Pork Production Reference Guide

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TOP PORK PRODUCING COUNTRIES

Country	1995	1997	1999	2000
		- 1,000 metric tonnes -		
China	36,484	34,643	36,788	37,890
United States	8,096	7,835	8,716	8,463
Germany	3,604	3,562	3,888	3,885
Spain	2,175	2,401	2,824	2,909
France	2,145	2,220	2,350	2,335
Brazil	1,450	1,540	1,742	1,836
Denmark	1,457	1,534	1,701	1,720
Canada	1,276	1,257	1,525	1,620
Netherlands	1,623	1,375	1,700	1,602
Poland	1,580	1,540	1,700	1,580
Italy	1,345	1,396	1,425	1,425
Russian Federation	1,865	1,570	1,485	1,400
Japan	1,322	1,283	1,283	1,280
United Kingdom	1,017	1,157	1,181	1,100
Philippines	754	901	980	1,036
Belgium-Luxembourg	1,057	1,024	1,041	1,034
Korea	799	873	961	973
Mexico	954	940	950	945
Taiwan	1,233	1,030	870	890
Ukraine	807	750	710	715
Czech Republic	650	680	686	661

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
Annual data expressed on a carcass weight basis; year 2000 is forecast.

PORK PRODUCTION BY REGION

Region	1995	1997	1999	2000
		- 1,000 metric tonnes -		
Other Asia	40,864	38,989	41,071	42,242
European Union	15,701	15,906	17,409	17,279
North America	10,326	10,032	11,191	11,028
Eastern Europe	3,316	3,280	3,464	3,277
Former Soviet Union	2,672	2,320	2,195	2,115
South America	1,450	1,540	1,742	1,836
Oceania	351	339	353	360
Total:	**74,680**	**72,406**	**77,425**	**78,137**

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
Annual data expressed on a carcass weight basis; year 2000 is forecast.

HOGS MARKETED IN CANADA BY PROVINCE

Province	1992	1994	1996	1998
		- 1,000 head -		
Quebec	4,703.2	4,856.0	5,463.4	6,257.0
Ontario	4,424.9	4,300.0	4,586.2	5,604.2
Manitoba	2,353.1	2,576.0	3,149.1	3,995.3
Alberta	2,589.6	2,591.0	2,681.8	2,826.1
Saskatchewan	1,174.5	1,183.4	1,195.1	1,385.3
British Columbia	358.4	370.6	332.7	357.7
Nova Scotia	212.7	202.4	218.5	235.2
Prince Edward Island	173.0	175.4	190.3	198.9
New Brunswick	123.6	129.0	134.1	173.7
Newfoundland	27.2	7.3	7.2	6.1

Source: Statistics Canada

HOG SLAUGHTER BY COUNTRY

Country	1995	1997	1999	2000
		- 1,000 head -		
China	475,591	450,772	484,000	495,000
United States	96,326	91,961	100,863	97,950
Germany	39,361	38,543	42,513	42,700
Spain	27,539	29,783	35,021	35,913
Russian Federation	24,262	29,130	27,534	26,934
France	24,525	24,757	27,230	26,920
Brazil	17,455	20,865	23,352	24,533
Denmark	19,253	19,667	21,980	22,210
Poland	22,700	21,335	23,050	21,500
Canada	15,771	15,388	19,500	20,714
Philippines	13,700	16,090	17,500	18,500
Netherlands	18,616	15,312	19,200	18,000
Japan	17,605	17,021	17,030	16,980
United Kingdom	14,391	15,442	15,220	14,047
Mexico	13,468	12,770	13,388	13,218
Italy	11,956	12,164	12,735	12,720
Korea	10,178	10,918	12,250	12,390
Belgium-Luxembourg	11,476	11,084	11,432	11,550
Taiwan	14,180	11,400	9,600	9,800
Ukraine	10,619	8,600	8,050	8,050
Romania	6,180	7,462	6,220	5,910
Hungary	4,912	5,790	5,900	5,737
Austria	4,954	5,100	5,360	5,250

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
Year 2000 is forecast.

HOG SLAUGHTER BY REGION

Region	1995	1997	1999	2000
		- 1,000 head -		
Other Asia	531,254	506,201	540,380	552,670
European Union	183,387	184,503	202,731	201,401
North America	125,565	120,119	133,751	131,882
Eastern Europe	42,267	42,695	43,894	41,806
Former Soviet Union	34,881	37,730	35,584	34,984
South America	17,455	20,865	23,352	24,533
Oceania	5,120	4,846	4,985	5,000
Total:	**939,929**	**916,959**	**984,677**	**992,276**

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
Year 2000 is forecast.

PIG INVENTORIES BY COUNTRY

Country	1995	1997	1999	2000
		- 1,000 head -		
China	414,619	362,836	396,000	397,000
United States	59,738	56,124	62,206	59,600
Brazil	31,338	31,369	30,997	29,810
Germany	24,698	24,283	26,299	27,049
Spain	18,295	18,651	21,715	22,328
Poland	19,138	17,697	19,275	18,300
Russian Federation	24,859	19,500	16,400	16,000
France	14,593	14,968	15,864	15,550
Canada	11,291	11,480	12,402	13,164
Netherlands	13,931	14,253	12,418	13,000
Denmark	10,864	11,081	11,891	12,147
Mexico	12,513	10,250	10,758	10,699
Philippines	8,914	9,750	10,398	10,550
Ukraine	13,946	11,236	9,909	10,000
Japan	10,250	9,823	9,873	9,880
Italy	8,000	8,100	8,225	8,225
Belgium-Luxembourg	7,060	7,190	7,682	7,705
United Kingdom	7,879	7,621	7,554	7,250
Korea	5,955	6,516	6,700	6,750
Romania	7,727	8,235	7,000	6,650
Taiwan	10,066	10,698	6,539	6,600

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
Year 2000 is forecast.

PIG INVENTORIES BY REGION

Region	1995	1997	1999	2000
		- 1,000 head -		
Other Asia	449,831	399,623	429,510	430,780
European Union	115,276	116,171	121,820	123,237
North America	83,542	77,854	85,366	83,463
Eastern Europe	37,069	36,780	37,447	36,140
South America	31,338	31,369	30,997	29,810
Former Soviet Union	38,805	30,736	26,309	26,000
Oceania	2,600	2,600	2,600	2,600
Total:	**758,461**	**695,133**	**734,049**	**732,030**

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
Year 2000 is forecast.

ANNUAL PER CAPITA PORK CONSUMPTION BY COUNTRY

Country	1995	1997	1999	2000
		- kg per person per year -		
Denmark	74.1	69.2	73.2	73.3
Czech Republic	64.9	64.8	67.7	66.7
Spain	54.0	57.8	65.6	65.5
Belgium-Luxembourg	54.4	43.0	55.7	62.3
Germany	54.8	53.2	57.4	57.4
Austria	56.3	55.0	57.7	57.1
Netherlands	44.2	42.9	48.7	45.5
Hong Kong	54.4	52.7	46.0	44.8
Ireland	37.9	40.2	41.6	42.8
Taiwan	40.2	39.6	43.6	42.6
Hungary	39.3	40.6	42.1	42.0
Poland	38.6	34.4	40.1	39.9
Sweden	35.8	35.8	38.5	38.8
France	35.8	35.3	37.2	38.2
Italy	33.6	34.8	36.3	36.5
Canada	31.9	29.4	32.6	33.6
Bulgaria	32.5	29.7	31.0	31.9
Portugal	35.3	28.8	31.1	31.1
United States	30.6	28.5	31.3	30.2
China	30.1	28.1	29.5	30.1
United Kingdom	22.8	24.1	24.6	23.5
Korea	18.4	18.9	20.8	20.9
Australia	19.4	18.5	18.8	18.9
Japan	16.7	16.5	16.6	16.6
Ukraine	15.9	14.7	14.2	14.3
Romania	17.5	13.1	15.0	13.5
Russian Federation	17.4	14.0	12.5	12.0

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
All data is expressed on a carcass weight basis; year 2000 is forecast.

TOP PORK IMPORTING COUNTRIES

Country	1995	1997	1999	2000
		- 1,000 metric tonnes/year -		
Japan	829	731	814	814
United States	301	287	375	363
Russia	454	500	350	350
Hong Kong	160	188	221	235
Korea	45	77	124	130
Mexico	30	62	110	120
Taiwan	5	0	60	65
China	3	25	48	50
Poland	47	36	40	50
Canada	27	59	45	40
Singapore	25	26	18	23
Australia	4	10	18	19
Romania	2	0	20	15
Germany	9	14	15	15
Philippines	2	8	13	15
Spain	6	16	11	10
Italy	4	15	10	10
United Kingdom	1	6	5	6

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
All data is expressed on a carcass weight basis; year 2000 is forecast.

