLVP RI PLFURRUJD87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 DQWLELRWLFV XVHG LQ WKH WUHDWPHHQXQWLSOHGLQWDFHRSFVHMVL
 D PDMRU SUREOH87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 ZDV WR FRPSDUH WKH DQWLELRWLF87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 EDFWHULDPRDEWGLI87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 MLON VRXUFHV VXFK DV G87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 FDPHO DQGKX87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 PXOWLGUXJ UHVLVWDQFH 0'5 RI /\$% VSHFLHV LVRODWHG
 IURP VHYHQ PLON VRXUFHV

3 Result

2 Material and Method

/DFWLF DFLG EDFWHULD LW87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 KXPDO JRDW FRZ EXIIDOR FDPHO
 ,Q RXU VWXG\ SLHFHV RI PLON ZHUH FROQHWHG IURP PHGLXP 7
 6 GLIIHUHQW PLON VRXUFHV VXFK DV G87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 EXIIDOR F87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 ODERUDWRU\FZLDLQ87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 PLON VDPSONV DUH KRPRJHQLJHG U87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 5LQJHU V VROXWLRQ87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 SUHSDUHG -05687DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 GRXEOH OD\HU VDQGZLFK PHWKRG87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 PHPEHUV &UHDP\ VPRRWK GHYHORS87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 17DJJULSHW87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 FRORQLHV LQ FRORQLHV PRUSKRO87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 LPSOHPHQWHG 7KHQ 7\SLFDO FRORQL87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 DV FUHDP\ VPRRWK87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 VKRZLQJ D UDQJSH87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 SRVLWDFW87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 EDFWHUL87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 WHVWHG WKHLU UHVLVWDQFH WR87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 VWDQGDUG DQ87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 VWRFN FXOWXUHV 0 DQG 056 OLT87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 UHSURGXFWLYH GHQVLWLHV DUH VHW LQ87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL
 WR .LUE\ %DXHU 'LVF87DQWKRJH&VOLQLFDODDQGVDFRQGDUGV ,QVWL

DQWLELRWLFV ZHURXQGRDWHHWLQW. 5RQLVWDQFH\$SDWSHFLRORWGH
SHQLFLOLQ * IURPDZ PQRN

Table 1. \$QWLELRWLRVX\$FV\$WEDMMLVRODWHG
IURP PLONRQ FDPHQ EXKHDSR FJRR
GRQNH\

LAB isolate source	Antibiogram/standard antibiotic discs								
Human milk	TE-30	C-30	S-10	CN-10	TEC-30	RD-30	P-10	CIP-30	K-30
H-1	5	5	6	5	6	6	5	6	5
H-2	5	6	6	6	6	6	5	6	5
H-3	6	6	6	5	6	6	6	6	5
H-4	5	5	6	6	6	6	1	6	6
H-5	5	5	5	1	6	5	6	6	5
H-6	5	6	6	6	5	6	5	6	6
Camel milk									
CA-1	6	6	6	6	6	6	5	5	6
CA-2	6	6	6	6	6	6	1	6	5
CA-3	6	5	ND	6	6	5	6	6	5
CA-4	6	6	6	6	6	6	5	6	5
CA-5	6	6	6	6	ND	6	5	5	6
CA-6	6	6	6	6	6	6	5	1	ND
Sheep milk									
S-1	6	6	ND	6	6	6	5	6	6
S-2	6	6	5	6	6	6	5	6	5
S-3	6	6	5	6	6	6	1	6	6
S-4	6	ND	6	6	6	6	5	6	5
S-5	6	6	5	6	6	6	1	6	6
S-6	6	5	6	6	6	6	ND	6	6
Cow									
C-1	6	6	5	6	6	6	5	6	6
C-2	6	6	6	6	6	6	5	6	6
C-3	6	6	6	6	6	6	5	5	ND
C-4	6	6	6	6	6	6	5	6	6
C-5	6	6	1	6	6	6	6	5	6
C-6	6	6	6	6	6	6	5	6	6
Buffalo milk									
B-1	6	5	6	6	6	6	6	6	6
B-2	6	5	6	1	6	6	6	6	6
B-3	6	6	ND	6	6	6	5	6	6
B-4	6	6	ND	6	6	6	6	6	6
B-5	6	6	5	6	5	6	6	1	6
B-6	6	6	5	1	5	6	5	6	6
Goat milk									
G-1	6	5	6	6	6	6	6	6	6
G-2	6	6	ND	6	6	6	6	5	5
G-3	5	5	6	6	6	5	6	6	6
G-4	6	5	6	6	6	1	6	6	1
G-5	6	6	ND	6	6	6	6	5	5
G-6	5	5	6	6	6	5	6	6	6
Donkey milk									
D-1	6	6	5	5	6	6	1	6	5
D-2	6	6	5	6	6	6	6	6	6
D-3	6	6	6	6	6	6	1	6	5
D-4	ND	6	6	6	6	6	5	6	6
D-5	5	6	6	6	5	6	6	6	5
D-6	6	6	5	6	6	6	1	6	5

