FEED INTO MILK

A new applied feeding system for dairy cows

Edited by C Thomas

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USING THE FIM MODEL IN RATION CALCULATION

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The aim of the CD is to translate the principles and equations presented in the main text into a working system. The **FiM** equations are listed in software format to enable users to incorporate the model into their own system. A guide to using the **FiM** system, essentially a statement of the principles of ration formulation, is followed by examples of the DSS systems. Finally the comprehensive feeds database enables the user to implement the system with almost immediate effect.

Contents

FiM model equations in software-compatible form with glossary of terms

This section provides a complete listing of the equations in the **FiM** model. The abbreviations for the terms are in a format to facilitate their incorporation into software. The origin of equations can be derived from the colour code and by reference to the **FiM** equation numbers as a link between the listing and the text.

Definition of Terms used in Equations

adin	feed ADIN (g/kgDM)
adm	'a' term for feed DM degradation (proportion)
an	'a' term for feed N degradation (proportion)
ash	ash (g/kgDM)
atpy	yield of ATP for a particular feed (moles/g degraded DM)
atpliquid	ATP supply from liquid and small particles (moles/d)
atpsolid	ATP supply from large particles (moles/d)
bdm	'b' term for feed DM degradation (proportion)
betadm	feed small particle DM (proportion)
betaddm	feed potentially degradable DM in small particles (proportion)
betadn	potentially degradable N in small particles (proportion)
betan	N in small particles (proportion)
bn	'b' term for feed N degradation (proportion)
cdm	'c' term for feed DM degradation (proportion)
cdmi	total concentrate DM intake (kg/d)
cs	cow condition score
ccp	concentrate CP concentration, (g/kg total concentrate DM)
ccpi	concentrate CP intake (g/d)

cmpcys	corrected cystine proportion in metabolisable protein supply (g/100g total amino acids)
cmphis	corrected histidine proportion in metabolisable protein supply (g/100g total amino acids)
cmplys	corrected lysine proportion in metabolisable protein supply (g/100g total amino acids)
cmpmet	corrected methionine proportion in metabolisable protein supply (g/100g total amino acids)
cmpthr	corrected threonine proportion in metabolisable protein supply (g/100g total amino acids)
cn	'c' term for feed N degradation (proportion)
cp	feed CP (g/kgDM)
cprat	ration CP concentration (g/kgDM)
cys	cystine content of feed (proportion of total amino acids)
dm	feed DM content (g/kg)
dmi	DM intake of a particular feed (kg/d)
$dmtp^{FIM}$	microbial digestible true protein yield (g/d)
dmcys	digestible microbial cystine supply (g/d)
dmhis	digestible microbial histidine supply (g/d)
dmlys	digestible microbial lysine supply (g/d)
dmmet	digestible microbial methionine supply (g/d)
dmthr	digestible microbial threonine supply (g/d)
domd	digestible organic matter (g/kg DM)
dpreg	number of days pregnant
$dupsupply^{FIM}$	DUP supply (g/d)
ducyssupply	digestible undegraded cystine supply (g/d)
duhissupply	digestible undegraded histidine supply (g/d)
dulyssupply	digestible undegraded lysine supply (g/d)
dumetsupply	digestible undegraded methionine supply (g/d)
duthrsupply	digestible undegraded threonine supply (g/d)

edn	effective degradability of feed N (proportion)
edpbalance	EDP balance (g/d)
edpreq	EDP requirement (g/d)
edpsupply	EDP supply (g/d)
fat	milk fat concentration (g/kg)
fatfac	milk fat concentration factor (rumen stability DSS)
fatscore	fat concentration score (g/kg) (milk quality DSS)
fatresponse	predicted change in fat concentration (g/kg) (milk quality DSS)
fatstate$	size of fat concentration response in words (milk quality DSS)
fatsign$	sign (+ or -) of fat concentration response in words (milk quality DSS)
fatystate$	size of fat yield response in words (milk quality DSS)
fatysign$	sign (+ or -) of fat yield response in words (milk quality DSS)
fatyscore	fat yield score (g/d) (milk quality DSS)
fatyresponse	predicted change in fat yield (g/d) (milk quality DSS)
faty	target milk fat yield (g/d)
fdm	forage DM content (g/kg)
feedlevel	ME feeding level (multiples of maintenance)
ffwi	forage fresh weight intake (kg/d)
fip	forage mixture intake potential (g/w.75)
foragedmi	total forage DM intake (kg/d)
forageprop	forage proportion in ration
fs	forage starch concentration (g/kg total forage DM)
his	histidine content of feed (proportion of total amino acids)
kconc	concentrate outflow rate (/hr) (decimal)

kfeed	feed outflow rate (/hr)
kforage	forage outflow rate (/hr) (decimal)
kliquid	liquid outflow rate (/hr) (decimal)
km	efficiency of utilisation of ME for maintenance
knl	efficiency of use of MP for milk
lacfac	lactation number factor (rumen stability DSS)
lys	lysine content of feed (proportion of total amino acids)
lpolyrat	ration long chain (>=C20) polyunsaturated fat concentration (g/kgDM)
lyswarn$	lysine adequacy warning in amino acid DSS
mcpatp	microbial CP yield limited by ATP (g/d)
mcpedn	microbial CP yield limited by edn (g/d)
me	feed ME (MJ/kgDM)
mealfac	concentrate meal frequency factor (rumen stability DSS)
mecorrection	correction needed to convert ME supply from sheep at maintenance to cow at feedlevel
metwarn$	methionine adequacy warning in amino acid DSS
mepreg	ME requirement for pregnancy (MJ/d)
mei	ration total ME intake (MJ/d) (sheep at maintenance i.e. standard calculation of ME intake)
meigain[FIM]	ME needed for weight gain (MJ/d)
mem[FIM]	ME needed for maintenance (MJ/d)
meo	milk NE output (MJ/d)
met	methionine content of feed (proportion of total amino acids)
metint	metabolic intake (kg/kg i.e. no units)
mereq[FIM]	ME required (MJ/d) (cow at particular level of feeding)
mesupply[FIM]	ME supplied by ration (MJ/d) (cow at particular level of feeding)

micdmy	microbial DM yield (g/d)
miccpy	microbial CP yield (g/d)
miccys	cystine in microbes (proportion of total amino acids)
michis	histidine in microbes (proportion of total amino acids)
miclys	lysine in microbes (proportion of total amino acids)
micmet	methionine in microbes (proportion of total amino acids)
micthr	threonine in microbes (proportion of total amino acids)
milkloss^{FIM}	NE from weight loss for milk production (MJ/d)
monorat	ration monounsaturated fat concentration (g/kgDM)
mpmaint^{FIM}	MP requirement for maintenance (g/d)
mpmilk	MP required for milk (g/d)
mpreq^{FIM}	total requirement for MP (g/d)
mppreg	MP requirement for pregnancy (g/d)
mpsupply^{FIM}	total Metabolisable Protein supply (g/d)
mpcys	cystine proportion in metabolisable protein supply (g/100g)
mphis	histidine proportion in metabolisable protein supply (g/100g)
mplys	lysine proportion in metabolisable protein supply (g/100g)
mpmet	methionine proportion in metabolisable protein supply (g/100g)
mpsup	additional MP supplied (used in MP DSS) (g/d)
mpthr	threonine proportion in metabolisable protein supply (g/100g)
mw	metabolic liveweight (kg)
ncgd	neutral cellulase gaminase digestibility (g/kg DM)
ndf	feed NDF (g/kgDM)
ndfrat	ration NDF concentration (g/kgDM)
nh3	forage ammonia (gN/kg total N)
npmilk	True protein output in milk (g/d)

oil	oil (B) (g/kgDM)
pal	feed potential acid load (meq/kg DM)
pgain	MP required for weight gain (g/d)
ph	forage pH
ploss	MP contribution from weight loss (g/d)
pmtp	predicted milk true protein output for diets providing a surplus of MP (g/d)
pmtpresponse	predicted milk true protein output response to extra MP above requirement (g/d)
polyrat	ration polyunsaturated fat concentration (g/kgDM)
ppreg	Protein for preganancy (g/d)
prot	milk protein concentration (g/kg)
protresponse	predicted change in milk protein concentration (g/kg)
protscore	protein concentration score (g/kg) (milk quality DSS)
protyscore	protein yield score (g/d) (milk quality DSS)
protstate$	size of protein concentration response in words (milk quality DSS)
protsign$	sign (+ or -) of protein concentration response in words (milk quality DSS)
protystate$	size of protein yield response in words (milk quality DSS)
protysign$	sign (+ or -) of protein yield response in words (milk quality DSS)
proty	target milk protein yield (g/d)
protyresponse	predicted change in milk protein yield (g/d)
predfat	predicted milk fat concentration (g/kg)
predprot	predicted milk protein concentration (g/kg)
predfaty	predicted fat yield (g/d) (milk quality DSS)
predproty	predicted protein yield (g/d) (milk quality DSS)
predy	predicted milk yield (kg/d)

rationmod	ration M/D (MJ/kg DM) feed ME values (sheep at maintenance)
rdpsupply	RDP supply (g/d)
rsvbal	ration RSV balance (rumen stability DSS)
rsvconc	ration RSV concentration (rumen stability DSS)
rsvreq	requirement for RSV (rumen stability DSS)
rsvfeed	feed RSV concentration (rumen stability DSS)
rsvsupply	feed / ration RSV supply (rumen stability DSS)
rsvwarn$	RSV warning (rumen stability DSS)
satrat	ration saturated fat concentration (g/kgDM)
sdm	solubility of feed DM degradation (proportion)
sdmcor	feed soluble DM corrected for total fermentation acids (proportion)
sn	solubility of feed N degradation (proportion)
starat	ration starch concentration (g/kgDM)
sugrat	ration sugar concentration (g/kgDM)
tdmi	total ration DM intake (kg/d)
thr	threonine content of feed (proportion of total amino acids)
udpsupply^{FIM}	UDP supply (g/d)
w	cow liveweight (kg)
wc	liveweight change (kg/d)
wl	week of lactation
y	target milk yield (kg/d)
yatpliquid	Yatp (liquid fraction) (g/mole)

yatpforage	Yatp (forage fraction) (g/mole)
yatpconc	Yatp (concentrate fraction) (g/mole)
yfac	yield factor (rumen stability DSS)

The ^{FIM} superscript is used to identify terms that have been used in previous UK models that are numerically different in the FIM model.

Feed into Milk – final model equations

NOTES

These equations are provided to facilitate incorporation of the **FiM** model into software and, where possible, are in the same form as in the text of the handbook. Variable names are however, often different because the conventions used in the text do not always give unique variable names for software (e.g. variable names are not case-sensitive).

Equations highlighted in red are adapted from the equations of Lewis (1981)

Lewis, M., 1981. Equation for predicting silage intake by beef and dairy cattle. In: Proceedings of the Sixth Silage Conference, Edinburgh pp. 35-36.

Equations highlighted in purple are adapted from ARFC (1993).

Agricultural and Food Research Council (AFRC), 1993. Energy and protein requirements of ruminants. An advisory manual prepared by the AFRC Technical Committee on Responses to Nutrients. CAB International, Wallingford, UK.

Intake

Grass silages with dm<550 g/kg fip values read in from data base (NIRS-predicted)

Non-grass conserved forages with dm<550 g/kg:

Non-fermented: fip=0.122 * dm + 0.088 * domd + 3.84 e.g. urea-treated wholecrop

Fermented: fip = 0.122 * dm + 0.088 * domd + 14.92 * ph – 0.076 * nh3 – 51.3

All conserved forages with dm>=550 g/kg:

$$fip = (8 / (1 - (.001 * domd))) * (w / w^{.75})$$

ccpi concentrate crude protein intake (g/d) limited to a maximum value of 3500.

Note where more than 1 forage is fed, the fip in equations 1 and 2 below is the mean for the forages in the mixture weighted according to their DM proportion.

Recommended equation including CCPI

tdmi = -7.68 + .1033 * fip - 0.00814 * (fip * cdmi) - 1.1185 * cs + 0.01896 * w + 0.734 * cdmi - 0.00421 * cdmi * cdmi + 0.04767 * meo -6.43*(0.6916^ wl) + .007182 * fs + 0.001988 * ccpi

(Equation 1.1 with bias term included)

Alternative equation not including CCPI for use where computing problems related to this term cannot be overcome

tdmi = -7.38 + .1018 * fip - 0.00795 * (fip * cdmi) - 1.065 * cs + 0.01929 * w + 0.954 * cdmi + 0.00364 * cdmi * cdmi + 0.05204 * meo - 6.894*(0.6932^ wl) + .010747 * fs

(Equation 1.2)

ME Requirement

meigain =	19.3 * wc / .65	if wc>0, ME needed for weight gain, milkloss=0 **(Equation 2.2)**
milkloss =	19.3 * wc * .78	if wc<0, NE available for milk production from weight loss, meigain=0 or no weight change, milkloss and meigain are zero **(Equation 2.3)**

pregnancy

EGU = EXP(((151.665 - (151.64 * (EXP(-.0000576 * dpreg))))) * 2.30258)

mepreg = (EGU * (.0201 * (EXP(-.0000576 * dpreg)))) / .133

N.B. dpreg set to 0 if <250

meo =	y * (1.509 + .0406 * fat)	milk NE output **(Equation 2.6)**
cormilkout =	(meo + milkloss) / w ^ .75	milk NE output corrected for weight loss **(Equation 2.5)**
memaintmilk =	(LOG_e((5.06 - cormilkout) / (5.06 + .453))) / -.1326	ME required for maintenance and milk prod. **(Equation 2.4)**
kl =	cormilkout / (memaintmilk - .647)	efficiency of use of ME for lactation
if kl < .59 then	memaintmilk = cormilkout / .59 + .647	constrains kl to be >=0.59 (within ref. data)

rationmod =	mei / tdmi	M/D ration (sheep at maintenance)
km =	0.019 * rationmod + .503	
mereq =	**-10 + (meigain + mepreg + memaintmilk * w ^ .75) +** ((.0013 * w) / km)	**ME requirement (cow)**

The term (.0013 *w)/km is derived from the horizontal component of the activity allowance shown in equation 44 of AFRC (1993). The allowances for standing, vertical movement and body position change were considered to be included in energy requirements derived from calorimetry studies and therefore included in the memaintmilk term.