PORK IMPORTS BY REGION

Region	1995	1997	1999	2000
		- 1,000 metric tonnes/year -		
Other Asia	1,069	1,055	1,298	1,332
North America	358	408	530	523
Former Soviet Union	455	520	353	353
Eastern Europe	93	44	86	94
European Union	32	61	49	43
Oceania	4	10	18	19
South America	10	6	1	1
Total:	**2,021**	**2,104**	**2,335**	**2,365**

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
All data is expressed on a carcass weight basis; year 2000 is forecast.

TOP PORK EXPORTING COUNTRIES

Country	1995	1997	1999
		- 1,000 metric tonnes/year -	
United States	357	474	572
Canada	357	416	550
Denmark	369	470	500
France	147	143	210
Poland	81	284	120
Korea	18	70	115
China	230	162	100
Belgium-Luxembourg	27	95	50
Spain	1	53	80
Brazil	29	64	77
Netherlands	50	91	50
Germany	45	31	65
Ireland	15	12	36
United Kingdom	24	28	38
Hungary	54	48	30
Austria	0	14	34
Australia	5	7	18
Czech Republic	0	19	8
Sweden	15	13	12
Taiwan	381	70	5

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
All data is expressed on a carcass weight basis.

PORK EXPORTS BY REGION

Region	1995	1997	1999
		- 1,000 metric tonnes -	
North America	718	912	1,147
European Union	708	972	1,094
Other Asia	642	324	285
Eastern Europe	173	423	166
South America	29	64	77
Oceania	5	7	18
Former Soviet Union	46	6	6
Total:	**2,321**	**2,708**	**2,793**

Source: Commodity and Marketing Program, Foreign Agriculture Service, 2000; USDA, 2000.
All data is expressed on a carcass weight basis.

MAJOR FRESH, CHILLED AND FROZEN PORK PROCESSORS IN CANADA

ATRAHAN Transformation Inc.
860, Chemin des Acadiens
Yamachiche, Quebec G0X 3L0
Tel: (819) 296-3791
Plant location: Yamachiche, QC

Abattoir St-Alexandre (1982) Inc.
511, rue de la Gare
St-Alexandre, Quebec G0L 2G0
Tel: (418) 495-2728
Plant location: St-Alexandre, QC

Agromex Inc.
251 route 235
Ange-Gardien, Quebec J0E 1E0
Tel: (450) 293-3694
Plant location: St. Blaise, QC

Aliments Jolibec Inc.
149, montee Allard
St-Jacques-de-Montcalm, Quebec J0K 2R0
Tel: (450) 839-3635
Plant location: St-Jacques-de-Montcalm, QC

Britco Export Packers
22940 Fraser Hwy
Langley, British Columbia V3A 4P6
Tel: (604) 533-3911
Plant location: Langley, BC

Conestoga Meat Packers Ltd.
R.R. #2
Breslau, Ontario N0B 1M0
Tel: (519) 648-2506
Plant location: Breslau, ON

Drummond Export Inc.
2825 Power St.
Drummondville, Quebec J2C 6Z6
Tel: (819) 472-1125
Plant location: Drummonville, QC

Fletcher's Fine Foods Ltd.
Bag 5641
Red Deer, Alberta T4N 6R7
Tel: (403) 343-8700
Plant locations: Red Deer, AB
Vancouver, BC

Garden Province Meats Inc.
Box 670
Charlottetown, PEI C1A 7L3
Tel: (902) 566-5211
Plant location: Charlottetown, PEI

Jadee Meat Products Ltd.
4710 Bartlett Road
Beamsville, Ontario L0R 1B0
Tel: (905) 563-5381
Plant location: Beamsville, ON

Hub Meat Packers Ltd.
144 Edinburgh Drive
Moncton, New Brunswick B1B 2K7
Tel: (506) 863-8899
Plant location: Moncton, NB

Larsen Packers Ltd.
316 Main Street
Berwick, Nova Scotia B0P 1E0
Tel: (902) 538-8060
Plant location: Berwick, NS

Source: Canadian Pork International

MAJOR FRESH, CHILLED AND FROZEN PORK PROCESSORS IN CANADA

Mitchell's Gourmet Foods Inc.
Box 850
Saskatoon, Saskatchewan S7K 3V7
Tel: (306) 931-4253
Plant location: Saskatoon, SK

Maple Leaf Pork
1016B Sutton Drive, Suite 201
Burlington, Ontario L7L 6B8
Tel: (905) 319-7208 or 319-7213
Plant locations: Lethbridge, AB
Burlington, ON
Brandon, MB

Olymel
700, rue Croisetiere
Iberville, Quebec J2X 4H7
Tel: (514) 585-9000
Plant locations: St. Simon, QC
Princeville, QC
St. Valerien, QC
Vallée Jonction, QC

Quality Meat Packers Ltd.
2 Tecumseth Street
Toronto, Ontario M5V 2R5
Tel: (416) 703-7675
Plant location: Toronto, ON

Les Salaisons Bronchu (Lafleur) Inc.
183, route Kennedy
Saint-Henri, (Levis), Quebec G0R 3E0
Tel: (418) 882-2282
Plant location: Saint-Henri, QC

J.M. Schneider Inc.
1 Warman Road
Winnipeg, Manitoba R2J 4E5
Tel: (204) 231-4114
Plant locations: Winnipeg, MB
Kitchener, ON

Springhill Farms
Box 10000
Neepawa, Manitoba R0J 1H0
Tel: (204) 476-3393
Plant location:
Neepawa, MB

Tai Wan Pork Inc.
#54-325 4th Avenue S.W.
Moose Jaw, Saskatchewan S6H 5V2
Tel: (306) 694-5300
Plant location:
Moose Jaw, SK

Trochu Meats Processor Ltd.
Box 266
Acme, Alberta T0M 0A0
Tel: (403) 546-3818
Plant location:
Tronchu, AB

Les Viandes DuBreton Inc.
151, rue de l'Englise
Notre-Dame-du-Lac, Quebec G0L 1X0
Tel: (418) 899-6711
Plant location:
Notre-Dame-du-Lac, QC

Les Viandes Or-Fil Inc.
2080, rue Monterey
Chomedey, Laval, Quebec H7L 3S3
Tel: (450) 687-5664
Plant location: Laval, QC

Viandes Kamouraska Packers Inc.
162 route 230 ouest
St-Pascal, Quebec G0L 3Y0
Tel: (418) 492-2128
Plant location: St-Pascal, QC

Source: Canadian Pork International

TEMPERATURE, RESPIRATION AND HEART RATE OF PIGS

Age of pig	Rectal Temperature		Respiratory Rate (breaths/min)	Heart Rate (beats/min)
	°C	°F		
Newborn[1]	39.0	102.2	50-60	200-250
Nursing piglet	39.2	102.6	-	-
Weaned piglet	39.3	102.7	25-40	90-100
Growing pig	39.0	102.3	30-40	80-90
Finishing pig	38.8	101.8	25-35	75-85
Gestating Sow	38.7	101.7	13-18	70-80
Prepartum Sow[2]	38.7	101.7	35-45	-
Farrowing Sow[3]	39.4	102.9	35-45	-
Lactating Sow	39.3	102.7	-	-

Adapted from Diseases of Swine, 1999; Pig Diseases, 1989; Canadian Council on Animal Care, 1993.