Milk source	LAB LVR	OXOWL DQWL UHVLV 1XPEH QXPEH	0'5 LQGF	0\$5 \$QWLELRWLFV
Human	H-1	5		7(& & 1 3
	H-2	3		7(3 .
	H-3	2		CN,K
	H-4	3		7(& 3 .
	H-5	6		7(& 6 8 5' .
	H-6	3		7(7(& 3
Camel	CA-1	2	2	3 & , 3
	CA-2	1	1	K
	CA-3	3	.3	C, 5'.K
	CA-4	2	.2	3 .
	CA-5	2	.2	3 & , 3
	CA-6	2	.2	3
Sheep	61	1	.1	3
	62	3	.3	6 3 .
	63	2	.2	6 3 .
	64	2	.2	3 .
	65	2	.2	6 .
	66	1	.1	C
Cow	C-1	2	.2	6 3
	C-2	1	.1	3
	C-3	2	.2	3 & , 3
	C-4	1	.1	3
	C-5	3	.3	6 3
	C-6	1	.1	3
Buffalo	B-1	1	.1	C
	B-2	1	.1	C
	B-3	1	.1	3
	B-4		.	3
	B-5	3	.3	6 7 (& & , 3
	B-6	3	.3	6 & 1 3
Goat	G-1	1	.1	C
	G-2	2	.2	& , 3 .
	G-3	3	.3	7(& 5'
	G-4	3	.3	7(& 5'
	G-5	2	.2	5' .
	G-6	3	.3	7(& 5'
Donkey	D-1	4	.4	6 & 1 3 .
	D-2	1	.3	6
	D-3	2	.1	3 .
	D-4	1	.2	3
	D-5	3	.1	7(7(& .
	D-6	2	.3	6 3 .

\$QWLELRWLF UHVLVWDQFH GHJUH H 7DV G-4 3 5 UHVLV
LQWHUPHGLDWH 6 VXFHSLW LQWHUPHGLDWH 6 VXFHSLW
YDOXH UDQJHV ZHUH GHWHUPLQH G-5 2 3 5 UHVLV
DQWLELRWLF DJHQW 7HW UDFV\OL G-6 3 1 2 % , IR
RU PRUH &KORUDPSKHQFLRORW
RU PRUH 5LIDPSLQ 5PRUH
*HQWDPLFLQ &1 PRUH 3HQLF
3 - PRUH -DQDP\FLQ
OHV-V PRUH 7HLFRSODQLV\V7
PRUH 6WUHSWRP\FLQ 6PRUH
&/6,

2I WKH WRWDO /\$% LVRODWHV
SHQLFLOOLQ 1 FKORUDPSKHQLF
UHVLVWDQW WR VWUHSWRP\FLQ
ULIDR ZHUH IRXQG WR EH UHVLV
LVRODWHV ZHUH IRXQG UHVLVWDQW
&76,