ME Supply

mei =	DMI_a*ME_a + DMI_b*ME_b ……. n	sum ME contributions from feeds a, b …n use standard feed ME values, sheep at maintenance
mecorrection =	0.02 * mei	correction for level/sheep/cow **(Equation 2.7)**
mesupply =	**mei - mecorrection**	**ME supply (cow)**

Protein and Amino Acid Supply

EDN/ EDP, DUP and Undegraded Amino Acid Supply

mw =	w ^ .75	metabolic liveweight
metint =	tdmi / mw	metabolic intake
forageprop =	foragedmi / tdmi	forage proportion in ration

kliquid = 0.0245 + (0.25 * metint) + 0.04 * forageprop * forageprop **(Equation 3.2)**
(liquid outflow rate)

kforage = 0.0035 + (0.22 * metint) + 0.02 * forageprop * forageprop **(Equation 3.3)**
(forage outflow rate)

kconc = 0.0025 + 0.0125 * kforage **(Equation 3.4)**
(concentrate outflow rate)

yatpliquid =	9 + 50 * kliquid	Yatp (liquid fraction)	**(Equation 3.11)**
yatpforage =	9 + 50 * kforage	Yatp (forage fraction)	**(Equation 3.11)**
yatpconc =	9 + 50 * kconc	Yatp (concentrate fraction)	**(Equation 3.11)**

********* ***For each feed in the ration, calculate and sum the supply terms in bold***

betan =	an – sn	small particle N
betadn =	betan * bn / (1 - an)	degradable N in small particles **(Equation 3.14)**
kfeed =	kforage	if feed is a forage
kfeed =	kconc	if feed is a concentrate
edn =	sn * .9 / (.9 + kliquid) + betadn * cn / (cn + kliquid) + bn * cn / (cn + kfeed)	effective degradability of N **(Equation 3.13)**
ednsupply =	edn*dmi	
edpsupply =	**ednsupply*6.25**	**degradable protein supply (Equation 3.15/3.16)**
mcpedn =	**edpsupply**	**Microbial CP yield limited by edn (Equation 3.15/3.16)**
udpsupply =	(dmi * cp) – (edn*6.25)	UDP supply **(Equation 3.17)**
dupsupply =	**0.9 * (udpsupply –(6.25 * dmi * adin))**	**DUP supply (Equation 3.18)**

Digestible undegraded amino acid supply

dulyssupply =	**dupsupply * lys**	lysine
duthrsupply =	**dupsupply* thr**	threonine
dumetsupply =	**dupsupply * met**	methionine
ducyssupply =	**dupsupply * cys**	cystine
duhissupply =	**dupsupply * his**	histidine

(Equation 4.8)

********** ***Finish loop*** **********

Microbial Protein and Amino Acid Supply

********** ***For each feed in the ration, calculate and sum the supply terms in bold***

kfeed =	kforage	if feed is a forage
kfeed =	kconc	if feed is a concentrate
yatpfeed =	yatpforage	if feed is a forage
yatpfeed =	yatpconc	if feed is a concentrate
atpy =	**27.34 - 0.0248 * cp**	**yield of ATP (moles/g degraded DM)**
sdmcor =	sdm - (tfa / 1000)	soluble DM corrected for total fermentation acids
betadm =	adm – sdm	small particle DM
betaddm =	betadm * bdm / (1 - adm)	degradable DM in small particles **(Equation 3.6)**
atpliquid =	(sdmcor * 0.9 / (0.9 + kliquid) + betaddm * cdm / (cdm + kliquid)) * dmi * atpy	ATP supply from liquid and small particles **(Equation 3.5/3.8)**
atpsolid =	(bdm * cdm / (cdm + kfeed)) * dmi * atpy	ATP supply from large particles **(Equation 3.7/3.9)**
micdmy =	atpliquid * yatpliquid + atpsolid * yatpfeed	Microbial DM yield **(Equation 3.10)**
mcpatp =	**micdmy * 0.1 * 6.25**	**Microbial CP yield limited by ATP (Equation 3.12)**
edpreq =	**mcpatp**	**Microbial requirement for degraded protein (ATP limiting)**

********** ***Finish loop*** **********

Metabolisable Protein and Amino Acid Supply

edpbalance = edpsupply – edpreq Balance of degraded protein in the rumen.

Microbial digestible true protein yield for diets limited by ATP
IF edpbalance >= 0 THEN dmtp = 0.6375 * mcpatp (Equation 3.19)

Microbial digestible true protein yield for diets limited by EDN
IF edpbalance < 0 THEN dmtp = 0.6375 * mcpedn (Equation 3.19)

mpsupply = dmtp + dupsupply Total Metabolisable Protein Supply
(Equation 3.20)

amino acid proportions in microbial total amino acids

miclys =	0.0779	lysine
micthr =	0.0565	threonine
micmet =	0.0243	methionine
miccys =	0.0127	cystine
michis =	0.0175	histidine

digestible microbial amino acid supply

dmlys =	miclys * dmtp	lysine
dmthr =	micthr * dmtp	threonine
dmmet =	micmet * dmtp	methionine
dmcys =	miccys * dmtp	cystine
dmhis =	michis * dmtp	histidine

(Equation 4.7)

Amino Acid proportions in MP

mplys =	100 * ((dmlys + dulyssupply) / mpsupply)	lysine
mpthr =	100 * ((dmthr + duthrsupply) / mpsupply)	threonine
mpmet =	100 * ((dmmet + dumetsupply) / mpsupply)	methionine
mpcys =	100 * ((dmcys + ducyssupply) / mpsupply)	cystine
mphis =	100 * ((dmhis + duhissupply) / mpsupply)	histidine

(Equation 4.10)

Corrected Amino Acid proportions in MP

cmplys =	mplys*0.759+1.904
cmpthr =	mpthr*0.546+2.387
cmpmet =	mpmet*0.733+0.322
cmpcys =	mpcys*1+0
cmphis =	mphis*1+0

(Equations 4.11)

Protein Requirements

mpmaint=4.1 * w ^ .5 + .3 * w ^ .6 + 30 * tdmi - .5 * ((dmtp / .8) - dmtp) + 2.34 * tdmi
MP requirement for maintenance **(Equation 3.1)**

TtT =	1000*(EXP(LOG$_e$(10) * (3.707 - (5.698 * (EXP(-.00262 * dpreg))))))	
ppreg =	TtT * (.03437 * (EXP(-.00262 * dpreg)))	pregnancy N.B. ppreg set to 0 if dpreg=0
mppreg =	ppreg / .85	MP requirment for pregnancy
ploss =	wc * 138	for weight loss, pgain set to 0
pgain =	wc * 233	for weight gain, ploss set to 0 N.B. ploss and pgain are zero for wc=0
npmilk =	(prot * .95 * y)	true protein output in milk
mpmilk =	npmilk / 0.68	MP required for milk
mpreq =	**mpmaint + mppreg + mpmilk + pgain + ploss**	**total requirement for MP**

Milk Quality DSS

Calculate the following for the existing diet.

milk yield
predy = 5.38 - .1427 * wl + .04849 * mei - .001366 * cprat - .003657 * ndfrat
+ .0001727 * starat - .0004392 * sugrat + .005951 * satrat
+ .06508 * monorat - .07675 * polyrat + .07395 * lpolyrat
+ .3501 * y - .1361 * fat + .2131 * prot + .00095849 * mei * y
(Equation 4.11)

milk fat concentration
predfat = 32.59 - .02344 * wl + .010543 * mei - .00441 * cprat
+ .008808 * ndfrat - .00983 * starat - .01609 * sugrat
+ .081605 * satrat - .15172 * monorat - .01957 * polyrat
- 1.78293 * lpolyrat - .18825 * y + .490607 * fat - .21412 * prot
(Equation 4.12)

milk protein concentration

predprot = 8.04 - .01914 * wl + .01688 * mei - .00909 * cprat + .005348 * ndfrat
+ .003181 * starat - .00593 * sugrat - .08896 * satrat
-.00249 * monorat + .016053 * polyrat - .40959 * lpolyrat
- .10768 * y - .00316 * fat + .750456 * prot

(Equation 4.13)

faty =	fat * y	target fat yield
proty =	prot * y	target protein yield
predfaty =	predy * predfat	predicted fat yield
predproty =	predy * predprot	predicted protein yield
fatscore =	**predfat – fat**	fat concentration score
fatyscore =	**predfaty – faty**	fat yield score
protscore =	**predprot – prot**	protein concentration score
protyscore =	**predproty – proty**	protein yield score

This set of calculations is then repeated for the proposed modified **(second) diet** using the same target values for y, fat and prot.

Predicted responses are then calculated

fatresponse = fatscore $_{\text{diet 1}}$ – fatscore $_{\text{diet 2}}$	**predicted fat concentration response**
fatyresponse = fatyscore $_{\text{diet 1}}$ – fatyscore $_{\text{diet 2}}$	**predicted fat yield response**
protresponse = protscore $_{\text{diet 1}}$ – protscore $_{\text{diet 2}}$	**predicted protein concentration response**
protyresponse = protyscore $_{\text{diet 1}}$ – protyscore $_{\text{diet 2}}$	**predicted protein yield response**

The following logical tests can be applied (in the sequence shown) to use generate **descriptions** of these responses:-

IF fatresponse < 0 THEN fatsign$ = “reduction”
IF fatresponse > 0 THEN fatsign$ = “increase”
IF protresponse < 0 THEN protsign$ = “reduction”
IF protresponse > 0 THEN protsign$ = “increase”

IF fatyresponse < 0 THEN fatysign$ = “reduction”
IF fatyresponse > 0 THEN fatysign$ = “increase”
IF protyresponse < 0 THEN protysign$ = “reduction”
IF protyresponse > 0 THEN protysign$ = “increase”

IF ABS(fatresponse) < 1.67 THEN fatstate$ = “small” *ABS ignores the sign of the value in brackets*
IF ABS(fatresponse) >= 1.67 THEN fatstate$ = “moderate”
IF ABS(fatresponse) > 4.83 THEN fatstate$ = “large”
IF ABS(fatresponse) > 12.51 THEN fatstate$ = “very large”

IF ABS(protresponse) < .53 THEN protstate$ = “small”
IF ABS(protresponse) >= .53 THEN protstate$ = “moderate”
IF ABS(protresponse) > 1.42 THEN protstate$ = “large”
IF ABS(protresponse) > 4.26 THEN protstate$ = “very large”

IF ABS(fatyresponse) < 45.0 THEN fatystate$ = “small”
IF ABS(fatyresponse) >= 45.0 THEN fatystate$ = “moderate”
IF ABS(fatyresponse) > 154.5 THEN fatystate$ = “large”
IF ABS(fatyresponse) > 486.3 THEN fatystate$ = “very large”

IF ABS(protyresponse) < 39.7 THEN protystate$ = “small”
IF ABS(protyresponse) >= 39.7 THEN protystate$ = “moderate”
IF ABS(protyresponse) > 154.5 THEN protystate$ = “large”
IF ABS(protyresponse) > 376.7 THEN protystate$ = “very large”

IF ABS(fatresponse) < .3 THEN fatstate$ = “no”: fatsign$ = “change”
IF ABS(protresponse) < .1 THEN protstate$ = “no”: protsign$ = “change”
IF ABS(fatyresponse) < 11 THEN fatystate$ = “no”: fatysign$ = “change”
IF ABS(protyresponse) < 9.5 THEN protystate$ = “no”: protysign$ = “change”

MILK Quality DSS Output

	Concentration	Yield
Milk fat	**fatstate$,fatsign$**	**fatystate$,fatysign$**
Milk protein	**protstate$,protsign$**	**protystate$,protysign$**

Rumen stability DSS

Requirement for RSV

yfac =	100 * ((y - 25) * .01)		yield factor
fatfac =	100 * ((44 - fat) * .005)		milk fat concentration factor
lacfac =	0	for lactation numbers <4	lactation number factor
lacfac =	-7	for fourth lactation	
lacfac =	-15	for fifth and subsequent lactations	

mealfac =	10	for 1 concentrate meal per day	meal frequency factor
mealfac =	5	for 2 concentrate meals per day	
mealfac =	0	for 3 or 4 concentrate meals per day	
mealfac =	-5	for 5 concentrate meals per day	
mealfac =	-10	for 6 or more concentrate meals per day or for TMR	

rsvreq = 100 + yfac + fatfac + lacfac + mealfac requirement for RSV (Equation 4.1))

Supply of RSV

Prediction of PAL

Grass silages by NIRS model to be released through FAA

PAL = 1121 –2.39*dm + 0.534 *domd grass silages if no NIRS prediction

PAL = 1691 – 2.31* dm maize silages

Straights and concentrates use database values from **FIM** model if available, otherwise the equation below

PAL = 536 - 1.106 * cp -0.891 * ash - 0.15 * oil + 0.948 * ncgd

********** ***For each feed in the ration, calculate and sum the supply terms in bold***

rsvfeed = 100 * (.006 * ndf - .001 * (pal - 800)) for forages only **(Equation 4.2))**

rsvfeed = 100 * (.175 + .00082 * ndf - .001 * (pal - 800)) for concentrates only **(Equation 4.3)**

rsvsupply = rsvfeed * dmi RSV supply (Equation 4.4)

********** ***Finish loop*** **********

RSV Balance

rsvconc = rsvsupply / tdmi ration RSV concentration **(Equation 4.5)**

rsvbal = rsvconc – rsvreq ration RSV balance (Equation 4.6)

warnings	apply logic **in sequence** as shown	
rsvwarn$ =	"rumen pH no problem"	rsvbal>=20
rsvwarn$ =	"risk of low pH effects"	rsvbal<20
rsvwarn$ =	"serious risk of low pH effects"	rsvbal<10
rsvwarn$ =	"low pH effects likely - modify diet"	rsvbal<0
rsvwarn$ =	"substantial low pH effects likely - modify diet"	rsvbal<-5
rsvwarn$ =	"acidosis likely - modify diet"	rsvbal<-10

Amino Acid DSS

warnings apply logic **in sequence** as shown

```
lyswarn$ = "adequate lysine supply"
IF (cmplys / 6.8) < 1.0   THEN    lyswarn$ = "borderline lysine supply"
IF (cmplys / 6.8) < .9    THEN    lyswarn$ = "poor lysine supply"
IF (cmplys / 6.8) < .8    THEN    lyswarn$ = "very poor lysine supply"

metwarn$ = "adequate methionine supply"
IF (cmpmet ) < 2.1        THEN    metwarn$ = "marginally adequate methionine supply"
IF (cmpmet) <1.9          THEN    metwarn$ = "marginally deficient methionine supply"
IF (cmpmet) < 1.7         THEN    metwarn$ = "poor methionine supply"
IF (cmpmet) < 1.5         THEN    metwarn$ = "very poor methionine supply"
```

A guide to using the FiM model

Principles of ration formulation

A flow chart describing the use of the **FiM** model when it is built into a least-cost rationing program is shown in Figure 1. The actions are colour coded in the figure and in the text below.

- Blue - Initial entries
- Green – Checking procedures using value judgements or DSS
- Purple – Ration modifications / iteration
- Least Cost Calculation

Initially, it is recommended that as few constraints as possible are applied to the least-cost calculation. This increases the chances of finding the cheapest ration.