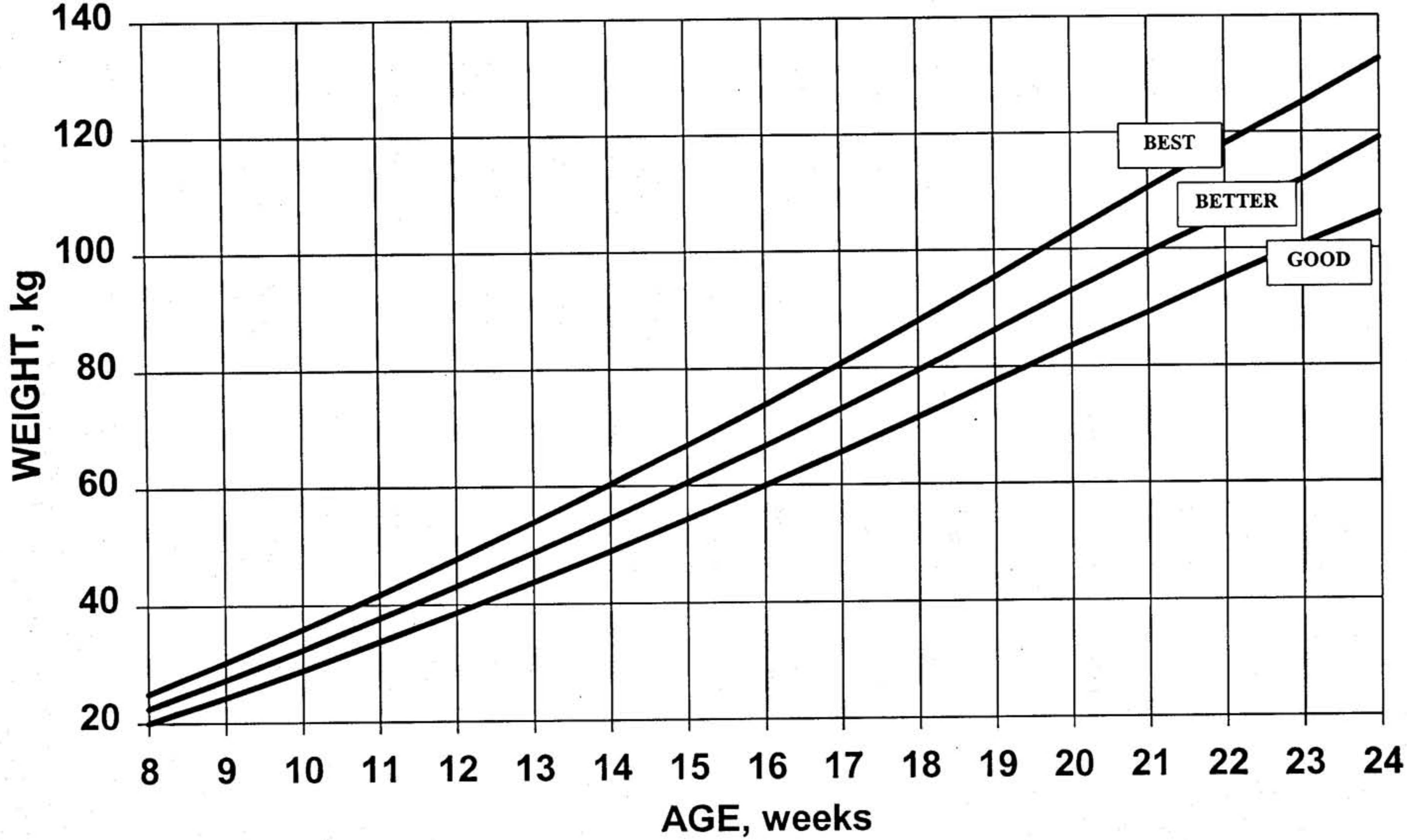
NB: There is a wide range of rectal temperatures in pigs (range ± 0.30°C, 0.5°F). Due to individual variation, as well as the rapidity with which temperatures will rise in response to stress, the above values should be used as guidelines only.

[1] The rectal temperature of the newborn will decrease approximately 1° (C or F) in the first hour after birth. It will increase to 38.6°C or 101.5°F after 24 hrs.

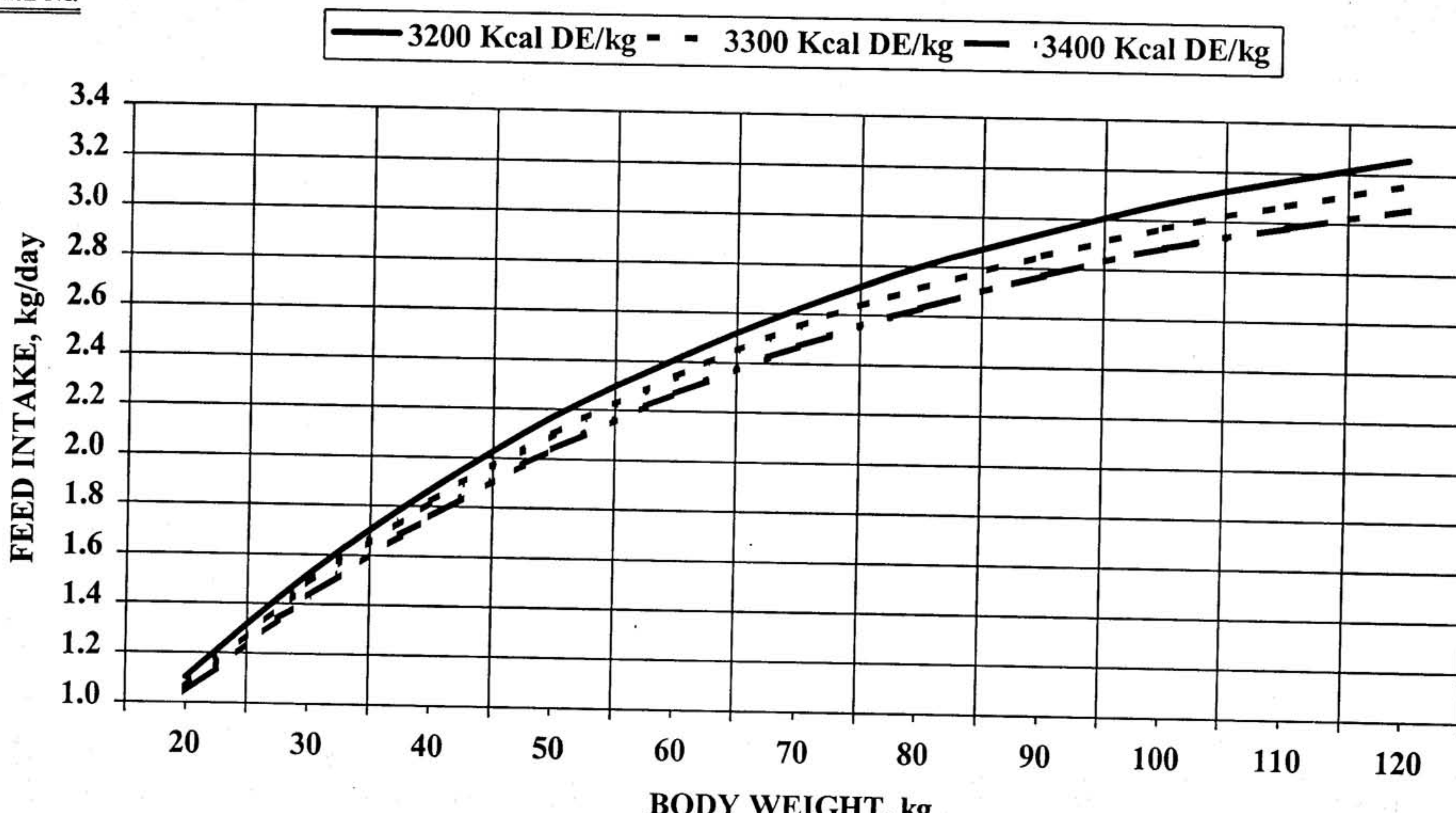
[2] The rectal temperatures in the prepartum sow increases by ~1° (C or F) by 12 hrs prepartum.

[3] The sow's temperature will rise to 40°C or 104°F at 24 hours postpartum and then decline and stabilize during lactation

PIG GROWTH CURVES



PIG FEED INTAKE CURVES



Source: NRC, 1998.

NB: This curve represents an "ideal" daily feed intake. Under commercial conditions, feed intake is affected by genotype, health status, environmental temperature, crowding, feeder design and water supply. Typically, feed intake in well-managed confinement type facilities will be 85% to 95% of that presented above. For pigs housed outdoors or under similar conditions, feed intake could exceed the above unless conditions of heat stress exist. Since feed intake is such a critical piece of information, it should be measured on individual farms and in at least two seasons, summer and winter.