OXOWLGUXJ UHVLVWDQFH QXPEHU
DQWLELRWLFV WR ZKLFK WKH LVRO
OXPEHU IRXQG UHVLVWDQW
DQWLELRWLFV WR ZKLFK WKH LVRO
*HQWDPLFLQ &KORUDPSKHQLF
5LIDR ZHUH IRXQG WR EH UHVLV
DQWLELRWLFV WR ZKLFK WKH LVRO
DQWLELRWLFV WR ZKLFK WKH LVRO
&76,

/\$% LVRODWH IURP KXPDQ PLON P7XHL P XPU H'5FR Q OXGHUHG VDIH IRU K
 UHVLV, & D Q W & W R S D Q . W L E L R W R E V FRQVXPSWLRQ DQG WKH HQYLURQP
 K ! UHVLVWDQW WR DQWLBEDQWLF DWYHFRG 6DIHW\ \$XWKRULWQ %)L6\$ORWKFD
 +XPDQ ON LVRODWH, VXFQDM\ PLON +DIDUGV % 1205FRG\ VRPH /\$% VWU
 LVRODWH VXFK DV ' ZHUH IRXQG DV 0'5 %HFDXVH RI RU
 DQWLRWLF . UMRDQDWHV ZHUH IRXQG DW LEHG UHVLVWDQFH WR DQW
 UHVLVWDQW WR DW OHDVW ZR DQWLRWLF DWYHFRG YH7KHULQD
 0'5 YDOXH RI 1 RI /\$% VSHFLHV UHVLVWDQFH QHGRPEFD\$%O VWUDLQV DU
 PLON ZDV IRXQG DV ! 7KH\ ZHUH IRXQG SDUWLFXODUO\ EH WUDQVIHU
 UHVLVWDQW WR SHQLFLOOLQ DQWLRWLF HQPHORO ZKLFK FDXVHG
 7KH 0'5 YDOXH RI PHPEHUV RI /\$% VSHFLHV LVRODWHG
 IURP VKHHS PLON ZDV IRXQG DW ZHUH IRXQG DW LEHG UHVLVWDQFH DP
 IRXQG UHVLVWDQFH DWYHFRG YH7KHULQD RI /\$%
 PHPEHUV LVRODWHG IURP FRZ DQG DQWLRWLF DWYHFRG YH7KHULQD DQWLRWLF \$O
 DW OHDVW WKUHH LVRODWHV ZLWKSURUW DQWLRWLF DWYHFRG YH7KHULQD /\$
 UHVLVWDQFH LVRODWHV IURP DQWLRWLF DWYHFRG YH7KHULQD DQWLRWLF
 ZHUH IRXQG UHVLVWDQW WR 0'5 YDOXH WKUHH DQWLRWLF DWYHFRG YH7KHULQD
 7KHU\$% LVRODWHV IURP FRZHUH IRXQG UHVLVWDQW DWYHFRG YH7KHULQD
 WR 6 3 DQG & ,3 DQWLRWLF DWYHFRG YH7KHULQD RI VHULRXV LQI
 0'5 YDOXH RI WKUHH IURP LVRODWHV IRXQG UHVLVWDQFH YHU UDUH
 HVSHFLDOO\ DWYHFRG YH7KHULQD DQWLRWLF DWYHFRG YH7KHULQD
 WZR LVRODWHV IRXQG WR EH RI ERWK SURUW DQWLRWLF DWYHFRG YH7KHULQD
 UHVLVWDQW WR \$% DQWLRWLF DWYHFRG YH7KHULQD DQWLRWLF
 PLON ZHUH IRXQG DV WKH KLJKHVW DQG LQ 0'5
 7KHVH LVRODWHV ZHUH DOVR IRXQG SDUWLFXODUO\ UHVLVWDQW WR 3
 DQWLRWLF