Initial entries

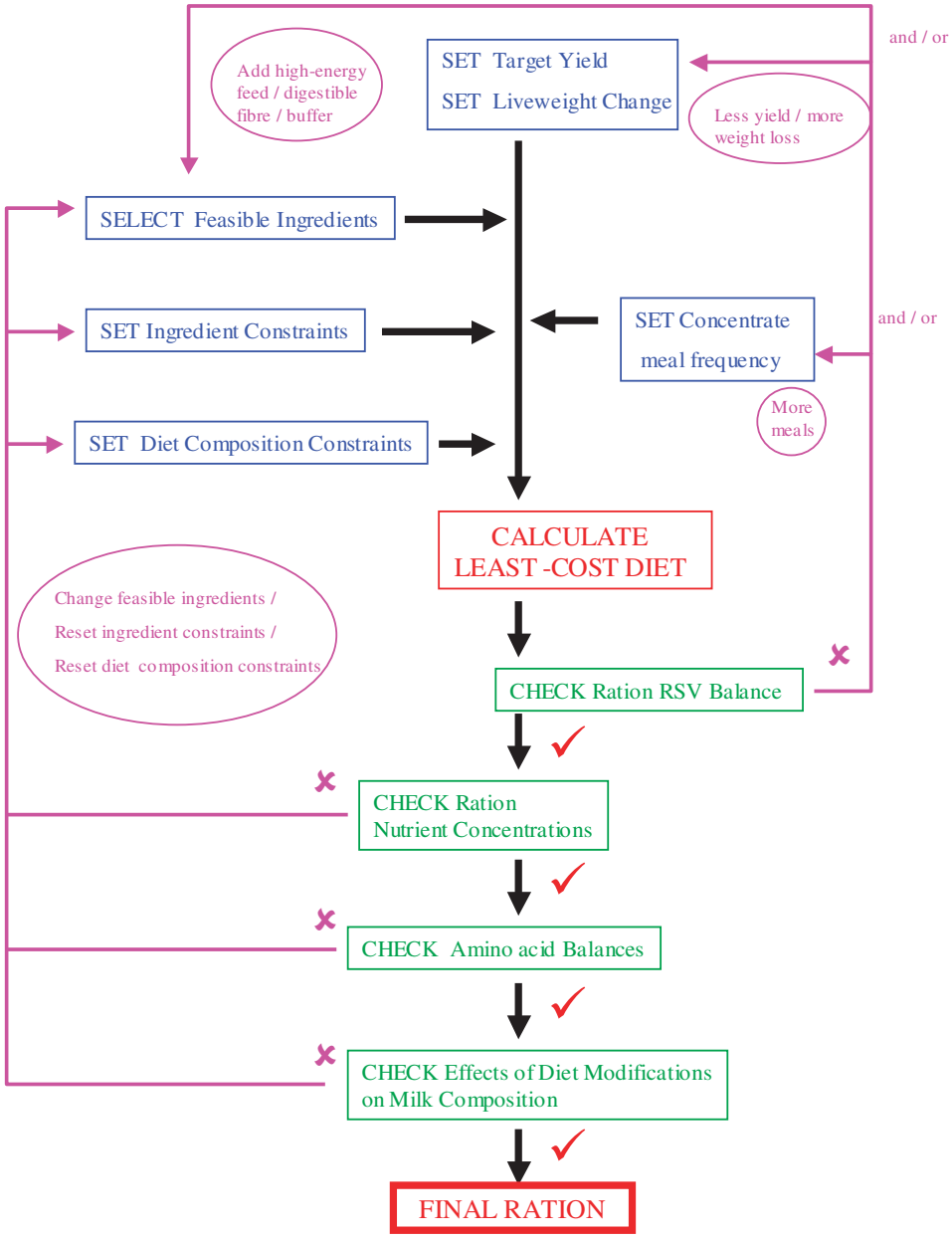
- **Enter cow data**: liveweight, condition score, week of lactation, month of pregnancy, liveweight change, and the target milk yield and composition.
- **Enter feed data**: number of concentrate meals per day, and a list of feasible ingredients.
- **Enter some ingredient constraints** (max and min inclusion levels for individual feeds) but, to begin with, it is better to use as few of these constraints as possible. The same is true for the Diet Composition constraints (e.g. min, max levels of CP, NDF, starch oil in the diet)..

At this point, the first least-cost calculation is made.

Then

Examine the first solution, resetting constraints if required, and re-run the least cost calculation.

A useful approach is to examine the various aspects of the diet in turn:


Add high-energy feed / digestible fibre / buffer
SET Target Yield
SET Liveweight Change
and / or
Less yield / more weight loss
SELECT Feasible Ingredients
SET Ingredient Constraints
SET Concentrate meal frequency
and / or
More meals
SET Diet Composition Constraints
CALCULATE LEAST -COST DIET
Change feasible ingredients /
Reset ingredient constraints /
Reset diet composition constraints
CHECK Ration RSV Balance
CHECK Ration Nutrient Concentrations
CHECK Amino acid Balances
CHECK Effects of Diet Modifications on Milk Composition
FINAL RATION

Check the RSV balance of the diet (see later examples) – the target RSV balance is +20 or greater, though sometimes for high yields in early lactation this may not quite be achieved.

If the RSV balance is too low, some constraints will need to be changed and the calculations re-run. The options are:

- increase the number of concentrate meals per day,
- add or "force in" a new high energy ingredient such as a fat source,
- increase the intake of digestible fibre,
- "force-in" a dietary buffer,
- accept a lower yield and / or a greater liveweight loss.

Then

Check the ration nutrient concentrations – DM, CP, starch, NDF, oil, etc. using value judgements about the acceptable ranges for the cows in question.

If any of the concentrations are unacceptable, some constraints will need to be changed and the calculations re-run. The options are:

- re-set the diet composition constraints,
- re-set the ingredient constraints,
- add or "force-in" a particular supplement to correct the problem.

Then

Check the ration ingredient levels. The first least-cost solution could give values that are either too high or too low.

Examples of "too high" are where palatability might be affected (e.g. 6 kg rapeseed meal/day) or when there are insufficient stocks of the feed (e.g. diet solution shows 25 kg/day of maize silage when only 15 kg/day is available.

An example of "too low" is when forage stocks already exist and need to be fed.

If any of the levels are unacceptable, some constraints will need to be changed and the calculations re-run. The options are:

- re-set the ingredient constraints,
- add or "force-in" a particular supplement to correct the problem.

Then

Check the ration amino acid status. The first least-cost solution could be deficient in lysine and / or methionine (see later examples).

If deficiencies are observed, some constraints will need to be changed and the calculations re-run. The options are:

- reset the ingredient constraints,
- add or "force-in" a particular supplement to correct the problem (e.g. a protected protein or amino acid source),
- reset the diet composition constraints (e.g. increase the min diet CP concentration).

Then

Check the effects of the diet change on milk composition. When milk composition is a problem, more importance should be assigned to this - using the milk composition DSS to explore ways of improving composition (see later examples).

To change milk compositions, constraints will need to be changed and the calculations re-run. The options are:

- reset the diet composition constraints (e.g. increase the min diet starch concentration),
- add or "force-in" a particular supplement.

Finally

When all checks have been carried out and passed, the optimal ration is produced.

Use of the rumen stability DSS

An initial ration (1a) is formulated which results in a serious risk of low rumen pH and solutions are provided to overcome the problem by achieving a target RSV balance of 20

- change number of concentrate meals / d
- add a mid-day feed of wheat dark grains
- change to a less acid silage

Cow Data

LW	lact. no.	CS	LW change	lact. week	mth preg.
620	3	2.5	-0.45	8	0
yield	**[fat]**	**[protein]**	**meals/d**		
36	37	32	2		

Initial ration

Ration 1a. Acid silage and dairy concentrate fed twice daily

Rations

Grass silage 1	Dairy 1	
9.91	9.66	kg DM/d
42	11.1	kg FW/d

Nutrient Balances

	supply	req.	balance
DMI	19.6		
ME	241	241	0
MP	2348	2129	218
EDP	2402	2100	303
RSV	126	120	**7**

Diet Composition

	g/kgDM	DM	369	g/kg
CP	184	M/D	12.3	MJ/kgDM
starch	114			
sugar	70			
NDF	327			
oil	59			
sat fat	16			
mono fat	11			
poly fat	32			
lpoly fat	0			

RUMEN pH serious risk of low pH effects

× Fails RSV check – reformulate

Option 1 Change number of concentrate meals / day

Ration 1b. Acid silage and dairy concentrate fed six times per day (TMR)

Rations

Grass silage 1	Dairy 1	
9.91	9.66	kg DM/d
42	11.1	kg FW/d

Nutrient Balances

	supply	req.	balance
DMI	**19.7**		
ME	241	241	0
MP	2271	2139	132
EDP	2592	2038	554
RSV	135	115	21

Diet Composition

	g/kgDM	**DM**	**351**	**g/kg**
CP	**196**	**M/D**	**12.2**	**MJ/kgDM**
starch	78			
sugar	70			
NDF	356			
oil	58			
sat fat	15			
mono fat	10			
poly fat	34			
lpoly fat	0			

RUMEN pH pH no problem

√ Passes RSV check

Option 2 Add a mid-day feed of wheat dark grains

(Alternative solution if TMR not possible)

Ration 1c. Acid silage with dairy concentrate and wheat dark grains in three meals per day

Rations

Grass silage 1	Dairy 1	Wheat dark grains	
10.86	6.18	2.7	kg DM/d
46	7.1	3	kg FW/d

Nutrient Balances

	supply	req.	balance
DMI	19.6		
ME	241	241	0
MP	2348	2129	218
EDP	2402	2100	303
RSV	126	105	**22**

Diet Composition

	g/kgDM	DM	369	g/kg
CP	**184**	**M/D**	**12.3**	**MJ/kgDM**
starch	114			
sugar	70			
NDF	327			
oil	59			
sat fat	16			
mono fat	11			
poly fat	32			
lpoly fat	0			

RUMEN pH pH no problem

√ ***Passes RSV check***

Option 3 Change to a less acid silage

Ration 1d. Low acid silage and dairy concentrate fed twice daily

Rations

Grass silage 2	Dairy 1	
10.56	9.14	kg DM/d
35.2	10.5	kg FW/d

Nutrient Balances

	supply	req.	balance
DMI	19.7		
ME	242	241	0
MP	2379	2128	250
EDP	2383	2161	222
RSV	146	120	**26**

Diet Composition

	g/kgDM			
CP	182	**DM**	**431**	**g/kg**
starch	107	**M/D**	12.3	MJ/kgDM
sugar	69			
NDF	334			
oil	58			
sat fat	16			
mono fat	11			
poly fat	32			
lpoly fat	0			

RUMEN pH pH no problem

√ **Passes RSV Check**

Use of the amino acid DSS

An initial ration (2a) is formulated which results in a poor supply of lysine and solutions are provided to over come the deficiency i.e. to achieve an EAA score (actual/ target) of =/> 1 by:

- adding a protected amino acid supplement
- substituting with feeds of higher lysine content.

Initial Ration *Diet 2a High content of Maize*

Cow Data

LW	lact. No.	CS	LW change	lact. Week	mth preg.
650	3	2.5	-0.6	12	0
yield	**[fat]**	**[protein]**	**meals/d**		
38	37	32	6		

Rations

Grass silage	Maize silage	Maize gluten	Wheat	Urea 200	
6	7.8	1.8	5.16	0.29	kg DM/d
20	30	2	6	0.3	kg FW/d

Nutrient Balances

	supply	req.	balance	pred/corr
DMI	21			**22.5**
ME	255	251	4	5
MP	2650	2244	406	
EDP	2347	2152	195	
RSV	171	107	64	

Diet Composition

	g/kgDM	DM	360	g/kg
CP	186	**M/D**	12.1	MJ/kgDM
starch	289			
sugar	26			
NDF	333			
oil	44			
sat fat	8			
mono fat	8			
poly fat	28			
lpoly fat	0			

Amino Acids

g/100g MP	lysine	meth.	cystine	threonine	histidine
	5.91	**1.94**	1.35	4.96	1.94

poor lysine supply **marginally adequate methionine supply**

× Fails Amino Acid Check – Reformulate

Option 1 Add a protected amino acid supplement

Ration 2b. same as 2a but with amino acid supplement

Rations

Grass si	Maize si	Maize gl	Wheat	Urea 200	Smartamine	
6	7.8	1.8	5.16	0.29	0.12	kg DM/d
20	30	2	6	0.3	0.12	kg FW/d

Nutrient Balances

	supply	req.	balance	pred/corr
DMI	21.2			22.6
ME	256	251	5	5
MP	2706	2248	458	
EDP	2353	2153	200	
RSV	170	107	64	

Diet Composition

	g/kgDM	DM	363	g/kg
CP	189	**M/D**	12.1	MJ/kgDM
starch	288			
sugar	26			
NDF	332			
oil	44			
sat fat	8			
mono fat	8			
poly fat	28			
lpoly fat	0			

Amino Acids

g/100g MP	lysine	Meth.	cystine	threonine	histidine
	6.94	**2.31**	1.32	4.91	1.9

adequate lysine supply **adequate methionine supply**

√ Passes Amino Acid Check

Option 2 Replace 2 kg/d of maize gluten meal and 2 kg/d of wheat by 3 kg/d of rapeseed meal and 2 kg/d of hipro soya

Ration 2c.

Rations

Grass si	Maize si	Soyabean	Wheat	Rapeseed	
6	7.8	1.77	3.44	2.7	kg DM/d
20	30	2	4	3	kg FW/d

Balances

	supply	req.	balance	pred/corr
DMI	21.7			22.5
ME	257	251	6	5
MP	2541	2262	279	
EDP	2551	2205	347	
RSV	169	107	63	

Diet Composition

	g/kgDM	**DM**	368	g/kg
CP	183	**M/D**	11.8	MJ/kgDM
starch	214			
sugar	44			
NDF	347			
oil	44			
sat fat	7			
mono fat	11			
poly fat	26			
lpoly fat	0			

Amino Acids **g/100g MP**

	lysine	meth.	cystine	threonine
MP	**6.96**	**1.9**	1.44	5.2

adequate lysine supply **marginally adequate methionine supply**

√ Passes Amino Acid Check

Use Of The Milk Composition DSS

A first run is made without calculation of responses, as a reference diet for other examples to include:

- Replacing increasing amounts dairy concentrate by wheat and soya,
- Inclusion of maize silage in the ration.