ESTIMATED FEED INTAKES (kg/d)

Body Weight	DE (Intake)	Diet Digestible Energy Concentration												
		3000	3050	3100	3150	3200	3250	3300	3350	3400	3450	3500	3550	3600
								- kcal/kg -						
20	3,905	1.30	1.28	1.26	1.24	1.22	1.20	1.18	1.17	1.15	1.13	1.12	1.10	1.08
25	4,685	1.56	1.54	1.51	1.49	1.46	1.44	1.42	1.40	1.38	1.36	1.34	1.32	1.30
30	5,399	1.80	1.77	1.74	1.71	1.69	1.66	1.64	1.61	1.59	1.57	1.54	1.52	1.50
35	6,053	2.02	1.98	1.95	1.92	1.89	1.86	1.83	1.81	1.78	1.75	1.73	1.71	1.68
40	6,652	2.22	2.18	2.15	2.11	2.08	2.05	2.02	1.99	1.96	1.93	1.90	1.87	1.85
45	7,200	2.40	2.36	2.32	2.29	2.25	2.22	2.18	2.15	2.12	2.09	2.06	2.03	2.00
50	7,703	2.57	2.53	2.48	2.45	2.41	2.37	2.33	2.30	2.27	2.23	2.20	2.17	2.14
55	8,163	2.72	2.68	2.63	2.59	2.55	2.51	2.47	2.44	2.40	2.37	2.33	2.30	2.27
60	8,584	2.86	2.81	2.77	2.72	2.68	2.64	2.60	2.56	2.52	2.49	2.45	2.42	2.38
65	8,969	2.99	2.94	2.89	2.85	2.80	2.76	2.72	2.68	2.64	2.60	2.56	2.53	2.49
70	9,323	3.11	3.06	3.01	2.96	2.91	2.87	2.83	2.78	2.74	2.70	2.66	2.63	2.59
75	9,646	3.22	3.16	3.11	3.06	3.01	2.97	2.92	2.88	2.84	2.80	2.76	2.72	2.68
80	9,942	3.31	3.26	3.21	3.16	3.11	3.06	3.01	2.97	2.92	2.88	2.84	2.80	2.76
85	10,213	3.40	3.35	3.29	3.24	3.19	3.14	3.09	3.05	3.00	2.96	2.92	2.88	2.84
90	10,462	3.49	3.43	3.37	3.32	3.27	3.22	3.17	3.12	3.08	3.03	2.99	2.95	2.91
95	10,689	3.56	3.50	3.45	3.39	3.34	3.29	3.24	3.19	3.14	3.10	3.05	3.01	2.97
100	10,898	3.63	3.57	3.52	3.46	3.41	3.35	3.30	3.25	3.21	3.16	3.11	3.07	3.03
105	11,088	3.70	3.64	3.58	3.52	3.47	3.41	3.36	3.31	3.26	3.21	3.17	3.12	3.08
110	11,263	3.75	3.69	3.63	3.58	3.52	3.47	3.41	3.36	3.31	3.26	3.22	3.17	3.13
115	11,423	3.81	3.75	3.68	3.63	3.57	3.51	3.46	3.41	3.36	3.31	3.26	3.22	3.17
120	11,569	3.86	3.79	3.73	3.67	3.62	3.56	3.51	3.45	3.40	3.35	3.31	3.26	3.21
125	11,704	3.90	3.84	3.78	3.72	3.66	3.60	3.55	3.49	3.44	3.39	3.34	3.30	3.25
130	11,826	3.94	3.88	3.81	3.75	3.70	3.64	3.58	3.53	3.48	3.43	3.38	3.33	3.29
135	11,939	3.98	3.91	3.85	3.79	3.73	3.67	3.62	3.56	3.51	3.46	3.41	3.36	3.32

$DE_{intake} = 13{,}162(1\text{-}e^{-0.0176BW})$ where "e" = 2.7183, NRC 1998.

NB: This curve represents an "ideal" daily feed intake. Under commercial conditions, feed intake is affected by genotype, health status, environmental temperature, crowding, feeder design and water supply. Typically, feed intake in well-managed confinement type facilities will be 85% to 95% of that presented above. For pigs housed outdoors or under similar conditions, feed intake could exceed the above unless conditions of heat stress exist. Since feed intake is such a critical piece of information, it should be measured on individual farms and in at least two seasons, summer and winter.

RECOMMENDED NEEDLE GAUGE AND LENGTH FOR PIGS

Pig Classification	Intramuscular		Subcutaneous	
	length	gauge	length	gauge
Adults	1 - 1½"	16 - 20	1 - 1½"	16 - 20
30-115 kg (60-250 lb)	1"	18 - 20	¾ - 1"	18 - 20
5-30 kg (10-60 lb)	¾ - 1"	18 - 20	½ - ¾"	18 - 20
< 5 kg (< 10 lb)	½" - ¾"	18 - 20	½"	20

Adapted from: Canadian Quality Assurance Manual, Canadian Pork Council, 1999.
NB: Gauge of needle depends partly on the volume of drug given and its consistency. For watery substances like oxytocin, smaller needles can be used. For thick materials such as penicillin (especially cold from the refrigerator), a larger gauge will be needed.

Guidelines for Injections:

- Inject in the appropriate location
  - neck for intramuscular, shoulder or flank for subcutaneous injections
- Never inject in the ham
- Do not inject wet/dirty pigs
- Change needles every 10 pigs
- Discard bent needles, do not restraighten them
- Maximum of 10 c.c. per site in adults, 2 c.c. per site in piglets

CANADIAN BREEDING HERD SUMMARY

Measurement	Average	Upper 25%	Upper 10%	Your Farm
Breeding Performance				
Repeat services, %	11.7	7.6	5.1	
Multiple matings, %	86.0	98.5	99.7	
Entry-to-service interval, days	32.9	19.4	13.9	
Sows bred by seven days, %	87.0	92.2	95.6	
Weaning-to-first-service interval	7.1	6.0	5.3	
Average nonproductive days	64.0	49.0	41.0	
Farrowing Performance				
Average gestation length	115.0	114.0	114.0	
Average parity of farrowed sows	3.63	4.2	4.6	
Farrowing interval	148.0	144.0	141.0	
Farrowing rate, %	80.0	86.2	88.3	
Average total pigs/litter	11.2	11.7	12.0	
Average pigs born alive/litter	10.4	10.7	11.1	
Average stillborn pigs	0.7	0.6	0.5	
Average mummies/litter	0.2	0.1	0.0	
Percent < 7 born alive	10.2	7.9	6.5	
PWM for farrowed and weaned	11.9	9.2	7.6	
Litters/female/year	2.21	2.34	2.41	
Litters/mated female/year	2.33	2.43	2.49	
Old litters/mated female/year	2.33	2.46	2.55	
Litters/farrowing crate/year	14.2	16.7	20.3	
Weaning Performance				
Pigs weaned/litter weaned	9.1	9.5	9.9	
Average age at weaning	20.9	17.7	15.9	
Adjusted 21-d litter weight (lb/kg)	61.0	65.0	73.0	
Pigs weaned/sow	9.1	9.5	9.9	
Pigs weaned/mated female/ year	20.9	22.7	24.2	
Old pigs weaned/mated female/year	21.6	23.6	25.4	
Pigs weaned/female/year	20.0	21.9	23.4	
Pigs weaned/lifetime	35.8	47.0	54.0	
Pigs weaned/farrowing crate/year	131.0	152.0	183.0	
Population				
Average female inventory (AFI)	377.0	463.0	802.0	
AFI/farrowing crate	6.6	7.3	9.8	
Average gilt pool inventory	23.0	28.0	59.0	
Sow: boar ratio	24.2	30.5	48.0	
Average parity	3.0	3.5	4.0	
Replacement rate, %	49.6	36.0	28.9	
Culling rate, %	41.1	32.3	25.4	
Death rate, %	4.7	2.7	1.5	
Average parity of culled sows	4.2	5.4	6.1	

Source: PigCHAMP 2000; total number of farms = 282.

UNITED STATES BREEDING HERD SUMMARY

Measurement	Average	Upper 25%	Upper 10%	Your Farm
Breeding Performance				
Repeat services, %	14.1	10.1	6.9	
Multiple matings, %	87.3	97.2	99.0	
Entry-to-service interval, days	42.6	25.5	15.9	
Sows bred by seven days, %	82.7	89.8	93.4	
Weaning-to-first-service interval	7.8	6.3	5.6	
Average nonproductive days	86.0	63.0	53.0	
Farrowing Performance				
Average gestation length	115.0	115.0	114.0	
Average parity of farrowed sows	3.1	3.7	4.1	
Farrowing interval	147.0	142.0	140.0	
Farrowing rate, %	76.4	82.0	85.1	
Average total pigs/litter	11.1	11.6	12.0	
Average pigs born alive/litter	10.1	10.5	10.8	
Average stillborn pigs	0.8	0.7	0.5	
Average mummies/litter	0.2	0.1	0.1	
Percent < 7 born alive	12.2	9.9	8.2	
PWM for farrowed and weaned	12.4	10.3	8.5	
Litters/female/year	2.08	2.29	2.37	
Litters/mated female/year	2.31	2.44	2.50	
Old litters/mated female/year	2.26	2.45	2.53	
Litters/farrowing crate/year	14.5	15.9	17.8	
Weaning Performance				
Pigs weaned/litter weaned	9.0	9.4	9.8	
Average age at weaning	18.0	16.1	14.8	
Adjusted 21-d litter weight (lb/kg)	126.0	134.0	143.0	
Pigs weaned/sow	8.8	9.2	9.5	
Pigs weaned/mated female/ year	19.6	22.0	23.2	
Old pigs weaned/mated female/year	20.6	22.7	24.2	
Pigs weaned/female/year	18.0	20.5	22.0	
Pigs weaned/lifetime	25.1	35.0	43.0	
Pigs weaned/farrowing crate/year	129.0	142.0	164.0	
Population				
Average female inventory (AFI)	869.0	1185.0	2028.0	
AFI/farrowing crate	7.0	7.4	9.0	
Average gilt pool inventory	60.0	88.0	132.0	
Sow: boar ratio	31.0	44.0	57.0	
Average parity	2.4	2.8	3.4	
Replacement rate, %	56.9	42.5	29.9	
Culling rate, %	44.6	32.9	25.5	
Death rate, %	6.9	4.2	2.7	
Average parity of culled sows	3.1	4.2	5.0	

Source: PigCHAMP, 2000; total number of farms = 612.