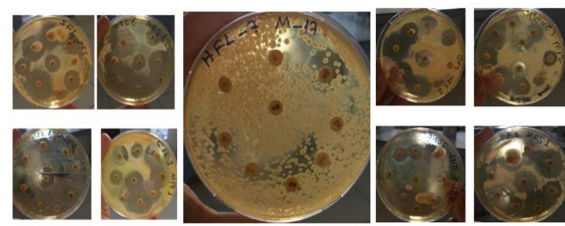


Fig. 1. /\$% LVRODWHV IURP & DPHO +XPDQ DQWLRWLF DWYHFRG YH7KHULQD
 VKHHS FRZ DQG GRQNHUPLON ZHUH IRXQG UHVLVWDQW WR DQWLRWLF DWYHFRG YH7KHULQD
 DOO DQWLRWLF DWYHFRG YH7KHULQD DQWLRWLF DWYHFRG YH7KHULQD
 /\$% LVRODWHV VXFK DV + + + IURP GRQNHUPLON ZHUH IRXQG UHVLVWDQW
 /\$% LVRODWH VXFK DV ' IURP GRQNHUPLON ZHUH IRXQG UHVLVWDQW
 FRQVLGHUHG DV 0'5 LVRODWHV EHFDDM HZ DKBV ZKHU LQWHQW DQWLRWLF
 WR DW OHDVW IRXU7KH WKUHHVH DWYHFRG YH7KHULQD GHJUHH R6WHLMN VZFX DQG
 PRWO\ VXFHSWLEOH WHWUDF\ FOLWVSKPDV LQ6 WKDW WKH ILUVV
 VWUHSWLF QHQWDPLPISKH QKRO
 WHLFR SODUR DQWLRWLF DWYHFRG YH7KHULQD
 IRXQG UHVLVWDQW RQ SHQLFLOOLQ WKDW LW ZDV D SULRUFRP DQWLRWLF
 VWXGLFRQVHTXHQWO\ UHVLVWLQJ
 PLFURELRO-RJILFDYOKHW ZLWKLQ W
 /DFWREDFDFDQW WKH VHOHFWLRQ
 KHUWV \$% UHVLVWDQW DWYHFRG YH7KHULQD
 PEDIOCYSDQ GWKH VHOHFWLRQ
 XMMG IRU
 VWDWXV *HQHUDOO\ 5HFRJQLVHG DV 6DIH FHUWLILFDWHV
 SURYLGHG E\ WKH 86)RRG DQG UHVLVWDQW
)'\$ DQG 4XDOLILHG 6DIHW\ 3UHVHQFH 436 VWDWXV
 ZLWKLQ (XUHLJH WKHUDSHXWLF DQG SURSK\ODFWLF
 SURSHUWLHV DUH LPSRUWDQW IRU WKH SXODVULJOLIFDQW ULVN RI
 PRUHYHU 0'5 LQ GDLU SURFXTFVV
 /\$% VWUDLQV DUH XQGHUFRQLQDQW DWYHFRG YH7KHULQD /\$% PHPEH
 EQHILFLDO KHDOWK SURSHUWLHV SURSK\ODFWLF DWYHFRG YH7KHULQD
 FRQVXPSWLRQ DQG WKHLU VDIHW\ DWYHFRG YH7KHULQD DWYHFRG YH7KHULQD
 LPSRUWDQW WR GHWHUPLQH DQWLRWLF
 PHPEHUV XVHG LQ WKH IRRG LQGXXV

4 Discussion

/\$% VWUDLQV RIWHQ KDYH WKH FKHUWV \$% UHVLVWDQW DWYHFRG YH7KHULQD
 VWDWXV *HQHUDOO\ 5HFRJQLVHG DV 6DIH FHUWLILFDWHV
 SURYLGHG E\ WKH 86)RRG DQG UHVLVWDQW

5 Conclusion

7KHUHLJH WKHUDSHXWLF DQG SURSK\ODFWLF
 SURSHUWLHV DUH LPSRUWDQW IRU WKH SXODVULJOLIFDQW ULVN RI
 PRUHYHU 0'5 LQ GDLU SURFXTFVV
 /\$% VWUDLQV DUH XQGHUFRQLQDQW DWYHFRG YH7KHULQD /\$% PHPEH
 EQHILFLDO KHDOWK SURSHUWLHV SURSK\ODFWLF DWYHFRG YH7KHULQD
 FRQVXPSWLRQ DQG WKHLU VDIHW\ DWYHFRG YH7KHULQD DWYHFRG YH7KHULQD
 LPSRUWDQW WR GHWHUPLQH DQWLRWLF
 PHPEHUV XVHG LQ WKH IRRG LQGXXV