Cow Data

LW	lact. no.	CS	LW change	lact. week	mth preg.
620	3	2.5	-0.3	8	0
yield	**[fat]**	**[protein]**	**meals/d**	**iterations**	
32	37	32	2	1	

Reference ration

Ration 3a. Average grass silage and dairy concentrate fed twice daily

Rations

Grass silage 3	**Dairy 1**	
9.87	8.7	kg DM/d
42	10	kg FW/d

Nutrient Balances

	supply	**req.**	**balance**
DMI	18.6		
ME	224	224	0
MP	2091	1961	130
EDP	2268	1819	449
RSV	148	116	33

Diet Composition

	g/kgDM	**DM**	369	**g/kg**
CP	182	**M/D**	12.0	MJ/kgDM
starch	108			
sugar	53			
NDF	339			
oil	56			
sat fat	16			
mono fat	11			
poly fat	30			
lpoly fat	0			

RUMEN pH rumen pH no problem

Milk Quality Scores

	[fat] (g/kg)	fat (g/d)	[prot] (g/kg)	prot. (g/d)
Current	2.1	66	-0.7	-24
Previous	2.1	66	-0.7	-24
Response	0	0	0	0

No Check – Reference ration

Option 1 Replacing dairy concentrate (1)

Ration 3b. Replacing 4 kg of dairy concentrate by wheat and soya

Rations

Grass silage 3	Dairy 1	Wheat	Soyabean	
9.4	5.22	3.01	0.89	kg DM/d
40	6	3.5	1	kg FW/d

Nutrient Balances

	supply	req.	balance
DMI	18.5		
ME	225	224	1
MP	2092	1958	133
EDP	2215	1830	386
RSV	136	111	26

Diet Composition

	g/kgDM			
CP	180	**DM**	366	g/kg
starch	187	**M/D**	12.2	MJ/kgDM
sugar	47			
NDF	308			
oil	47			
sat fat	12			
mono fat	8			
poly fat	27			
lpoly fat	0			

RUMEN pHrumen pH no problem

Milk Quality Scores

	[fat] (g/kg)	fat (g/d)	[prot] (g/kg)	prot. (g/d)
Current	**1.4**	**54**	**-0.3**	**-2**
Previous (3a)	**2.1**	**66**	**-0.7**	**-24**
Response	**-0.7**	**-12**	**0.4**	**22**
	small reduction	**small reduction**	**small increase**	**small increase**

N.B. Responses compare this diet to 3a.

Option 2 Replacing dairy concentrate (2)

Ration 3c. Replacing 7kg of dairy concentrate by wheat and soya

Rations

Grass silage 3	Dairy 1	Wheat	Soyabean	
9.4	2.61	4.64	1.77	kg DM/d
40	3	5.4	2	kg FW/d

Nutrient Balances

	supply	req.	balance
DMI	18.4		
ME	224	224	0
MP	2117	1958	159
EDP	2234	1803	431
RSV	133	111	23

Diet Composition

	g/kgDM			
		DM	365	g/kg
CP	184	**M/D**	12.2	MJ/kgDM
starch	222			
sugar	43			
NDF	293			
oil	41			
sat fat	10			
mono fat	6			
poly fat	25			
lpoly fat	0			

RUMEN pH rumen pH no problem

Milk Quality Scores

	[fat] (g/kg)	fat (g/d)	[prot] (g/kg)	prot. (g/d)
Current	1.1	45	-0.1	4
Previous (2a)	2.1	66	-0.7	-24
Response	-1	-21	0.6	28
	small reduction	**small reduction**	**moderate increase**	**small increase**

N.B. Responses compare this diet to 3a.

Option 3 Inclusion of maize silage

Ration 3d. Maize silage added, TMR, intake predicted to increase.

Rations

Grass silage 3	Maize silage	Dairy 1	Soyabean	Wheat	
6.34	7.02	1.3	2.66	2.58	kg DM/d
27	27	1.5	3	3	kg FW/d

Nutrient Balances

	supply	req.	balance
DMI	19.9		
ME	235	224	11
MP	2363	1998	365
EDP	2190	1893	297
RSV	179	101	79

Diet Composition

	g/kgDM			
CP	180	**DM**	324	g/kg
starch	201	**M/D**	11.8	MJ/kgDM
sugar	33			
NDF	350			
oil	43			
sat fat	8			
mono fat	8			
poly fat	27			
lpoly fat	0			

RUMEN pH **rumen pH no problem**

Milk Quality Scores

	fat (g/kg)	fat (g/d)	prot. (g/kg)	prot. (g/d)
Current	**1.7**	**89**	**0.6**	**49**
Previous (3a)	**2.1**	**66**	**-0.7**	**-24**
Response	**-0.4**	**22**	**1.3**	**72**
	small reduction	**small increase**	**moderate increase**	**moderate increase**

N.B. Responses - compare this diet to 3a.

FEED INTO MILK FEEDS DATABASE

Feed name	Feed ID	Forage=1	FIP	TFA	DM	ME	CP	NDF	Sta	Sug	Oil	Ash	PAL
Carrot, fresh	1	1	0	0	130	12.8	98	105	0	600	6	89	1200
Clover, red, aerial part, fresh, vegetative	2	1	0	0	200	10.5	245	272	0	85	26	92	800
Cocksfoot, aerial part, fresh	3	1	0	0	206	10.0	173	538	0	75	20	75	880
Fescue, tall, aerial part, fresh	4	1	0	0	205	10.0	190	541	0	100	20	75	850
Grass hay average	5	1	0	0	850	8.6	114	678	0	100	16	69	793
Grass hay good	6	1	0	0	860	9.2	100	650	0	150	16	82	800
Grass hay poor	7	1	0	0	820	7.5	60	725	0	50	16	78	740
Grass silage average	8	1	95	90	235	10.8	211	461	0	30	44	114	950
Grass silage good high acid	9	1	90	150	236	11.2	140	450	0	60	48	84	1200
Grass silage good low acid	10	1	105	60	300	11.2	140	450	0	60	48	84	950
Grass silage poor	11	1	85	70	220	9.9	118	545	0	10	40	91	800
Grass silage, big bale	12	1	90	50	350	10.0	120	600	0	42	40	91	800
Grass, grazing	13	1	0	0	200	11.2	155	577	0	120	22	80	950
Grass, high temperature dried	14	1	0	0	900	10.7	190	540	0	150	48	108	969
Kale	15	1	0	0	140	12.0	160	250	0	250	18	120	1000
Lotus, aerial part, fresh	16	1	0	0	200	10.0	216	350	0	85	26	92	850
Lucerne dried	17	1	0	0	900	8.8	199	465	0	70	32	102	790
Lucerne hay, beginning of flowering	18	1	0	0	850	9.5	182	357	0	50	30	114	820
Lucerne hay, flowering	19	1	0	0	850	9.0	183	388	0	50	30	114	780
Lucerne hay, vegetative	20	1	0	0	850	9.6	263	250	0	50	30	122	730
Lucerne haylage	21	1	0	20	400	9.0	177	350	0	50	30	130	780
Lucerne silage	22	1	0	70	250	8.5	190	500	0	12	24	120	750
Lucerne, fresh	23	1	0	0	201	9.8	176	476	0	70	30	100	860
Lucerne, fresh, beginning of flowering	24	1	0	0	132	9.6	178	442	0	70	30	100	850
Lucerne, fresh, flowering	25	1	0	0	188	9.1	180	526	0	70	30	100	800
Lucerne, fresh, vegetative	26	1	0	0	188	9.7	269	310	0	70	30	100	750
Lucerne, high temperature dried	27	1	0	0	900	8.8	199	465	0	70	32	102	790
Maize silage	28	1	0	80	260	11.0	90	480	250	5	50	60	1000
Maize silage, dehydrated	29	1	0	8	910	11.0	103	434	250	5	50	74	950
Oats grass	30	1	0	0	200	11.0	150	550	0	150	30	80	980
Pea, garden, crop byproduct, fresh	31	1	0	0	200	9.0	145	412	50	100	19	113	850
Ryegrass, aerial part, fresh	32	1	0	0	176	11.5	180	455	0	150	25	90	980
Straw oats	33	1	0	0	850	7.2	35	817	0	19	14	65	660
Straw, barley	34	1	0	0	860	6.5	40	811	10	15	14	57	600
Straw, NaOH treated	35	1	0	0	800	9.0	45	676	10	15	12	115	854
Straw, wheat	36	1	0	0	860	6.0	36	810	0	12	12	69	820
Wheat silage, dehydrated	37	1	0	5	962	10.2	100	513	240	35	30	74	950
Whole crop wheat, fermented	38	1	0	70	400	10.5	95	467	200	40	30	67	854
Apple pomace, dehydrated	39	2	0	0	900	9.1	55	434	30	160	29	23	980

FEED INTO MILK
FEEDS DATABASE

Feed name	Feed ID	Forage=1	FIP	TFA	DM	ME	CP	NDF	Sta	Sug	Oil	Ash	PAL
Barley, ground/rolled	40	2	0	0	860	13.2	141	154	567	35	28	21	1100
Barley rootlets, dehydrated	41	2	0	0	900	11.2	297	443	63	100	26	67	850
Barley, 2-row	42	2	0	0	860	13.2	143	155	567	35	29	28	1100
Barley, heated	43	2	0	0	943	13.2	115	155	567	35	18	24	1150
Bean faba	44	2	0	0	881	13.3	292	188	390	50	20	46	1020
Bean faba, extruded	45	2	0	0	915	13.3	299	227	400	55	17	49	1020
Beans	46	2	0	0	850	13.3	300	167	365	50	17	36	800
Biscuit blend	47	2	0	0	900	12.3	130	180	130	80	145	200	800
Biscuit meal	48	2	0	0	900	12.3	130	180	130	80	145	200	800
Brewers' grains, barley dehydrated	49	2	0	5	938	11.5	261	640	40	13	83	41	850
Brewers grains, fresh	50	2	0	50	280	11.5	245	618	40	13	77	38	900
Cassava root, dehydrated	51	2	0	0	900	12.6	39	114	650	47	6	50	1250
Citrus pulp dried	52	2	0	0	882	12.6	72	228	0	250	18	65	1033
Cocoa hulls	53	2	0	0	900	7.0	160	534	0	50	100	85	600
Copra meal, expeller extraction	54	2	0	0	933	12.9	219	583	2	114	128	74	850
Copra meal, solvent extraction	55	2	0	0	910	12.3	232	579	3	140	54	86	925
Cottonseed meal	56	2	0	0	924	11.3	361	347	17	70	44	75	820
Cottonseed meal, decorticated, expeller extraction, CF<16	57	2	0	0	959	11.4	439	222	50	60	98	68	820
Cottonseed meal, decorticated, expeller extraction, CF>22	58	2	0	0	943	11.3	300	350	50	60	67	54	820
Cottonseed meal, decorticated, solvent extraction, CF<160	59	2	0	0	913	11.0	478	254	50	60	35	75	820
Cottonseed meal, partially decorticated, expeller extractior	60	2	0	0	864	11.3	377	380	50	60	68	63	820
Cottonseed meal, partially decorticated, solvent extraction	61	2	0	0	920	11.2	433	409	50	60	39	70	820
Dairy 1 compound feed	62	2	0	0	870	13.5	230	200	350	0	80	92	940
Dairy 2 high NDF compound feed	63	2	0	0	870	11.8	184	300	180	80	69	126	860
Crambe hulls	64	2	0	0	892	*	82	565	*	*	29	88	*
Crambe oil meal, expeller extraction	65	2	0	0	930	*	292	261	*	*	169	73	*
Crambe oil meal, solvent extraction	66	2	0	0	968	*	494	107	*	*	18	104	*
Distillers' dark grains, maize	67	2	0	0	890	14.0	317	343	25	50	108	46	970
Distillers' dark grains, malt	68	2	0	0	890	12.2	265	420	30	39	85	39	900
Distillers' dark grains, wheat	69	2	0	0	900	13.5	340	335	44	86	70	52	1050
Distillers' grains, maize, dehydrated	70	2	0	0	958	14.0	306	340	25	50	108	46	970
Distillers' grains, wheat,dehydrated	71	2	0	0	900	13.5	354	346	44	86	70	52	950
Feather meal	72	2	0	0	951	8.0	900	0	0	0	65	25	250
Fish meal, white	73	2	0	0	910	14.2	693	1	0	0	91	213	375
Fish oil	74	2	0	0	950	34.0	0	0	0	0	0	0	400
Fodder beet	75	2	0	0	180	12.0	60	136	0	660	4	81	1030
Groundnut meal	76	2	0	0	900	13.2	530	160	60	80	70	70	760

FEED INTO MILK FEEDS DATABASE

Feed name	Feed ID	Forage=1	FIP	TFA	DM	ME	CP	NDF	Sta	Sug	Oil	Ash	PAL
Linseed meal, expeller	77	2	0	0	900	13.2	391	180	52	40	96	51	860
Linseed meal, extracted	78	2	0	0	900	11.9	404	200	55	45	36	73	800
Linseeds (crushed)	79	2	0	0	900	19.0	260	100	220	30	313	50	600
Lupin, blue, seed	80	2	0	0	942	14.2	343	200	15	55	72	30	960
Lupin, seed	81	2	0	0	900	14.2	342	206	15	55	88	37	925
Lupin, white determinate, UK grown	82	2	0	0	870	14.5	350	210	15	55	110	40	900
Lupin, white, seed	83	2	0	0	844	14.2	392	240	15	55	88	46	860
Lupin, white, seed, extruded	84	2	0	0	956	14.2	383	204	15	55	79	46	890
Maize, ground	85	2	0	0	860	13.8	103	100	743	18	42	15	1170
Maize germ meal, ext.	86	2	0	0	880	14.0	250	370	240	60	45	30	1180
Maize gluten feed CP 200 g/kg	87	2	0	0	880	12.9	220	386	200	25	52	72	1080
Maize gluten meal CP 600 g/kg	88	2	0	0	900	17.5	669	55	155	5	69	11	840
Maize starch byproduct, dehydrated, Corex M 100	89	2	0	0	900	13.4	99	672	181	0	31	22	1250
Maize starch byproduct, fresh, perlite added	90	2	0	0	900	12.9	243	538	80	0	65	100	1200
Maize, flaked	91	2	0	0	880	13.8	95	101	740	18	35	14	1290
Maize, toasted	92	2	0	0	938	13.8	93	101	740	18	35	14	1290
Malt culms	93	2	0	0	900	11.2	283	463	63	100	26	65	827
Megalac™	94	2	0	0	950	29.0	0	0	0	0	850	10	400
Minerals	95	2	0	0	990	0	0	0	0	0	995	0	-600
Molasses, cane	96	2	0	0	750	12.7	40	0	0	660	0	100	1030
Oatfeed	97	2	0	0	860	5.6	51	700	100	0	25	60	760
Oats	98	2	0	0	918	12.0	92	290	500	10	34	32	1150
Oats, flaked	99	2	0	0	880	12.0	123	290	500	10	39	26	1130
Oats, toasted	100	2	0	0	957	12.0	108	290	500	10	39	26	1140
Palm kernel meal, expeller extraction	101	2	0	0	920	11.5	154	714	10	0	109	44	900
Palm kernel meal, solvent extraction	102	2	0	0	907	11.4	205	786	12	0	12	45	1020
Palm kernel meal	103	2	0	0	900	11.5	163	656	4	40	76	44	960
Pea, extruded	104	2	0	0	896	13.5	260	160	480	57	8	34	1120
Peas	105	2	0	0	875	13.5	257	159	440	75	24	31	1090
Pot ale syrup	106	2	0	0	450	14.2	374	2	13	23	2	95	850
Potato feed liquid, fresh	107	2	0	0	115	11.5	181	175	348	50	13	108	990
Potato tuber, whole, fresh	108	2	0	0	207	13.3	93	76	570	75	2	49	1200
Rapeseed hulls	109	2	0	0	880	10.5	178	500	0	0	208	42	625
Rapeseed meal	110	2	0	0	900	12.0	400	248	40	105	53	76	867
Rapeseed meal, (before 1991)	111	2	0	0	900	12.0	382	296	40	105	53	76	880
Rapeseed meal, 00	112	2	0	0	880	12.0	383	246	40	105	53	76	880
Rapeseed, canola, meal	113	2	0	0	937	12.0	412	250	40	105	53	76	850
Rapeseeds (crushed)	114	2	0	0	990	23.1	215	396	4	35	485	50	600
Rice bran	115	2	0	0	900	8.6	180	350	250	24	20	130	750
Rye	116	2	0	0	919	13.2	106	132	550	10	29	18	1200