INTERNATIONAL BREEDING HERD SUMMARY

Measurement	Average	Upper 25%	Upper 10%	Your Farm
Breeding Performance				
Repeat services, %	13.1	8.8	5.8	
Multiple matings, %	85.6	97.7	99.5	
Entry-to-service interval, days	41.3	23.8	15.5	
Sows bred by seven days, %	83.9	90.6	94.0	
Weaning-to-first-service interval	7.5	6.2	5.4	
Average nonproductive days	80.0	58.0	47.0	
Farrowing Performance				
Average gestation length	115.0	115.0	114.0	
Average parity of farrowed sows	3.3	3.9	4.3	
Farrowing interval	148.0	143.0	141.0	
Farrowing rate, %	77.4	83.3	87.0	
Average total pigs/litter	11.2	11.6	12.0	
Average pigs born alive/litter	10.2	10.6	10.9	
Average stillborn pigs	0.8	0.6	0.5	
Average mummies/litter	0.2	0.0	0.0	
Percent < 7 born alive	11.6	8.9	7.0	
PWM for farrowed and weaned	12.3	9.9	8.0	
Litters/female/year	2.10	2.30	2.38	
Litters/mated female/year	2.29	2.43	2.49	
Old litters/mated female/year	2.25	2.44	2.54	
Litters/farrowing crate/year	13.9	15.7	17.8	
Weaning Performance				
Pigs weaned/litter weaned	9.0	9.5	9.9	
Average age at weaning	19.2	16.7	15.3	
Adjusted 21-d litter weight (lb/kg)	128/58	137/62	146/66	
Pigs weaned/sow	8.9	9.3	9.7	
Pigs weaned/mated female/ year	19.9	22.2	23.6	
Old pigs weaned/mated female/year	20.6	22.9	24.6	
Pigs weaned/female/year	18.5	20.9	22.5	
Pigs weaned/lifetime	29.2	41.0	50.0	
Pigs weaned/farrowing crate/year	128.0	139.0	164.0	
Population				
Average female inventory (AFI)	664.0	858.0	1545.0	
AFI/farrowing crate	6.7	7.3	8.8	
Average gilt pool inventory	44.0	62.0	113.0	
Sow: boar ratio	27.0	38.0	53.0	
Average parity	2.6	3.1	3.6	
Replacement rate, %	54.0	39.0	29.0	
Culling rate, %	43.0	32.0	26.0	
Death rate, %	5.9	3.5	2.0	
Average parity of culled sows	3.5	4.8	5.6	

Source: PigCHAMP 2000; total number of farms = 1,208.

TYPICAL BUSHEL WEIGHT STANDARDS FOR GRAINS

Crop	Bushels/Tonne	Pounds/Bushel	Kilogram/Hectolitre[1]
Barley	45.93	48	59.9
Buckwheat	45.93	48	59.9
Canola seed	44.09	50	62.4
Corn	39.37	56	69.9
Flaxseed	39.37	56	69.9
Hulless barley[2]	36.74	60	74.9
Mustard seed	44.09	50	62.4
Oats	64.84	34	42.4
Peas	36.74	60	74.9
Rice	48.99	45	56.1
Rye	39.37	56	69.9
Sorghum	39.37	56	69.9
Soybeans	36.74	60	74.9
Sunflower Seed	73.49	30	37.4
Wheat	36.74	60	74.9

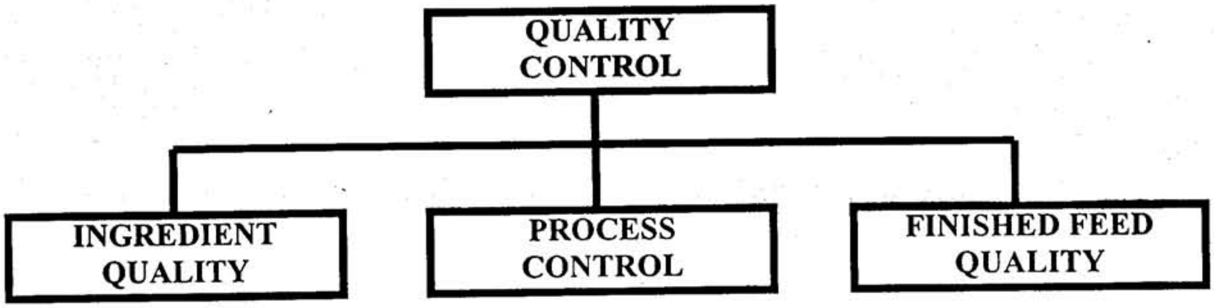
Source: Swine Nutrition Guide, 1995.
[1] 1 lb/bu=1.2475 kg/hL.
[2] Clean, free of all hulls.

QUALITY ASSURANCE

Any effective feed quality-control program contains 3 basic components: ingredient quality, process control and finished feed quality. The quality assurance program implemented in any particular feed mill or farm will depend on individual circumstances. For example, evaluation of ingredient composition offers the greatest opportunity for economic benefit; formulating diets based on precise nutrient specifications of ingredients contributes heavily to developing the lowest cost feeding program. However, directing all resources to testing incoming ingredients leaves the owner with no information on the accuracy of formulation, mixing and diet delivery.

Consequently, most quality assurance programs include testing at all phases to confirm that previous actions have been adequately completed. It is self-evident that if finished feed quality is on target, then diet mixing and formulation must be operating correctly as well. If deviations in nutrient content of finished feed are found, then further testing of earlier phases in diet preparation must be initiated to determine the exact source of the error.

There are no guides on how much testing is required, nor how much money should be spent on quality assurance. To minimize cost, we recommend focusing most ingredient assays on grains early in the new crop year, on protein ingredients year round and on newly introduced ingredients. For finished feeds, the most effective strategy is to select certain diets that are representative of a given formula type and testing these more extensively, rather than spot tests of all mixed diets. For example, grower and finisher diets are often similar; developing more detailed information on a typical formulation will be more beneficial than having only a few assays per year conducted on all diets. The reason is simple – more assays on a given formulation will define the nature of deviation from specification. Half a dozen tests on one formulation over a period of a few months will determine if any particular nutrient is routinely off-spec; if only one test is done, there is no way of knowing if the deviation is a random error, a lab error, a sampling error or a true error in formulation or mixing.



1) INGREDIENT QUALITY

Ingredients can account for 70-90% of the cost of producing feeds and often variation in finished feed quality can be traced back to the ingredients. Therefore it makes good economic sense to ensure that the ingredients you purchase are of top quality. It is important to note that ingredient quality control means more than chemical analysis; it starts with purchasing, to ensure that the standard of quality assumed in diet formulation is reflected in ingredient purchasing. If grains are grown on the farm, then as cereal grain quality changes, diet formulations must also change. In the case of purchased ingredients, either a certain minimum standard of quality is required to complete the purchase (eg. protein content of soybean meal or canola meal), or formulations must change as new shipments arrive. Maintaining minimum standards provides for the smoothest formulation/mixing continuum, but may result in missing some economically advantageous purchasing opportunities. Following are key steps on the quality control pathway as it relates to ingredient purchasing.

- **Ingredient specifications**

  Be sure to specify what you want in ingredients, or what specification guarantees are available from the supplier. For example, if soybean meal contains less than guaranteed protein content, or excess fibre, the supplier will often reimburse the purchaser. However, very specific procedures must be followed in order to submit a successful claim.

  There is no doubt that as we develop the ability to characterize cereal grains more precisely, the pork industry will purchase grains meeting certain standards, much like soybean meal is now purchased. For example, it is known that acid detergent fibre (ADF) is a much better indicator of the energy content of barley than bushel weight; already, some producers are using ADF as their purchasing standard, rather than the more traditional - and entrenched - bushel weight. This will be much more common in the future, particularly when NIR technology develops to the point that rapid and inexpensive measurements of grain energy content are readily available.