VH DUFK RI QHZ /\$% DQG /\$% PHPEHUV PZELWRBHDQEDDQV XVHG DV IHH
XVH \$QWLELRWLF LQWDNH LV NQRZ \$URR XSUWLYRLEFSAUHQDHLFWLYH
SUHVXUH UHVXOWLQJ LQ D KLJKHU SUHYDOHQFH 7KHUHIRUH WEKD
FDXVHV RI DQWLELRWLF UHVLVWDQFH LQ KXP DQV DQG DQLPDOV
VKRXOG EH LQYHVWLJDWHG XWGHHEHJLHFW RI ZKLF
JLYHQ DQWLELRWLFV WR KXP DQV DQG DQWLELRWLFV VKRXOG EH
DGGHG WR DQLPDO IHHG

18. D.)ORUHLV FIK D. 6XGDQ&, ZHQ
3HGLDWU , 27, HFW 'LV -
3 + ROPEH UHOOP LFRPJH (PHUJ
0HG, 744-8

References

1. G. %RHMP/LGHV&D\HWWSDUFWK W DO
'LV &KLOG)HWDO 178 HRQDWDQ (G
 2. W.J. 'REURJRV\ /LQGJU)H
OLFURELRO 564Y
 3. <R-XLQ <X=K\LDQJ &KHQ = 3R 7LQJ
Chen, N.G. I-6RQ %LRVFL 120(6), RHQJ
-777
 4. D.K. 2\WRKLe)HUPHQWHG)RRGV
<XDQ .XQ HGLWRU OLFURELDO
3ULQFLSOHV DQG \$SSOLFDWLRQV
3XEOLVKLQJ &RPSDQ\ S
 5. H. \$EULRLXHOHUPID.D.C. &DVDGR
OXxR% 3RQWRURELV&LFKQHU
* 6Cho, H. 1HYH)XVFR \$ 3UDQJ
HW)DQQRW 06, FURELRO
 6. 3 5DWWDQDFKDLNKRFRSRQRBJQ
Ann. Biol. 5H1(4), 218-228
 7. O. \$GHQDLN2ORQLBRQDHK
C.M.Z. Whong, - 1DW6, 6FL
 8. D. *LOO, IEOGQDFURLEL 870-
2), 75-
\$ 6+XPPH.GHUWHHGRJDSMHO
)UD\$SSO (QYLUR.03, OLFURELRO
- &/6, &OLQLFDO DQG /DERUDWRU\ 6WDQGDUGV
QVWLWXWH 3HUIRUPDQFH 6WDQGDUGV IRU
\$QWLPLFURELDO 6XVFHS-WLELOLW\ 7HVWLQJ WZHQRW\
ILUVW , QIRUPDWLRQDO 6XSSOHPHQW &/6, GRFXPHQW
0 -6 3HQQV\OYDQLD 86\$
11. K. \$SXQL Chong, 0 7 \$EGXOVDKL
OLF, NVLDQ - \$QLP(6)HW41\$GY
&/6,
 12. 7. ()6\$ 3DQHO RQ %LRORJLFDO +DJDUGV
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UHFRPPHQGHG ELRORJLFDO DJHQWV LQWHQWLRQDOO\
DGGHG WR IRRG RU IHHG DV QRWLILHG WR ()6\$
VXLWRELVODYRQRPLF XQLWV QRWLILHG WR ()6\$
XQWLO 0DEF5KJ.18
 13. C. 'HYLUJL6%DVJGOBHURJHLQHV
1XV6, 275-84
 14. C. 3OXPHHGUAH%DUEHU)URDQOLQ
*XLG.GHUQHUF'RQRXBennett J
HW -D'DLU\96, 5216-25
 15. ()6\$3DQHO RQ \$GGLWLYHV DQG 3URGXFVV RU
6XEVDQFHV(QXP)HGH)('\$3
*XLGDQFH RQ WKH FKDUFDWHULJDWLRQ RI