FEED INTO MILK FEEDS DATABASE

Feed name	Feed ID	Forage=1	FIP	TFA	DM	ME	CP	NDF	Sta	Sug	Oil	Ash	PAL
Smartamine™ M	117	2	0	0	1000	13.6	776	0	0	0	0	222	400
Smartamine™ ML	118	2	0	0	1000	9.8	558	0	0	0	0	442	200
Sorghum	119	2	0	0	900	13.3	113	107	730	15	30	17	1200
Soyabean flour, not defatted	120	2	0	0	955	*	418	*	*	*	139	57	1100
Soyabean hulls	121	2	0	0	932	14.2	179	483	8	47	70	50	1100
Soyabean meal	122	2	0	0	896	13.4	503	127	19	99	17	83	860
Soyabean meal, Brazilian, (Soya 48)	123	2	0	0	900	13.4	530	110	34	105	31	70	815
Soyabean meal, formaldehyde treated	124	2	0	0	880	13.2	520	110	34	100	31	70	815
Soyabean meal, Hipro	125	2	0	0	886	13.8	568	64	7	100	27	68	814
Soyabean meal, tanned	126	2	0	0	900	13.4	503	127	19	99	17	83	860
Soyabean seed	127	2	0	0	900	14.5	400	122	15	76	228	55	680
Soyabean seed, extruded	128	2	0	0	900	14.0	413	170	22	80	177	56	730
Soyabean seed, toasted	129	2	0	0	890	14.1	390	150	20	75	193	64	730
Sugar beet pulp, dehydrated	130	2	0	0	920	12.5	99	512	20	79	5	68	1150
Sugar beet pulp, dehydrated, molassed	131	2	0	0	898	12.5	103	333	50	280	5	60	1150
Sugarbeet pulp, molassed	132	2	0	0	890	11.9	115	297	4	280	4	85	990
Sunflower ext. Arg 350 g/kg protein	133	2	0	0	900	10	389	260	0	70	25	77	840
Sunflower ext. EC 290 g/kg protein	134	2	0	0	900	9.6	322	362	0	36	17	67	910
Sunflower hulls	135	2	0	0	900	5.0	47	821	0	20	20	35	920
Sunflower meal	136	2	0	0	904	9.6	362	379	0	35	18	76	850
Sunflower meal, decorticated	137	2	0	0	900	10.0	427	260	0	70	25	73	800
Sunflower seed meal	138	2	0	0	900	9.6	336	473	5	66	27	71	871
Sunflower, ext. Arg 350 g/kg protein	139	2	0	0	900	10.0	389	260	0	70	25	77	840
Supergrains	140	2	0	50	260	13.0	320	560	20	2	106	16	900
Urea 2000	141	2	0	0	950	0	2300	0	0	0	0	0	-600
Wheat, ground/rolled	142	2	0	0	860	13.6	101	92	748	27	23	18	1250
Wheat bran, fine	143	2	0	0	880	10.8	173	418	196	63	39	68	940
Wheat middlings	144	2	0	0	934	11.9	195	399	280	85	51	47	990
Wheat shorts	145	2	0	0	880	11.9	206	390	270	85	51	47	975
Wheat, sodium hydroxide treated	146	2	0	0	760	13.1	97	88	718	26	22	57	600
Wheat, soft	147	2	0	0	882	13.7	138	124	675	27	16	23	1250
Wheat, toasted	148	2	0	0	953	13.8	134	124	680	27	18	17	1260
Wheatfeed	149	2	0	0	880	11.3	191	341	244	85	51	51	990

FEED INTO MILK FEEDS DATABASE

Long chain fatty acids (as propn. Total fatty acids)

sat=saturates
mono=monounsaturates
poly=polyunsaturates
lpoly=long chain polyunsaturates

Solubility, a, b, c values

Source of data:

=estimated values
= ADAS NSRU in situ
= literature data mainly from French database
= discounted ADIN values

Feed name	[sat]	[mono]	[poly]	[lpoly]	sDM	aDM	bDM	cDM	sN	aN	bN	cN	ADIN
Carrot, fresh	0.30	0.10	0.60	0.000	0.70	0.73	0.27	0.12	0.80	0.87	0.13	0.12	0.30
Clover, red, aerial part, fresh, vegetative	0.10	0.11	0.79	0.000	0.35	0.40	0.44	0.17	0.30	0.39	0.53	0.24	0.80
Cocksfoot, aerial part, fresh	0.25	0.06	0.70	0.006	0.30	0.34	0.52	0.09	0.35	0.44	0.49	0.14	0.60
Fescue, tall, aerial part, fresh	0.25	0.06	0.70	0.006	0.30	0.41	0.51	0.07	0.40	0.56	0.39	0.13	0.60
Grass hay average	0.25	0.06	0.70	0.006	0.10	0.16	0.54	0.05	0.10	0.12	0.72	0.09	1.20
Grass hay good	0.25	0.06	0.70	0.006	0.20	0.25	0.60	0.06	0.18	0.22	0.60	0.08	1.20
Grass hay poor	0.25	0.06	0.70	0.006	0.16	0.20	0.40	0.02	0.18	0.22	0.60	0.08	1.20
Grass silage average	0.25	0.06	0.70	0.006	0.29	0.35	0.49	0.06	0.50	0.62	0.27	0.13	0.50
Grass silage good high acid	0.25	0.06	0.70	0.006	0.36	0.45	0.50	0.10	0.50	0.63	0.26	0.14	0.50
Grass silage good low acid	0.25	0.06	0.70	0.006	0.32	0.40	0.50	0.09	0.50	0.63	0.26	0.14	0.50
Grass silage poor	0.25	0.06	0.70	0.006	0.24	0.30	0.40	0.03	0.36	0.45	0.53	0.10	0.50
Grass silage, big bale	0.25	0.06	0.70	0.006	0.24	0.32	0.50	0.04	0.36	0.58	0.28	0.09	0.50
Grass, grazing	0.15	0.04	0.83	0.006	0.18	0.25	0.61	0.08	0.20	0.21	0.71	0.13	1.00
Grass, high temperature dried	0.25	0.06	0.70	0.006	0.20	0.30	0.55	0.08	0.22	0.37	0.63	0.04	2.30
Kale	0.16	0.01	0.84	0.000	0.25	0.25	0.65	0.15	0.25	0.25	0.65	0.27	0.40
Lotus, aerial part, fresh	0.10	0.11	0.79	0.000	0.30	0.37	0.36	0.17	0.30	0.38	0.50	0.25	0.70
Lucerne dried	0.32	0.05	0.63	0.000	0.20	0.35	0.40	0.02	0.34	0.56	0.38	0.04	2.00
Lucerne hay, beginning of flowering	0.32	0.05	0.63	0.000	0.20	0.35	0.40	0.03	0.30	0.38	0.49	0.09	0.60
Lucerne hay, flowering	0.32	0.05	0.63	0.000	0.20	0.35	0.40	0.03	0.40	0.44	0.40	0.12	0.60
Lucerne hay, vegetative	0.32	0.05	0.63	0.000	0.20	0.35	0.40	0.03	0.35	0.43	0.54	0.07	0.80
Lucerne haylage	0.32	0.05	0.63	0.000	0.20	0.36	0.49	0.03	0.40	0.64	0.32	0.02	0.90
Lucerne silage	0.32	0.05	0.63	0.000	0.20	0.40	0.34	0.13	0.40	0.66	0.25	0.17	1.80
Lucerne, fresh	0.32	0.05	0.63	0.000	0.20	0.37	0.37	0.17	0.40	0.51	0.41	0.27	0.60
Lucerne, fresh, beginning of flowering	0.32	0.05	0.63	0.000	0.20	0.33	0.37	0.16	0.40	0.54	0.38	0.17	0.60
Lucerne, fresh, flowering	0.32	0.05	0.63	0.000	0.20	0.33	0.33	0.13	0.40	0.50	0.37	0.16	0.60
Lucerne, fresh, vegetative	0.32	0.05	0.63	0.000	0.30	0.47	0.37	0.15	0.45	0.63	0.29	0.18	0.80
Lucerne, high temperature dried	0.32	0.05	0.63	0.000	0.14	0.35	0.40	0.02	0.34	0.56	0.38	0.04	2.00
Maize silage	0.13	0.26	0.61	0.000	0.31	0.39	0.42	0.10	0.53	0.66	0.19	0.06	1.00
Maize silage, dehydrated	0.13	0.26	0.61	0.000	0.10	0.20	0.41	0.13	0.30	0.51	0.30	0.06	1.00
Oats grass	0.15	0.04	0.83	0.006	0.20	0.30	0.52	0.07	0.20	0.30	0.60	0.05	1.00
Pea, garden, crop byproduct, fresh	0.25	0.17	0.58	0.000	0.20	0.30	0.65	0.05	0.30	0.40	0.47	0.16	0.50
Ryegrass, aerial part, fresh	0.25	0.06	0.70	0.006	0.30	0.43	0.48	0.09	0.35	0.55	0.39	0.16	0.60
Straw oats	0.22	0.16	0.62	0.000	0.01	0.01	0.49	0.05	0.04	0.04	0.40	0.03	0.10
Straw, barley	0.22	0.16	0.62	0.000	0.08	0.05	0.57	0.04	0.24	0.30	0.50	0.12	1.00
Straw, NaOH treated	0.22	0.16	0.62	0.000	0.24	0.30	0.55	0.06	0.40	0.50	0.35	0.20	1.50
Straw, wheat	0.22	0.16	0.62	0.000	0.05	0.09	0.54	0.04	0.04	0.04	0.40	0.03	0.30
Wheat silage, dehydrated	0.20	0.18	0.62	0.000	0.15	0.22	0.33	0.24	0.40	0.50	0.80	0.05	0.35
Whole crop wheat, fermented	0.20	0.18	0.62	0.000	0.20	0.25	0.50	0.05	0.48	0.60	0.30	0.08	1.00
Apple pomace, dehydrated	0.20	0.10	0.70	0.000	0.15	0.20	0.60	0.06	0.06	0.06	0.77	0.06	0.50

FEED INTO MILK
FEEDS DATABASE

Long chain fatty acids
(as propn. Total fatty acids)

sat=saturates
mono=monounsaturates
poly=polyunsaturates
lpoly=long chain polyunsaturates

Solubility, a, b, c values

Source of data:

=estimated values
= ADAS NSRU in situ
= literature data mainly from French database
= discounted ADIN values

Feed name	[sat]	[mono]	[poly]	[lpoly]	sDM	aDM	bDM	cDM	sN	aN	bN	cN	ADIN
Barley, ground/rolled	0.22	0.13	0.65	0.000	0.05	0.52	0.36	0.13	0.08	0.24	0.71	0.20	0.40
Barley rootlets, dehydrated	0.22	0.13	0.65	0.000	0.30	0.41	0.44	0.06	0.30	0.47	0.44	0.12	2.80
Barley, 2-row	0.22	0.13	0.65	0.000	0.10	0.14	0.78	0.11	0.08	0.08	0.85	0.12	0.50
Barley, heated	0.22	0.13	0.65	0.000	0.10	0.42	0.51	0.12	0.20	0.25	0.74	0.05	1.00
Bean faba	0.17	0.27	0.56	0.000	0.20	0.37	0.59	0.07	0.30	0.53	0.46	0.15	1.50
Bean faba, extruded	0.17	0.27	0.56	0.000	0.30	0.53	0.44	0.06	0.20	0.37	0.61	0.06	1.50
Beans	0.20	0.20	0.60	0.000	0.06	0.16	0.86	0.05	0.14	0.24	0.83	0.06	0.50
Biscuit blend	0.50	0.40	0.10	0.000	0.08	0.25	0.50	0.10	0.05	0.10	0.65	0.07	8.00
Biscuit meal	0.50	0.40	0.10	0.000	0.08	0.25	0.50	0.10	0.05	0.10	0.65	0.07	8.00
Brewers' grains, barley dehydrated	0.20	0.13	0.67	0.000	0.10	0.11	0.54	0.05	0.10	0.13	0.57	0.07	2.00
Brewers grains, fresh	0.20	0.13	0.67	0.000	0.12	0.29	0.62	0.05	0.19	0.32	0.62	0.03	1.00
Cassava root, dehydrated	0.15	0.24	0.61	0.000	0.10	0.30	0.85	0.20	0.30	0.58	0.10	0.10	0.12
Citrus pulp dried	0.30	0.28	0.42	0.000	0.10	0.24	0.75	0.08	0.31	0.51	0.49	0.07	1.40
Cocoa hulls	0.55	0.35	0.10	0.000	0.01	0.03	0.57	0.11	0.10	0.15	0.60	0.04	2.30
Copra meal, expeller extraction	0.78	0.22	0.00	0.000	0.10	0.20	0.75	0.06	0.10	0.20	0.63	0.06	1.80
Copra meal, solvent extraction	0.91	0.07	0.02	0.000	0.20	0.35	0.61	0.06	0.15	0.30	0.70	0.07	1.90
Cottonseed meal	0.27	0.22	0.51	0.000	0.10	0.29	0.53	0.05	0.20	0.33	0.60	0.06	3.20
Cottonseed meal, decorticated, expeller extraction, CF<16	0.27	0.22	0.51	0.000	0.15	0.30	0.55	0.05	0.40	0.62	0.37	0.06	3.20
Cottonseed meal, decorticated, expeller extraction, CF>22	0.27	0.22	0.51	0.000	0.15	0.30	0.55	0.05	0.20	0.32	0.56	0.09	2.80
Cottonseed meal, decorticated, solvent extraction, CF<160	0.27	0.22	0.51	0.000	0.20	0.36	0.61	0.05	0.15	0.32	0.68	0.07	2.50
Cottonseed meal, partially decorticated, expeller extractior	0.27	0.22	0.51	0.000	0.20	0.30	0.49	0.06	0.25	0.44	0.55	0.04	2.50
Cottonseed meal, partially decorticated, solvent extraction	0.27	0.22	0.51	0.000	0.20	0.30	0.49	0.06	0.10	0.28	0.48	0.04	2.50
Dairy 1 compound feed	0.30	0.28	0.42	0.000	0.14	0.35	0.62	0.12	0.20	0.33	0.56	0.12	0.90
Dairy 2 high NDF compound feed	0.30	0.28	0.42	0.000	0.12	0.30	0.67	0.11	0.18	0.30	0.55	0.07	1.00
Crambe hulls	*	*	*	*	0.10	0.17	0.26	0.13	0.10	0.29	0.37	0.14	0.30
Crambe oil meal, expeller extraction	*	*	*	*	0.30	0.52	0.21	0.09	0.40	0.78	0.13	0.11	1.30
Crambe oil meal, solvent extraction	*	*	*	*	0.30	0.57	0.39	0.13	0.30	0.56	0.42	0.13	1.30
Distillers' dark grains, maize	0.13	0.26	0.61	0.000	0.30	0.63	0.32	0.05	0.19	0.32	0.46	0.05	10.0
Distillers' dark grains, malt	0.22	0.13	0.65	0.000	0.25	0.44	0.43	0.06	0.10	0.32	0.46	0.06	3.00
Distillers' dark grains, wheat	0.19	0.19	0.62	0.000	0.27	0.70	0.21	0.11	0.40	0.74	0.18	0.17	7.00
Distillers' grains, maize, dehydrated	0.13	0.26	0.61	0.000	0.09	0.42	0.49	0.06	0.23	0.38	0.46	0.08	10.0
Distillers' grains, wheat,dehydrated	0.19	0.19	0.62	0.000	0.20	0.70	0.21	0.11	0.02	0.02	0.92	0.33	7.00
Feather meal	0.50	0.46	0.03	0.000	0.05	0.15	0.17	0.26	0.05	0.16	0.14	0.23	7.00
Fish meal, white	0.28	0.28	0.22	0.220	0.30	0.46	0.54	0.02	0.18	0.30	0.63	0.02	0.00
Fish oil	0.28	0.28	0.22	0.220	0.00	0.00	0.00	1.00	0.60	1.00	0.00	0.90	0.00
Fodder beet	0.25	0.06	0.70	0.006	0.20	0.50	0.40	0.25	0.15	0.25	0.65	0.44	0.20
Groundnut meal	0.20	0.51	0.30	0.000	0.22	0.55	0.33	0.01	0.27	0.45	0.54	0.16	4.00