  For larger farms, and commercial mills, specification sheets for all purchased ingredients are often prepared so that a common standard of purchasing can be applied. This spec sheet may include a small sample to aid in visual evaluation of incoming ingredients.

- **Examine ingredients**

  No ingredients should be purchased sight unseen. Upon arrival, samples of grains and protein ingredients should be properly collected and visually evaluated. In the case of cereal grains, field peas and the like, the obvious target of visual inspection will be contaminants, including dockage, ergot, moulds, etc. In the case of hulless barley, the degree of hulls present in the sample will be important..

Samples must be collected correctly; for bulk ingredients, this can be accomplished by serial sampling during the unloading process, or the use of a probe inserted into the load in various locations to obtain representative samples. If samples are to be sent away for analysis, the collected sample should be split, with half clearly labeled (date, supplier, etc.) and retained for future reference and the other half submitted for assay.

- **Chemical Analysis**
  Use qualified laboratories to analyze feed samples and communicate to the supplier that you are aware of the quality of the product you are receiving. This will emphasize the fact that you are dedicated to quality.

  When submitting samples, remember that the lab generally needs less than 5 grams for each analyses. There is no need to submit more than 100 grams of a sample; it adds to the cost of shipping and provides no benefit. However, it is important that the sample submitted is uniformly representative of the load as received. Thus, subsamples collected as above must be thoroughly mixed before shipping.

- **Make adjustments**
  The results of laboratory assays need to be reviewed immediately, so that proper adjustments in diet formulation can be implemented if required. This information can also be used for submitting claims or for making changes in purchasing practices if the results are not satisfactory.

- **Contact supplier, file claim if required**
  If you encounter problems with the product, contact the supplier and discuss the results. If you are not satisfied with the response, be prepared to submit a deficiency claim. Claim procedures are very precise, and need to be followed precisely for a claim to be successful. Different suppliers have different procedures that they will accept. As always, communication is generally the key to success. Note that there is always more money to be made by achieving success in purchasing the quality of ingredient you expect, than in submitting deficiency claims.

2) PROCESS CONTROL

There are three important components to process control; personnel, machinery and procedures.

- **Personnel**
  Feed mixing, whether on the farm or in a commercial mill, is generally managed by some form of process control system or computer. While the role of the individual is reduced, people are still important. Feed mills must be kept clean in order to reduce the health risk to workers and to reduce the risk of inadvertent contamination of feeds. Also, maintenance is a key function that cannot be computerized; if not conducted routinely, feed quality and consistency will be reduced.

- **Machinery**
  While the need to replace hammers and screens is obvious, other moving parts also require attention. Augers wear over time, and scales need to be regularly tested to ensure they are working properly. During installation, be sure that all components are working properly while the installation people are still on site. Ensure that this is part of the purchasing agreement.

  Do not assume anything when it comes to machinery performance. Test and re-test, as any errors found then will reduce problems later. For example, during installation, the standard is to use a 1/8" screen to produce mash diets of the desired particle size of 650 to 750 µm. However, experience has shown that a smaller screen is often required as the 1/8" screen in some mills result in particle sizes of 800 µm or more.

Pay particular attention to capacity. An on-farm system that must run more than 8 hours a day places considerable pressure on time. For example, if the system fails overnight, and is not detected until the next day or repairs are not possible until the next day, pigs could run out of feed fairly quickly. The solution is to have a higher capacity mill or more storage on hand in case of down-time. Obviously, if complete feed is purchased, this is less of an issue.

- **Procedures**
  All successful milling operations, whether on-farm or commercial, depend on the successful completion of all procedures. If more than one person is involved procedures must be prepared in writing so that no breakdown in communication occurs. Handling of inventories (eg. first-in, first-out), equipment maintenance (regular and routine), mixing procedures (mixing times), post-mixing handling of feed (to avoid separation), hauling (to avoid contamination), receiving (as discussed above), weighing (to ensure accuracy and consistency), etc. should all be well-understood by the owner/operator and documented for use by employees.

3) FINISHED FEED QUALITY

The adage "the proof of the pudding is in the eating" applies directly to the manufacturing of feed. However, since pigs don't communicate problems with their feed directly, chemical analysis are often carried out to confirm that the desired quality is present. Two types of testing may be employed:

- **Feed quality**
  Initially, or when major changes in formulations are implemented, 3 or 4 separate samples of a mixed feed should be submitted to the laboratory for analysis. Once the initial testing is completed, it is more efficient to select one diet from each category (eg. starter, growout, sow) and submit one sample each month to confirm overall quality. If the diet is consistent, the frequency of testing can be reduced to once every 4 months. The individual diets selected for testing within each category should change every 4 to 6 samples, at some time to ensure all diets are tested.

- **Feed consistency**
  When mash diets are used, separation is an issue that must be addressed. Separation can occur at any stage beyond the mixer, including transport to the barn, delivery into the bin or delivery from the bin to the feeders. Thus, from time to time, samples should be collected from three or four feeders in each of two or three sections of the barn, following the delivery system (eg. start, middle and end). The samples collected within a section should be combined, but the composite samples from each of the three sections should be kept separate. Submit these three samples to the laboratory for analysis of nutrients (eg. crude protein, crude fibre (or ADF) and one or two minerals, such as calcium and sodium) to determine if feed is constant across all sections of the barn. If not, the source of the separation must be determined and eliminated.

IMPROVING ACCURACY OF ANALYSIS

Since considerable time and money is spent on conducting laboratory assays, everything possible should be done to ensure the results are as accurate as possible. Incorrect or inaccurate information can lead to false conclusions, and errors in managing a quality assurance program.

Sampling

Laboratory accuracy begins with sampling. Collecting feed or ingredient samples seems simple enough, but to do it right, considerable effort is required. Single grab samples will not suffice. Whether one is collecting incoming ingredients, or manufactured feed, multiple grad samples are required. While there is no hard and fast rule, half a dozen grab samples, provided they are collected properly, should be adequate.

Samples must be taken in a way that prevents separation of the sample during collection. For example, holding a collection vessel under an unloading truck is less desirable than quickly passing the vessel through the stream of grain two or three times. If one is collecting mixed feed in the barn, samples should not be taken from the top of the pile of feed in the feeder, but rather the top feed should be moved aside to obtain a more uniform sample below.

Where should feed samples be collected? This will depend on the purpose of the test. If the desire is to evaluate the feed as it is provided to the pig, then the feed should be sampled from the feeder (the hopper, not the base). If the objective is to evaluate the mixer, then the sample should be taken as the feed leaves the mixer.

Accuracy of analyses

No laboratory assay is perfectly accurate. The Association of American Feed Control Officials (AAFCO) have conducted extensive testing under highly controlled conditions to determine the acceptable variation that is inherent in various assays. Following is a simplified summary of the acceptable analytical variation in various feed assays. More detailed explanation of the analytical variation is available from AAFCO. If the acceptable variance is 10%, then the assay result should be within 10% of the actual value. For example, if a grain sample is tested for protein, and found to contain 9.6% crude protein, and the acceptable variance is ± 4%, then the actual crude protein could be between 9.2% and 10.0%.

Analysis	Mixed Feeds, Grains	Protein Supplements (eg. canola meal)
Moisture	± 12%	± 12%
Protein	± 3 to 4%	± 3%
Fat	± 10%	± 10%
Crude fibre	± 10 to 14%	± 10 to 14%

IDEAL PATTERN OF APPARENT DIGESTIBLE AMINO ACIDS

Amino Acid	Growing Pigs				Adults	
	5 - 25 kg	25-50 kg	50-75 kg	75-120 kg	Gestation	Lactation
Lysine	100	100	100	100	100	100
Threonine	60	61	63	63	76	65
Methionine	28	28	29	28	33	26
T.S.A.A.	56	57	58	59	67	52
Tryptophan	17	17	18	18	19	19
Leucine	100	99	98	97	91	112
Isoleucine	55	55	55	55	55	55
Valine	67	67	67	67	67	84
Arginine	41	40	37	33	-	56
Histidine	33	33	33	33	33	39
Phenylalanine	59	59	59	59	57	55
T.A.A.A.	95	95	95	95	100	113

IDEAL PATTERN OF TOTAL AMINO ACIDS

Amino Acid	Growing Pigs				Adults	
	5 - 25 kg	25-50 kg	50-75 kg	75-120 kg	Gestation	Lactation
Lysine	100	100	100	100	100	100
Threonine	63	64	66	66	79	68
Methionine	28	28	29	29	32	25
T.S.A.A.	56	57	58	59	65	50
Tryptophan	18	18	19	19	20	20
Leucine	98	97	96	95	89	110
Isoleucine	55	55	55	55	55	55
Valine	68	68	68	68	65	85
Arginine	40	39	36	32	-	55
Histidine	32	32	32	32	32	38
Phenylalanine	58	58	58	58	56	54
T.A.A.A.	93	93	93	93	98	111

SUGGESTED LYSINE:ENERGY RATIOS

The following lysine:energy ratios are presented as guidelines only. The optimum ratio for a given farm will depend on many factors, including genotype, feed intake, environmental conditions and health status. The relative economics of feed cost and market prices (including carcass bonuses) must also be considered. The ranges presented herein reflect differences due to protein deposition rates and daily feed intake. Pork producers are strongly encouraged to consult with their nutritionist or feed supplier for further assistance in selecting the most profitable feeding program for their farm.