FEED INTO MILK FEEDS DATABASE

Long chain fatty acids (as propn. Total fatty acids)

sat=saturates
mono=monounsaturates
poly=polyunsaturates
lpoly=long chain polyunsaturates

Solubility, a, b, c values

Source of data:

=estimated values
= ADAS NSRU in situ
= literature data mainly from French database
= discounted ADIN values

Feed name	[sat]	[mono]	[poly]	[lpoly]	sDM	aDM	bDM	cDM	sN	aN	bN	cN	ADIN
Linseed meal, expeller	0.07	0.60	0.33	0.000	0.12	0.30	0.55	0.08	0.23	0.38	0.60	0.10	1.90
Linseed meal, extracted	0.07	0.60	0.33	0.000	0.17	0.30	0.55	0.08	0.17	0.29	0.68	0.06	1.90
Linseeds (crushed)	0.07	0.60	0.33	0.000	0.04	0.10	0.60	0.04	0.06	0.10	0.70	0.06	1.80
Lupin, blue, seed	0.14	0.58	0.28	0.000	0.15	0.26	0.70	0.12	0.19	0.23	0.72	0.32	0.40
Lupin, seed	0.14	0.58	0.28	0.000	0.15	0.51	0.45	0.14	0.20	0.26	0.74	0.13	0.40
Lupin, white determinate, UK grown	0.14	0.58	0.28	0.000	0.15	0.15	0.85	0.06	0.17	0.19	0.80	0.06	0.40
Lupin, white, seed	0.14	0.58	0.28	0.000	0.15	0.35	0.62	0.11	0.40	0.61	0.38	0.15	0.40
Lupin, white, seed, extruded	0.14	0.58	0.28	0.000	0.15	0.40	0.57	0.08	0.20	0.37	0.61	0.10	0.40
Maize, ground	0.13	0.26	0.61	0.000	0.05	0.26	0.73	0.06	0.08	0.24	0.73	0.06	0.40
Maize germ meal, ext.	0.12	0.24	0.63	0.000	0.08	0.41	0.57	0.05	0.05	0.11	0.83	0.10	0.40
Maize gluten feed CP 200 g/kg	0.18	0.21	0.61	0.000	0.19	0.45	0.48	0.07	0.37	0.61	0.35	0.10	1.40
Maize gluten meal CP 600 g/kg	0.18	0.21	0.61	0.000	0.05	0.12	0.78	0.05	0.05	0.08	0.76	0.03	6.40
Maize starch byproduct, dehydrated, Corex M 100	0.13	0.26	0.61	0.000	0.05	0.40	0.60	0.05	0.05	0.30	0.69	0.04	0.40
Maize starch byproduct, fresh, perlite added	0.13	0.26	0.61	0.000	0.05	0.42	0.58	0.03	0.05	0.77	0.23	0.03	0.40
Maize, flaked	0.13	0.26	0.61	0.000	0.05	0.28	0.71	0.06	0.06	0.17	0.62	0.02	0.40
Maize, toasted	0.13	0.26	0.61	0.000	0.05	0.28	0.71	0.03	0.08	0.13	0.86	0.01	0.40
Malt culms	0.22	0.13	0.65	0.000	0.08	0.20	0.65	0.06	0.10	0.19	0.67	0.07	1.00
Megalac™	0.52	0.39	0.09	0.000	0.00	0.00	0.00	1.00	0.60	1.00	0.00	0.90	0.00
Minerals	0.30	0.28	0.42	0.000	0.00	0.00	0.00	1.00	0.60	1.00	0.00	0.90	0.00
Molasses, cane	0.25	0.06	0.70	0.006	0.40	1.00	0.00	0.90	0.60	1.00	0.00	0.90	0.10
Oatfeed	0.17	0.39	0.44	0.000	0.05	0.15	0.30	0.04	0.10	0.51	0.22	0.07	1.30
Oats	0.17	0.40	0.44	0.000	0.06	0.49	0.38	0.06	0.10	0.74	0.20	0.09	0.50
Oats, flaked	0.17	0.40	0.44	0.000	0.06	0.55	0.20	0.13	0.10	0.63	0.27	0.14	0.50
Oats, toasted	0.17	0.40	0.44	0.000	0.06	0.52	0.34	0.04	0.10	0.53	0.41	0.15	0.50
Palm kernel meal, expeller extraction	0.48	0.44	0.09	0.000	0.06	0.10	0.78	0.04	0.10	0.17	0.79	0.05	3.00
Palm kernel meal, solvent extraction	0.48	0.44	0.09	0.000	0.06	0.16	0.83	0.04	0.17	0.29	0.69	0.05	3.00
Palm kernel meal	0.48	0.44	0.09	0.000	0.06	0.15	0.77	0.04	0.11	0.18	0.82	0.03	3.00
Pea, extruded	0.14	0.25	0.61	0.000	0.20	0.48	0.46	0.18	0.07	0.15	0.74	0.16	0.50
Peas	0.14	0.25	0.61	0.000	0.10	0.28	0.71	0.13	0.20	0.54	0.47	0.13	0.50
Pot ale syrup	0.22	0.13	0.65	0.000	0.32	0.80	0.20	0.35	0.48	0.80	0.20	0.25	4.00
Potato feed liquid, fresh	0.25	0.06	0.70	0.006	0.20	0.40	0.50	0.20	0.08	0.14	0.78	0.16	0.50
Potato tuber, whole, fresh	0.25	0.06	0.70	0.006	0.30	0.62	0.39	0.06	0.20	0.83	0.17	0.12	0.20
Rapeseed hulls	0.06	0.68	0.26	0.000	0.10	0.20	0.40	0.05	0.10	0.21	0.43	0.05	2.00
Rapeseed meal	0.06	0.68	0.26	0.000	0.24	0.31	0.54	0.11	0.18	0.30	0.64	0.16	3.60
Rapeseed meal, (before 1991)	0.06	0.68	0.26	0.000	0.16	0.35	0.45	0.08	0.15	0.28	0.60	0.17	3.60
Rapeseed meal, 00	0.06	0.68	0.26	0.000	0.10	0.25	0.60	0.09	0.10	0.18	0.75	0.10	3.60
Rapeseed, canola, meal	0.06	0.68	0.26	0.000	0.10	0.26	0.61	0.13	0.08	0.15	0.81	0.16	3.60
Rapeseeds (crushed)	0.06	0.68	0.26	0.000	0.09	0.20	0.74	0.22	0.06	0.10	0.70	0.06	1.50
Rice bran	0.26	0.48	0.26	0.000	0.05	0.10	0.40	0.04	0.10	0.23	0.67	0.08	2.60
Rye	0.21	0.14	0.64	0.000	0.06	0.59	0.36	0.37	0.08	0.48	0.50	0.27	0.40

FEED INTO MILK FEEDS DATABASE

Long chain fatty acids (as propn. Total fatty acids)

sat=saturates
mono=monounsaturates
poly=polyunsaturates
lpoly=long chain polyunsaturates

Solubility, a, b, c values

Source of data:

=estimated values
= ADAS NSRU in situ
= literature data mainly from French database
= discounted ADIN values

Feed name	[sat]	[mono]	[poly]	[lpoly]	sDM	aDM	bDM	cDM	sN	aN	bN	cN	ADIN
Smartamine™ M	0.00	0.00	0.00	0.000	0.00	0.00	0.25	0.04	0.00	0.00	0.25	0.04	0.00
Smartamine™ ML	0.00	0.00	0.00	0.000	0.00	0.00	0.25	0.04	0.00	0.00	0.25	0.04	0.00
Sorghum	0.32	0.05	0.63	0.000	0.05	0.30	0.50	0.10	0.08	0.20	0.41	0.09	0.50
Soyabean flour, not defatted	0.15	0.25	0.60	0.000	0.15	0.25	0.65	0.09	0.06	0.19	0.81	0.05	1.50
Soyabean hulls	0.15	0.25	0.60	0.000	0.10	0.07	0.97	0.05	0.06	0.17	0.71	0.08	1.80
Soyabean meal	0.15	0.25	0.60	0.000	0.31	0.31	0.68	0.06	0.20	0.22	0.77	0.05	2.20
Soyabean meal, Brazilian, (Soya 48)	0.15	0.25	0.60	0.000	0.31	0.31	0.68	0.06	0.20	0.22	0.77	0.05	2.20
Soyabean meal, formaldehyde treated	0.15	0.25	0.60	0.000	0.11	0.20	0.79	0.09	0.05	0.08	0.90	0.06	2.20
Soyabean meal, Hipro	0.15	0.25	0.60	0.000	0.31	0.31	0.68	0.06	0.20	0.22	0.77	0.05	2.20
Soyabean meal, tanned	0.15	0.25	0.60	0.000	0.08	0.20	0.70	0.08	0.05	0.13	0.65	0.02	2.50
Soyabean seed	0.14	0.22	0.65	0.000	0.30	0.36	0.64	0.08	0.10	0.33	0.67	0.11	1.50
Soyabean seed, extruded	0.14	0.22	0.65	0.000	0.30	0.40	0.60	0.08	0.01	0.05	0.95	0.03	2.50
Soyabean seed, toasted	0.14	0.22	0.65	0.000	0.30	0.40	0.60	0.08	0.03	0.13	0.87	0.07	2.20
Sugar beet pulp, dehydrated	0.23	0.11	0.66	0.000	0.10	0.20	0.70	0.10	0.05	0.09	0.84	0.08	1.00
Sugar beet pulp, dehydrated, molassed	0.23	0.11	0.66	0.000	0.20	0.50	0.40	0.11	0.05	0.09	0.91	0.04	1.00
Sugarbeet pulp, molassed	0.23	0.11	0.66	0.000	0.20	0.50	0.40	0.11	0.05	0.09	0.85	0.06	1.00
Sunflower ext. Arg 350 g/kg protein	0.12	0.21	0.67	0.000	0.10	0.25	0.48	0.10	0.19	0.31	0.64	0.16	2.00
Sunflower ext. EC 290 g/kg protein	0.12	0.21	0.67	0.000	0.11	0.25	0.48	0.10	0.19	0.31	0.64	0.16	2.00
Sunflower hulls	0.15	0.25	0.60	0.000	0.02	0.09	0.18	0.12	0.05	0.16	0.38	0.17	2.50
Sunflower meal	0.12	0.21	0.67	0.000	0.10	0.39	0.36	0.11	0.19	0.23	0.74	0.15	2.00
Sunflower meal, decorticated	0.12	0.21	0.67	0.000	0.10	0.25	0.48	0.10	0.06	0.12	0.85	0.16	2.00
Sunflower seed meal	0.13	0.21	0.66	0.000	0.17	0.25	0.48	0.10	0.19	0.31	0.64	0.16	2.00
Sunflower, ext. Arg 350 g/kg protein	0.12	0.21	0.67	0.000	0.17	0.25	0.48	0.10	0.19	0.31	0.64	0.16	2.00
Supergrains	0.19	0.19	0.62	0.000	0.16	0.40	0.65	0.06	0.21	0.35	0.64	0.05	2.00
Urea 2000	0.00	0.00	0.00	0.000	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
Wheat, ground/rolled	0.19	0.19	0.62	0.000	0.06	0.52	0.41	0.20	0.08	0.17	0.82	0.13	0.50
Wheat bran, fine	0.20	0.16	0.63	0.000	0.15	0.34	0.43	0.09	0.18	0.46	0.47	0.16	0.40
Wheat middlings	0.20	0.16	0.63	0.000	0.05	0.49	0.33	0.12	0.00	0.41	0.54	0.17	0.40
Wheat shorts	0.20	0.16	0.63	0.000	0.05	0.53	0.33	0.15	0.12	0.39	0.55	0.19	0.40
Wheat, sodium hydroxide treated	0.19	0.19	0.62	0.000	0.06	0.08	0.90	0.08	0.06	0.10	0.88	0.07	0.48
Wheat, soft	0.19	0.19	0.62	0.000	0.05	0.42	0.55	0.13	0.08	0.22	0.71	0.18	0.50
Wheat, toasted	0.19	0.19	0.62	0.000	0.04	0.32	0.63	0.07	0.05	0.11	0.87	0.04	0.50
Wheatfeed	0.19	0.19	0.62	0.000	0.15	0.40	0.55	0.14	0.14	0.34	0.57	0.11	0.40

FEED INTO MILK FEEDS DATABASE

Amino acids (expressed as % total amino acids)

Source of amino acid data:

= AmiPig

= ADAS NSRU database

= Rhône-Poulenc Rhodimet (Feed guide 1993)