Nursery Phase

Body Weight (kg)	Target Wt. Gain	Total Lysine	Apparent Ileal Digestible Lysine
	- kg/d -	- grams per Mcal DE -	
4.5 to 7.5	210 to 230 g/d	4.4 to 4.7	3.7 to 4.0
7.5 to 10	325 to 370 g/d	3.8 to 4.1	3.1 to 3.4
10 to 25	575 to 650 g/d	3.3 to 3.7	2.7 to 3.0

NB: Feed intake will have a major impact on actual performance observed during each of these nursery phases. Performance above these targets is possible if feed intake is excellent. Apparent ileal digestible lysine can be converted to true ileal digestible lysine by dividing above factors by 0.92.

Growout Phase

Body weight (kg)	Lean Growth Potential		
	Excellent	Very Good	Good
	- gram apparent digestible lysine/Mcal DE -		
25 to 50 kg	2.6	2.4	2.2
50 to 75 kg	2.3	2.1	1.9
75 to 100 kg	2.0	1.8	1.7
100 to 120 kg	1.8	1.6	1.5

NB: Lean growth potentials correspond to overall protein deposition rates of 150 g/d, 135 g/d and 120 g/d for excellent, very good and good categories, respectively. Above based on diet DE content declining from 3,400 kcal/kg to 3,250 kcal/kg from the early through to the final growout phase.

The above specifications are guidelines only. A great deal of research is underway to determine the best way to express amino acid requirements during the growout period. Traditionally, up to about 60 kg, lysine requirements have been presented as a ratio to energy; above this weight, it has been expressed on a daily intake basis. This may still be the correct approach, but it allows the nutritionist to overlook the importance of energy in driving lean gain in the pig. In other words, providing adequate daily lysine when energy is deficient will result in sub-optimum performance.

LYSINE REQUIREMENT OF THE BREEDING HERD

Gestation

The gestating sow requires no more than 0.50% total lysine, or 0.37% apparent ileal digestible lysine, in her diet, assuming feed intake is 2.3 to 2.5 kg per day. In other words, 8.5 to 9.0 g of apparent ileal digestible lysine per day is satisfactory, even for young gilts requiring protein to continue their growth to mature body weight during gestation.

Lactation

Feeding the lactating sow is much more difficult than the dry sow, as feed intake is difficult to predict. In addition to the vagaries of feed intake is the impact of sow body condition, plus the producer's target for sow weight loss during lactation. While most people expect nursing sows to lose weight, if feed intake is adequate, this does not necessarily have to be the case.

If a producer wishes to achieve zero weight loss during lactation, and assuming feed intake is modest (5.5 to 6.5 kg/d averaged throughout lactation), then apparent ilea digestible lysine levels of 0.80% to 0.85% may be required. However, with such feed intake, sow weight loss is almost obligatory, so feeding such high levels of lysine may not be economical, or even effective.

If weight losses in the range of 10 kg during lactation can be tolerated, sows beyond the first parity can perform very well at 0.75% to 0.80% apparent ileal digestible lysine. This all assumes the sow is nursing a litter of at least 10 piglets, with an average litter weight gain in the range of 2.25 to 2.50 kg/d.

VITAMIN AND MICROMINERAL SUPPLEMENTATION

Nutrient	Units /kg	Bodyweight, kg < 10	10 - 25	25 - 50	50 - 100	100 - 120	Gestation	Lactation
Vitamin A	IU	8,500	7,500	5,000	4,500	4,500	8,500	7,000
Vitamin D_3	IU	850	850	600	550	500	850	850
Vitamin E	IU	50	50	40	40	40	40	40
Vitamin K	mg	2	2	2	2	2	2	2
Biotin	μg	300	250	200	200	200	250	250
Folic acid	mg	1	1	0	0	0	2	2
Niacin	mg	50	40	30	20	15	30	30
Pantothenic acid	mg	30	20	15	10	10	15	15
Pyridoxine	mg	2	1	0	0	0	1	1
Riboflavin	mg	5	4	4	3	3	5	5
Thiamine	mg	2	1	0	0	0	1	1
Vitamin B_{12}	μg	25	25	15	15	15	25	25
Choline	mg	500	500	200	0	0	600	600
Iron	mg	125	125	70	40	40	80	80
Copper	mg	25	25	20	20	20	20	20
Zinc	mg	150	150	100	75	75	100	100
Manganese	mg	20	20	20	20	20	20	20
Iodine	mg	0.2	0.2	0.2	0.2	0.2	0.4	0.3
Selenium	mg	0.3	0.3	0.3	0.3	0.3	0.3	0.3

NB: The above recommendations apply only to animals destined for slaughter. Gilts and boars intended for use as breeding stock should receive vitamin and trace mineral levels about 25 to 35% higher than those listed above during the full growout period. The matter of B-vitamin supplementation levels remains uncertain, with little definitive science used with the modern, high producing pig. Thiamine and pyridoxine were added to certain diets above, although there is no definitive data suggesting this is necessary. While higher levels than those above may be required in certain unique circumstances, producers are cautioned about supplementing excessive quantities of B-vitamins above the levels necessary for maximum performance and health.

MACROMINERAL LEVELS IN PIG DIETS

Nutrient	Units	Bodyweight, kg < 10	10 -25	25 - 50	50 - 100	100 - 120	Gestation	Lactation
Calcium	%	0.85	0.80	0.70	0.60	0.55	0.80	0.80
Phosphorus	%	0.70	0.65	0.60	0.50	0.45	0.65	0.65
Av. Phosphorus	%	0.45	0.35	0.25	0.20	0.16	0.40	0.40
Sodium	%	0.15	0.15	0.15	0.15	0.15	0.20	0.20
Chloride	%	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Potassium	%	0.35	0.30	0.26	0.23	0.20	0.30	0.30
Magnesium	%	0.05	0.05	0.05	0.05	0.05	0.05	0.05

NB: There is a need to maintain a 1.3:1 calcium:total phosphorus ratio, which may require calcium levels higher than those specified above, depending on the ingredients used. If animals are intended for use as breeding stock, calcium and phosphorus levels in finisher diets should not fall below those recommended for the growing market pig.

WATER INTAKE, RECOMMENDED FLOW RATE AND HEIGHT OF NIPPLE DRINKERS

Phase	Weight (kg)	Intake (L/day)[1]	Nipple Drinkers		
			Flow (mL/min)	Height (cm, 45°)	Height (cm, 90°)
Gestation		Variable	0.5 to 1.0	90 cm (35")	75 cm (30")
Lactation		12 - 20	1.0 to 2.0	90 cm (35")	75 cm (30")
Piglets		Variable	0.5 to 0.7	15 cm (6")	10 cm (4")
Weanling	5	1.0 to 2.0	0.5 to 1.0	30 cm (12")	25 cm (10")
Weanling	7	1.5 to 2.5	0.5 to 1.0	35 cm (14")	30 cm (12")
Growout	15	2.5 to 3.5	0.5 to 1.0	45 cm (18")	35 cm (14")
Growout	20	3 to 4	0.5 to 1.0	50 cm (20")	40 cm (16")
Growout	25	3 to 4	0.5 to 1.0	55 cm (22")	45 cm (18")
Growout	50	5 to 7	0.5 to 1.0	65 cm (26")	55 cm (22")

[1] Water disappearance may exceed consumption by as much as 100% (average is 35%) if traditional nipple drinkers are employed. Consumption will increase 15 to 50% if barn temperatures are above the temperature comfort zone.
[2] Waste will increase if drinkers are poorly positioned, if flow rates are excessive or if feed intake is restricted.

FACTORS AFFECTING AD LIBITUM WATER INTAKE

Increase Intake	Decrease Intake
Heat stress	Cold stress
Hunger	Warm water temperatures
Boredom	Very saline water
Elevated dietary protein	
Elevated dietary minerals	
Moderately elevated minerals in water	
Pelleted feed	

WATER QUALITY STANDARDS

Total dissolved solids: Is the sum of all inorganic material present in the water. Tolerance by pigs will depend on the chemicals which make up the solids. Further assays are therefore recommended whenever TDS exceeds 1,500 ppm.

pH: Most water falls between pH 6.5 and 8.5 and therefore is rarely a quality concern. If pH is high, the effectiveness of chlorination is impaired. Low pH may cause precipitation of some water soluble medications. Refer to pharmaceutical suppliers for details if you have a concern.