= H. Rulquin, INRA

= Other

Feed name	LYS	THR	MET	CYS	TRP	HIS	ILE	VAL	LEU	PHE	TYR	ARG	ALA	ASP	GLU	GLY	SER	PRO
Carrot, fresh	5.77	5.48	1.01	1.15	*	2.50	*	*	*	*	*	*	*	*	*	*	*	*
Clover, red, aerial part, fresh, vegetative	5.89	5.10	1.53	1.02	*	2.61	*	*	*	*	*	*	*	*	*	*	*	*
Cocksfoot, aerial part, fresh	5.50	5.22	1.52	1.13	1.19	2.12	5.04	6.54	8.85	5.82	3.72	5.53	6.88	10.47	11.45	7.11	4.78	7.11
Fescue, tall, aerial part, fresh	5.50	5.22	1.52	1.13	1.19	2.12	5.04	6.54	8.85	5.82	3.72	5.53	6.88	10.47	11.45	7.11	4.78	7.11
Grass hay average	5.50	5.22	1.52	1.13	1.19	2.12	5.04	6.54	8.85	5.82	3.72	5.53	6.88	10.47	11.45	7.11	4.78	7.11
Grass hay good	5.50	5.22	1.52	1.13	1.19	2.12	5.04	6.54	8.85	5.82	3.72	5.53	6.88	10.47	11.45	7.11	4.78	7.11
Grass hay poor	5.50	5.22	1.52	1.13	1.19	2.12	5.04	6.54	8.85	5.82	3.72	5.53	6.88	10.47	11.45	7.11	4.78	7.11
Grass silage average	5.13	6.07	2.03	0.77	1.05	2.09	5.64	8.27	10.17	6.13	2.52	2.91	9.48	10.45	8.92	6.35	4.63	7.40
Grass silage good high acid	5.13	6.07	2.03	0.77	1.05	2.09	5.64	8.27	10.17	6.13	2.52	2.91	9.48	10.45	8.92	6.35	4.63	7.40
Grass silage good low acid	5.13	6.07	2.03	0.77	1.05	2.09	5.64	8.27	10.17	6.13	2.52	2.91	9.48	10.45	8.92	6.35	4.63	7.40
Grass silage poor	5.13	6.07	2.03	0.77	1.05	2.09	5.64	8.27	10.17	6.13	2.52	2.91	9.48	10.45	8.92	6.35	4.63	7.40
Grass silage, big bale	5.13	6.07	2.03	0.77	1.05	2.09	5.64	8.27	10.17	6.13	2.52	2.91	9.48	10.45	8.92	6.35	4.63	7.40
Grass, grazing	5.92	5.07	1.82	0.91	1.30	2.28	5.18	6.52	8.94	5.47	3.69	5.88	7.15	10.41	5.59	13.22	4.85	5.81
Grass, high temperature dried	5.92	5.07	1.82	0.91	1.30	2.28	5.18	6.52	8.94	5.47	3.69	5.88	7.15	10.41	5.59	13.22	4.85	5.81
Kale	5.82	4.35	0.95	1.28	*	2.50	*	*	*	*	*	*	*	*	*	*	*	*
Lotus, aerial part, fresh	5.89	5.10	1.53	1.02	*	2.61	*	*	*	*	*	*	*	*	*	*	*	*
Lucerne dried	5.46	4.72	1.64	1.34	1.39	2.44	4.98	6.34	8.29	5.32	3.59	5.16	5.98	15.39	11.54	5.53	5.21	5.66
Lucerne hay, beginning of flowering	5.89	5.10	1.53	1.02	1.06	2.61	4.91	6.06	8.49	5.54	3.59	5.19	6.25	15.16	11.13	5.35	5.38	5.75
Lucerne hay, flowering	5.89	5.10	1.53	1.02	1.06	2.61	4.91	6.06	8.49	5.54	3.59	5.19	6.25	15.16	11.13	5.35	5.38	5.75
Lucerne hay, vegetative	5.54	5.11	1.34	1.02	1.06	1.94	5.03	5.90	8.43	5.12	3.57	5.01	5.98	14.98	10.96	5.48	5.60	7.91
Lucerne haylage	5.89	5.10	1.53	1.02	1.06	2.61	4.91	6.06	8.49	5.54	3.59	5.19	6.25	15.16	11.13	5.35	5.38	5.75
Lucerne silage	4.36	3.57	3.03	0.78	0.92	1.86	7.14	10.52	12.00	6.84	2.35	1.77	15.72	7.35	6.04	6.55	3.52	5.68
Lucerne, fresh	5.89	5.10	1.53	1.02	1.06	2.61	4.91	6.06	8.49	5.54	3.59	5.19	6.25	15.16	11.13	5.35	5.38	5.75
Lucerne, fresh, beginning of flowering	5.89	5.10	1.53	1.02	1.06	2.61	4.91	6.06	8.49	5.54	3.59	5.19	6.25	15.16	11.13	5.35	5.38	5.75
Lucerne, fresh, flowering	5.89	5.10	1.53	1.02	1.06	2.61	4.91	6.06	8.49	5.54	3.59	5.19	6.25	15.16	11.13	5.35	5.38	5.75
Lucerne, fresh, vegetative	5.89	5.10	1.53	1.02	1.06	2.61	4.91	6.06	8.49	5.54	3.59	5.19	6.25	15.16	11.13	5.35	5.38	5.75
Lucerne, high temperature dried	5.46	4.72	1.64	1.34	1.39	2.44	4.98	6.34	8.29	5.32	3.59	5.16	5.98	15.39	11.54	5.53	5.21	5.66
Maize silage	3.59	4.40	1.84	1.32	0.43	2.79	4.23	5.90	11.58	4.82	3.05	3.05	9.38	8.46	17.28	4.72	4.95	8.22
Maize silage, dehydrated	3.59	4.40	1.84	1.32	0.43	2.79	4.23	5.90	11.58	4.82	3.05	3.05	9.38	8.46	17.28	4.72	4.95	8.22
Oats grass	3.98	4.61	2.09	0.83	1.59	2.17	6.15	4.61	7.43	5.25	3.35	2.44	7.99	12.16	13.30	8.26	5.55	8.26
Pea, garden, crop byproduct, fresh	7.52	3.96	1.24	2.97	*	2.62	*	*	*	*	*	*	*	*	*	*	*	*
Ryegrass, aerial part, fresh	4.97	4.91	2.02	1.14	1.21	3.31	4.97	6.75	9.00	5.88	4.06	6.13	7.58	8.83	13.47	5.90	4.83	5.03
Straw oats	3.98	4.61	2.09	0.83	1.59	2.17	6.15	4.61	7.43	5.25	3.35	2.44	7.99	12.16	13.30	8.26	5.55	8.26
Straw, barley	4.31	4.31	1.58	1.42	1.88	2.18	2.36	3.54	4.31	2.76	3.98	1.43	9.49	14.44	15.79	9.81	6.60	9.81
Straw, NaOH treated	4.31	4.31	1.58	1.42	1.88	2.18	2.36	3.54	4.31	2.76	3.98	1.43	9.49	14.44	15.79	9.81	6.60	9.81
Straw, wheat	4.31	4.31	1.58	1.42	1.88	2.18	2.36	3.54	4.31	2.76	3.98	1.43	9.49	14.44	15.79	9.81	6.60	9.81
Wheat silage, dehydrated	4.64	4.64	1.95	0.67	1.13	3.96	4.42	6.39	7.31	4.67	3.30	2.22	7.87	11.98	13.10	8.14	5.47	8.14
Whole crop wheat, fermented	4.64	4.64	1.95	0.67	1.13	3.96	4.42	6.39	7.31	4.67	3.30	2.22	7.87	11.98	13.10	8.14	5.47	8.14
Apple pomace, dehydrated	3.89	3.01	1.37	1.17	0.87	1.84	3.10	4.07	5.53	3.28	3.96	4.48	10.90	12.88	14.86	7.93	4.95	11.89

FEED INTO MILK FEEDS DATABASE

Amino acids (expressed as % total amino acids)

Source of amino acid data:

= AmiPig

= ADAS NSRU database

= Rhône-Poulenc Rhodimet (Feed guide 1993)

= H. Rulquin, INRA

= Other

Feed name	LYS	THR	MET	CYS	TRP	HIS	ILE	VAL	LEU	PHE	TYR	ARG	ALA	ASP	GLU	GLY	SER	PRO
Barley, ground/rolled	4.02	3.64	1.80	2.28	1.35	2.46	3.85	5.33	7.24	5.26	2.86	5.32	4.31	6.28	24.69	4.28	4.53	10.51
Barley rootlets, dehydrated	4.02	3.64	1.80	2.28	1.35	2.46	3.85	5.33	7.24	5.26	2.86	5.32	4.31	6.28	24.69	4.28	4.53	10.51
Barley, 2-row	4.02	3.64	1.80	2.28	1.35	2.46	3.85	5.33	7.24	5.26	2.86	5.32	4.31	6.28	24.69	4.28	4.53	10.51
Barley, heated	4.02	3.64	1.80	2.28	1.35	2.46	3.85	5.33	7.24	5.26	2.86	5.32	4.31	6.28	24.69	4.28	4.53	10.51
Bean faba	6.61	3.73	0.83	1.37	0.87	2.74	4.56	5.16	8.03	4.51	3.16	9.34	4.48	11.19	19.05	4.56	5.21	4.61
Bean faba, extruded	6.61	3.73	0.83	1.37	0.87	2.74	4.56	5.16	8.03	4.51	3.16	9.34	4.48	11.19	19.05	4.56	5.21	4.61
Beans	5.59	3.66	0.81	1.35	1.23	2.55	3.95	5.93	8.23	4.94	3.95	9.88	5.93	7.57	19.10	5.93	5.60	3.80
Biscuit blend	1.73	3.17	1.85	1.96	0.89	1.79	3.15	4.62	7.19	4.83	5.05	4.23	6.06	10.09	13.12	10.09	8.08	12.11
Biscuit meal	1.74	3.20	1.87	1.98	0.90	1.81	3.18	4.67	7.26	4.87	5.10	4.27	6.12	10.20	13.26	9.18	8.16	12.24
Brewers' grains, barley dehydrated	3.85	3.80	1.95	2.05	1.22	2.05	4.29	5.65	7.21	5.50	2.49	4.48	5.21	5.98	24.26	4.38	4.53	11.11
Brewers grains, fresh	3.85	3.80	1.95	2.05	1.22	2.05	4.29	5.65	7.21	5.50	2.49	4.48	5.21	5.98	24.26	4.38	4.53	11.11
Cassava root, dehydrated	3.19	3.19	1.60	1.20	0.80	1.20	3.19	3.99	5.19	3.19	17.17	4.79	2.99	3.99	7.98	3.59	26.75	5.99
Citrus pulp dried	3.44	4.55	1.38	1.79	0.41	2.48	3.44	5.10	6.89	3.99	3.03	7.30	5.92	13.50	12.67	6.06	6.34	11.71
Cocoa hulls	3.13	3.41	2.26	4.63	1.16	2.08	3.59	5.79	7.52	5.03	3.47	14.47	5.15	9.03	15.16	4.86	5.09	4.17
Copra meal, expeller extraction	3.13	3.41	2.26	4.63	1.16	2.08	3.59	5.79	7.52	5.03	3.47	14.47	5.15	9.03	15.16	4.86	5.09	4.17
Copra meal, solvent extraction	3.13	3.41	2.26	4.63	1.16	2.08	3.59	5.79	7.52	5.03	3.47	14.47	5.15	9.03	15.16	4.86	5.09	4.17
Cottonseed meal	4.38	3.33	1.49	1.60	1.37	3.13	3.59	4.99	6.42	5.63	3.27	11.65	4.26	10.53	21.50	4.64	4.72	3.49
Cottonseed meal, decorticated, expeller extraction, CF<16	4.25	3.57	1.67	1.80	1.36	3.01	3.78	5.24	6.36	5.36	3.01	11.50	4.35	10.04	21.54	4.46	4.68	4.02
Cottonseed meal, decorticated, expeller extraction, CF>22	4.25	3.57	1.67	1.80	1.36	3.01	3.78	5.24	6.36	5.36	3.01	11.50	4.35	10.04	21.54	4.46	4.68	4.02
Cottonseed meal, decorticated, solvent extraction, CF<160	4.24	3.57	1.67	1.79	1.37	3.01	3.79	5.24	6.36	5.36	3.01	11.49	4.35	10.04	21.53	4.46	4.69	4.02
Cottonseed meal, partially decorticated, expeller extraction	4.39	3.63	1.80	1.64	1.25	2.85	3.53	5.21	6.43	5.70	3.20	11.49	4.10	9.58	22.18	4.34	4.72	3.96
Cottonseed meal, partially decorticated, solvent extraction	4.39	3.63	1.80	1.64	1.25	2.85	3.53	5.21	6.43	5.70	3.20	11.49	4.10	9.58	22.18	4.34	4.72	3.96
Dairy 1 compound feed	4.27	3.52	1.64	1.75	*	1.37	*	*	*	*	*	*	*	*	*	*	*	*
Dairy 2 high NDF compound feed	4.30	3.59	1.72	1.73	*	1.32	*	*	*	*	*	*	*	*	*	*	*	*
Crambe hulls	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Crambe oil meal, expeller extraction	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Crambe oil meal, solvent extraction	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Distillers' dark grains, maize	3.40	4.45	1.80	2.38	0.50	2.57	4.55	5.98	11.56	5.13	4.10	4.71	8.24	7.82	20.23	5.16	5.22	2.21
Distillers' dark grains, malt	4.52	4.53	1.75	2.13	1.31	2.62	4.77	6.51	8.52	6.15	3.88	4.46	3.94	5.33	28.95	4.50	3.97	2.14
Distillers' dark grains, wheat	3.01	3.60	1.84	2.01	1.42	3.01	4.30	5.23	7.74	5.39	3.01	5.43	4.26	5.77	31.32	4.52	5.81	2.32
Distillers' grains, maize, dehydrated	3.40	4.45	1.80	2.38	0.50	2.57	4.55	5.98	11.56	5.13	4.10	4.71	8.24	7.82	20.23	5.16	5.22	2.21
Distillers' grains, wheat,dehydrated	3.01	3.60	1.84	2.01	1.42	3.01	4.30	5.23	7.74	5.39	3.01	5.43	4.26	5.77	31.32	4.52	5.81	2.32
Feather meal	2.19	4.59	0.59	4.69	0.66	0.76	4.83	7.65	8.48	4.96	2.85	6.65	4.68	6.74	10.92	7.76	11.17	9.82
Fish meal, white	8.17	4.60	2.96	0.95	1.17	3.29	4.77	5.58	8.00	4.28	3.46	6.37	6.58	9.64	14.23	6.99	4.33	4.63
Fish oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fodder beet	5.56	4.50	1.73	1.82	*	2.50	*	*	*	*	*	*	*	*	*	*	*	*
Groundnut meal	3.44	2.83	1.04	1.09	0.00	2.33	3.80	4.60	6.78	5.06	3.90	12.88	4.32	12.01	20.20	6.15	5.14	4.42

FEED INTO MILK FEEDS DATABASE

Amino acids (expressed as % total amino acids)

Source of amino acid data:

= AmiPig

= ADAS NSRU database

= Rhône-Poulenc Rhodimet (Feed guide 1993)

= H. Rulquin, INRA

= Other

Feed name	LYS	THR	MET	CYS	TRP	HIS	ILE	VAL	LEU	PHE	TYR	ARG	ALA	ASP	GLU	GLY	SER	PRO
Linseed meal, expeller	3.90	4.01	2.11	2.00	1.90	2.22	4.54	5.49	6.33	4.85	2.85	9.60	4.54	9.60	20.46	6.12	5.59	3.90
Linseed meal, extracted	3.90	4.01	2.11	2.00	1.90	2.22	4.54	5.49	6.33	4.85	2.85	9.60	4.54	9.60	20.46	6.12	5.59	3.90
Linseeds (crushed)	3.90	4.00	2.11	2.00	1.90	2.21	4.53	5.48	6.32	4.85	2.85	9.59	4.53	9.59	20.44	6.11	5.69	3.90
Lupin, blue, seed	5.02	3.63	0.75	1.60	0.85	2.88	4.48	4.38	7.47	3.95	3.52	11.53	3.52	9.93	22.41	4.27	5.66	4.16
Lupin, seed	4.86	3.48	0.66	1.54	0.75	2.70	4.71	4.30	7.43	4.03	3.72	10.68	3.51	10.28	23.92	4.23	5.21	3.98
Lupin, white determinate, UK grown	5.03	3.94	0.59	1.76	0.59	2.43	4.52	4.27	7.54	4.10	4.86	10.89	3.43	10.89	21.19	4.10	5.70	4.19
Lupin, white, seed	5.02	3.63	0.75	1.60	0.85	2.88	4.48	4.38	7.47	3.95	3.52	11.53	3.52	9.93	22.41	4.27	5.66	4.16
Lupin, white, seed, extruded	5.02	3.63	0.75	1.60	0.85	2.88	4.48	4.38	7.47	3.95	3.52	11.53	3.52	9.93	22.41	4.27	5.66	4.16
Maize, ground	3.08	3.71	2.17	2.14	0.76	2.80	3.72	5.06	12.41	5.03	3.41	4.54	7.73	6.61	19.32	3.74	4.96	8.81
Maize germ meal, ext.	5.06	4.30	2.30	1.76	1.13	3.89	3.93	6.23	8.19	4.77	2.96	7.94	6.56	7.65	14.42	5.89	5.31	7.71
Maize gluten feed CP 200 g/kg	3.70	4.06	1.97	2.23	0.78	3.61	3.71	5.49	9.79	4.21	3.06	5.49	7.72	6.78	17.44	5.04	4.90	10.02
Maize gluten meal CP 600 g/kg	1.64	3.24	2.19	1.61	0.47	2.05	3.98	4.31	15.71	5.84	4.88	2.87	8.36	5.59	20.80	2.33	5.01	9.12
Maize starch byproduct, dehydrated, Corex M 100	3.08	3.71	2.17	2.14	0.76	2.80	3.72	5.06	12.41	5.03	3.41	4.54	7.73	6.61	19.32	3.74	4.96	8.81
Maize starch byproduct, fresh, perlite added	3.08	3.71	2.17	2.14	0.76	2.80	3.72	5.06	12.41	5.03	3.41	4.54	7.73	6.61	19.32	3.74	4.96	8.81
Maize, flaked	3.08	3.71	2.17	2.14	0.76	2.80	3.72	5.06	12.41	5.03	3.41	4.54	7.73	6.61	19.32	3.74	4.96	8.81
Maize, toasted	3.08	3.71	2.17	2.14	0.76	2.80	3.72	5.06	12.41	5.03	3.41	4.54	7.73	6.61	19.32	3.74	4.96	8.81
Malt culms	6.02	4.29	1.81	1.78	1.09	2.57	4.17	5.83	6.90	4.01	2.83	5.29	6.04	13.74	12.62	4.86	4.06	12.09
Megalac™	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Minerals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Molasses, cane	0.90	2.47	0.90	1.87	1.01	0.45	2.25	4.95	2.70	1.35	1.35	0.45	7.42	39.12	25.18	3.37	3.37	0.90
Oatfeed	3.92	3.70	1.63	2.72	1.42	2.29	4.25	5.88	7.63	5.23	3.92	7.08	5.01	7.95	20.92	5.12	5.56	5.77
Oats	4.46	3.57	1.86	2.96	1.33	2.46	3.89	5.31	7.67	5.11	2.94	6.77	5.07	8.27	21.48	5.12	5.02	6.71
Oats, flaked	4.46	3.57	1.86	2.96	1.33	2.46	3.89	5.31	7.67	5.11	2.94	6.77	5.07	8.27	21.48	5.12	5.02	6.71
Oats, toasted	4.46	3.57	1.86	2.96	1.33	2.46	3.89	5.31	7.67	5.11	2.94	6.77	5.07	8.27	21.48	5.12	5.02	6.71
Palm kernel meal, expeller extraction	2.89	3.58	1.90	1.29	0.82	2.04	4.25	6.18	7.23	4.60	2.65	12.59	4.76	9.34	22.11	5.15	5.17	3.46
Palm kernel meal, solvent extraction	2.89	3.58	1.90	1.29	0.82	2.04	4.25	6.18	7.23	4.60	2.65	12.59	4.76	9.34	22.11	5.15	5.17	3.46
Palm kernel meal	2.89	3.58	1.90	1.29	0.82	2.04	4.25	6.18	7.23	4.60	2.65	12.59	4.76	9.34	22.11	5.15	5.17	3.46
Pea, extruded	7.35	3.89	1.02	1.51	0.91	2.81	4.25	4.85	7.30	4.76	3.24	9.34	4.65	11.94	17.65	4.92	5.01	4.61
Peas	7.63	3.92	0.99	1.38	0.97	2.64	4.45	4.88	7.41	4.96	3.01	9.08	4.61	12.12	18.12	4.52	5.05	4.28
Pot ale syrup	6.47	5.61	1.06	2.11	0.41	3.23	4.03	4.08	6.34	3.17	2.64	3.30	8.98	10.30	15.71	5.61	5.54	11.42
Potato feed liquid, fresh	7.94	4.99	1.66	2.30	1.83	2.69	5.12	7.68	7.81	4.74	4.86	5.38	4.10	12.29	11.14	4.74	5.63	5.12
Potato tuber, whole, fresh	7.94	4.99	1.66	2.30	1.83	2.69	5.12	7.68	7.81	4.74	4.86	5.38	4.10	12.29	11.14	4.74	5.63	5.12
Rapeseed hulls	5.77	4.80	2.33	2.71	1.39	2.86	4.56	5.78	7.48	4.33	3.00	6.55	4.78	7.82	18.75	5.45	4.83	6.82
Rapeseed meal	5.77	4.80	2.33	2.71	1.39	2.86	4.56	5.78	7.48	4.33	3.00	6.55	4.78	7.82	18.75	5.45	4.83	6.82
Rapeseed meal, (before 1991)	5.77	4.80	2.33	2.71	1.39	2.86	4.56	5.78	7.48	4.33	3.00	6.55	4.78	7.82	18.75	5.45	4.83	6.82
Rapeseed meal, 00	5.77	4.80	2.33	2.71	1.39	2.86	4.56	5.78	7.48	4.33	3.00	6.55	4.78	7.82	18.75	5.45	4.83	6.82
Rapeseed, canola, meal	5.77	4.80	2.33	2.71	1.39	2.86	4.56	5.78	7.48	4.33	3.00	6.55	4.78	7.82	18.75	5.45	4.83	6.82
Rapeseeds (crushed)	6.47	4.63	2.31	2.44	1.52	3.07	4.40	5.60	7.13	4.34	3.19	6.62	4.63	8.05	18.70	5.29	4.60	6.99
Rice bran	5.28	4.24	2.39	2.31	1.24	3.06	3.87	5.96	7.58	4.74	3.60	9.33	6.13	9.85	14.86	6.04	5.01	4.53
Rye	4.22	3.55	1.77	2.41	1.18	2.44	3.58	4.93	6.45	4.62	2.28	5.97	4.85	8.06	24.96	4.72	4.61	9.42

FEED INTO MILK FEEDS DATABASE

Amino acids (expressed as % total amino acids)

Source of amino acid data:

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= H. Rulquin, INRA

= Other

Feed name	LYS	THR	MET	CYS	TRP	HIS	ILE	VAL	LEU	PHE	TYR	ARG	ALA	ASP	GLU	GLY	SER	PRO
Smartamine™ M	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Smartamine™ ML	72.72	0.00	27.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sorghum	2.30	3.40	1.70	1.80	1.10	2.10	4.20	5.30	13.20	4.90	4.20	4.10	8.80	6.90	19.10	3.30	5.00	8.60
Soyabean flour, not defatted	6.44	4.05	1.33	1.17	1.55	2.55	4.50	4.47	7.55	4.88	3.58	7.30	4.54	11.92	19.46	3.94	5.52	5.25
Soyabean hulls	6.60	4.21	1.65	1.74	1.38	2.75	4.49	5.22	7.51	4.40	3.29	5.96	5.12	10.35	14.93	7.69	6.41	6.30
Soyabean meal	6.33	3.98	1.38	1.47	1.36	2.69	4.99	5.17	7.77	5.17	3.74	7.55	4.29	11.27	18.39	4.23	5.25	4.97
Soyabean meal, Brazilian, (Soya 48)	6.19	3.96	1.37	1.42	1.37	2.74	4.86	4.97	7.65	5.22	3.82	7.62	4.34	11.40	18.60	4.26	5.20	5.02
Soyabean meal, formaldehyde treated	6.24	3.90	1.41	1.48	1.27	2.72	4.94	4.95	7.64	4.88	3.38	7.80	4.51	11.52	18.56	4.27	5.48	5.04
Soyabean meal, Hipro	6.33	3.96	1.43	1.51	1.29	2.80	4.83	4.88	7.69	5.04	3.62	7.75	4.26	11.39	18.86	4.11	5.19	5.07
Soyabean meal, tanned	6.33	3.98	1.38	1.47	1.36	2.69	4.99	5.17	7.77	5.17	3.74	7.55	4.29	11.27	18.39	4.23	5.25	4.97
Soyabean seed	6.44	4.05	1.33	1.17	1.55	2.55	4.50	4.47	7.55	4.88	3.58	7.30	4.54	11.92	19.46	3.94	5.52	5.25
Soyabean seed, extruded	6.44	4.05	1.33	1.17	1.55	2.55	4.50	4.47	7.55	4.88	3.58	7.30	4.54	11.92	19.46	3.94	5.52	5.25
Soyabean seed, toasted	6.44	4.05	1.33	1.17	1.55	2.55	4.50	4.47	7.55	4.88	3.58	7.30	4.54	11.92	19.46	3.94	5.52	5.25
Sugar beet pulp, dehydrated	6.53	6.06	1.86	1.63	1.17	3.73	4.66	7.34	7.23	4.55	5.94	5.36	5.59	10.37	11.19	5.01	6.41	5.36
Sugar beet pulp, dehydrated, molassed	5.31	4.55	1.26	1.52	1.39	3.92	4.30	5.69	6.45	3.67	4.68	3.54	4.30	8.47	24.79	4.68	5.06	6.42
Sugarbeet pulp, molassed	4.58	4.19	1.78	1.15	1.15	2.93	4.45	5.72	5.97	3.44	4.07	3.30	4.83	8.52	27.21	4.83	4.96	6.94
Sunflower ext. Arg 350 g/kg protein	3.97	3.96	2.60	1.76	1.39	2.81	4.63	5.34	6.68	4.87	2.52	9.29	4.55	9.21	20.83	6.04	4.68	4.88
Sunflower ext. EC 290 g/kg protein	4.04	4.15	2.74	1.69	1.32	2.62	4.73	5.28	6.80	4.87	2.03	8.51	4.65	9.75	20.53	6.29	4.88	5.12
Sunflower hulls	4.04	4.15	2.74	1.69	1.32	2.62	4.73	5.28	6.80	4.87	2.03	8.51	4.65	9.75	20.53	6.29	4.88	5.12
Sunflower meal	4.04	4.15	2.74	1.69	1.32	2.62	4.73	5.28	6.80	4.87	2.03	8.51	4.65	9.75	20.53	6.29	4.88	5.12
Sunflower meal, decorticated	3.97	3.96	2.60	1.76	1.39	2.81	4.63	5.34	6.68	4.87	2.52	9.29	4.55	9.21	20.83	6.04	4.68	4.88
Sunflower seed meal	4.04	4.15	2.74	1.69	1.32	2.62	4.73	5.28	6.80	4.87	2.03	8.51	4.65	9.75	20.53	6.29	4.88	5.12
Sunflower, ext. Arg 350 g/kg protein	3.97	3.96	2.60	1.76	1.39	2.81	4.63	5.34	6.68	4.87	2.52	9.29	4.55	9.21	20.83	6.04	4.68	4.88
Supergrains	3.01	3.60	1.84	2.01	*	3.01	*	*	*	*	*	*	*	*	*	*	*	*
Urea 2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wheat, ground/rolled	3.04	3.06	1.70	2.22	1.25	2.52	3.80	4.45	6.87	4.84	2.62	5.13	3.68	5.38	29.84	4.06	4.84	10.71
Wheat bran, fine	4.61	3.69	1.79	2.15	1.56	3.16	3.54	5.10	7.01	4.43	2.93	8.01	5.20	7.90	21.64	5.69	4.80	6.82
Wheat middlings	4.56	3.68	1.91	2.21	1.35	2.75	3.51	5.13	6.94	4.41	2.89	7.48	4.94	7.30	23.19	5.36	4.83	7.56
Wheat shorts	4.38	3.30	1.59	2.03	1.33	2.60	3.43	5.01	6.22	3.81	2.86	6.98	3.47	5.08	28.15	5.08	4.57	10.11
Wheat, sodium hydroxide treated	3.04	3.06	1.70	2.22	1.25	2.52	3.80	4.45	6.87	4.84	2.62	5.13	3.68	5.38	29.84	4.06	4.84	10.71
Wheat, soft	3.04	3.06	1.70	2.22	1.25	2.52	3.80	4.45	6.87	4.84	2.62	5.13	3.68	5.38	29.84	4.06	4.84	10.71
Wheat, toasted	3.04	3.06	1.70	2.22	1.25	2.52	3.80	4.45	6.87	4.84	2.62	5.13	3.68	5.38	29.84	4.06	4.84	10.71
Wheatfeed	3.82	3.95	1.94	2.43	1.43	2.86	3.76	5.55	7.09	4.43	2.19	6.48	5.54	8.00	22.67	5.68	5.28	6.91