Sulphates: Tolerance by pigs varies with age and other unknown factors. Successful pork production has occurred with sulphates in excess of 1,500 ppm; osmotic diarrhea will be observed in weanling pigs if sulphates exceed 750 ppm. Diarrhea caused by sulphates does not necessarily result in reduced growth. 21-day-old weanling pigs have performed very well at sulphates in excess of 2,000 ppm; however, osmotic diarrhea was profuse. The only effective method to remove sulphates is reverse osmosis, with attendant high capital and operating costs.

Hardness: Hardness represents the sum of polyvalent cations, primarily calcium and magnesium. Water with hardness below 50 ppm is considered soft; if in excess of 300 ppm the water is considered very hard and the results will be scale accumulation and the need for additional soap. Impact on pigs is minimal, other than possible reduced trace mineral absorption. Softening can be accomplished using ion exchange system, but will result in an increase in sodium, which at high levels may have greater impact on pig health than calcium or magnesium. Softening by other methods is generally prohibitive due to cost.

Sodium: Limited nutritional significance unless present at levels above 500 ppm. Diet can be adjusted via salt, but care must be taken to ensure that chloride deficiency does not result from lowering dietary salt. Most, but not all, waters in western Canada that are high in sodium are low in chloride

Chloride: Is rarely a problem in Prairie ground water. The biggest concern is dietary chloride deficiency, which may occur if salt is removed from feed to reduce diarrhea resulting from elevated sulphates.

Iron: will result in staining, plugging of screens in water lines if above 0.3 ppm. Also associated with iron bacteria, which cause foul odors and may reduce or eliminate water flow in wells. Iron is removed by filters or settling tanks; iron bacteria is removed by shock chlorination.

Manganese: will result in staining if present in water above 0.05 ppm. Can be removed by filters or settling tanks.

Magnesium: By itself, magnesium is of little concern. However, magnesium in the water is generally associated with sulphates, which may cause diarrhea as mentioned above. Magnesium also contributes to hardness.

SURVEY RESULTS OF WELL WATER QUALITY ON SASKATCHEWAN PIG FARMS

Constituent	Mean	Standard Deviation	Range Minimum	Range Maximum	% Below Detectable Limit
Depth	67	75	4	457	-
TDS	1,578	1,018	232	6590	0
Specific conductivity	2,043	1,143	375	6,300	0
Bicarbonate	527	149	182	1,160	0
Calcium	155.5	109.7	2.5	514	0
Chloride	115.8	295.3	0.4	2,100	0
Iron	2.1	3.6	0.012	31	0
Magnesium	79.0	83.0	0.9	683	0
Manganese	0.37	0.47	0.002	2.3	2.2
Nitrate/nitrite[1]	2.8	5.0	0.007	32	0
pH	7.96	0.30	7.35	8.78	0
Potassium	8.6	5.5	1.0	36	0
Sodium	258.3	285.8	4.1	1,390	0
Sulphate	661.4	615.8	0.1	3,760	1.5
Total hardness	716.9	586.0	12.0	3,890	0
Aluminum	0.06	0.11	0.005	0.48	58.8
Barium	0.06	0.14	0.002	1.10	0
Beryllium	0.002	0.001	0.001	0.005	79.4
Boron	0.71	0.98	0.02	5.70	8.1
Cadmium	0.001	0.0004	0.001	0.002	96.3
Chromium	0.006	0.018	0.001	0.150	44.9
Cobalt	0.002	0.0002	0.001	0.007	82.4
Copper	0.019	0.065	0.001	0.570	41.9
Flouride	0.35	0.44	0.05	4.10	0
Lead	0.012	0.008	0.10	0.070	20.6
Molybdenum	0.014	0.006	0.005	0.039	29.4
Nickel	0.006	0.010	0.001	0.076	33.8
Phosphate	0.12	0.17	0.01	0.96	47.1
Phosphorus	0.27	0.17	0.06	0.96	1.4
Silicon (soluble)	4.58	1.64	1.10	9.90	0
Silver	0.0	0.0	0.0	0.0	100.0
Titanium	0.012	0.012	0.042	0.042	90.4
Tungsten	0.0	0.0	0.0	0.0	100.0
Vanadium	0.025	0.012	0.070	0.070	20.6
Zinc	0.165	0.457	4.200	4.200	8.8

Source: McLeese et al., 1991.

NB: All values are given in mg L^{-1}, except specific conductivity ($\mu S\ cm^{-1}$), depth (m) and pH. Mean and standard deviation were based upon observations above detection limits; n = 135.

[1] Nitrate plus nitrite as nitrogen.

TOTAL ON-FARM WATER USE ESTIMATE

	Inventory	Daily Water Use (L)	Total Water Use (L)
Gestating sows and boars	90	15	1,350
Lactating sows and litters	15	20	300
Nursery	250	3	750
Growout	670	7	4,690
Gilt pool	5	8	40
	1,030		7,130
Wash -10%:			713
Total:			**7,843**

NB: Above calculation per 100 sows farrow-to-finish (eg. 78L /sow). Actual usage will depend on the amount of spill from drinkers, the extent of washing and system leakage. Water usage has been reported as low as 65 L/sow and as high as 120 L/sow. Clearly, more research is required in this important area.

Ways to reduce water use:

- Water troughs for gestating sows in place of nipple drinkers
- Wet-dry feeders or bowl drinkers in place of nipple drinkers
- Keep barn temperature within the pig's temperature comfort zone as much as possible
- Repair or replace leaky drinkers and water lines
- Do not feed excess protein or minerals above the pig's requirement

MICROBIAL CONTAMINATION OF WATER

Microbial contamination of water is more likely to occur when surface water is used versus well water. However, well water is not immune to the growth of bacteria or viruses if the conditions are right.

Well water

Perhaps the most common microbial contaminant in well water on the prairies is iron bacteria. These bacteria are able to extract the energy they need to live from a chemical conversion of iron that occurs as a natural process. Iron bacteria do not pose a direct threat to the health of pigs, but the slime they produce can cause a foul odour and plug delivery lines, in addition to the well itself. The most common course of action is shock chlorination (see below) although this sometimes is temporary and needs to be repeated. Steam treatment, in which very hot water is forced down into the well has also been used to remove or reduce iron bacteria.

Another possible source of contamination in ground water systems is the cistern. In many farms, well water is pumped from the well into a cistern and thence pumped throughout the barns. The presence of a cistern offers many advantages, not the least of which is a supply of water on hand in case of problems with the well. However, over time, the cistern can become contaminated with bacteria; consequently, the cistern should be emptied and cleaned at least annually to avoid microbial build-ups.

Surface water

Obviously, because surface water is exposed to many more potential sources of contamination, it represents a greater risk to microbial contamination. Therefore, surface water supplies should be tested annually, at least for organic matter (eg. algae), microbiological contaminants and nitrates.

Prevention is always better than treatment, so care should be taken to avoid contamination before it occurs. Much of this is common sense, including siting the dugout away from livestock pastures and carefully controlling the application of sprays, fertilizers and manure in the vicinity of the dugout.

Microbial contaminants

The most common, serious microbial contaminants of water from the perspective of pork producers are *Salmonella, Leptospira* and *Escherichia coli*. Pathogenic protozoa and eggs or cysts of intestinal worms can also infect water supplies. Other possibilities exist, but are not commonly observed.

The Bureau of National Affairs (1973) states that water used for livestock should not contain more than 5,000 coliforms/100 mL (NRC, 1998). It is important to note that this recommendation is only a guideline; the level of contamination ultimately depends on the type of pathogen present and its' virulence.

WATER CHLORINATION TECHNIQUES

Continuous

The question about the need for continuous chlorination of water for pigs often arises; however, there is little information on the benefits of treatment, unless a specific problem of microbial contamination exists.

In order for chlorination to be effective as an antimicrobial treatment, the source water must be clean. For example, if organic matter is present, the chlorine is converted to a chemical called trihalomethanes (THM) which have been implicated as carcinogens. THM has some antibacterial action, but it is much less effective than chloride or chlorine.

Disinfection with chlorine is often monitored by measuring the residual chlorine in the water after treatment. Residual total chlorine should be 0.5 mg/L and residual free chlorine should be 0.1 mg/L.

While chlorination is effective against many bacteria, it has less impact on viruses and will not kill cryptosporidium.

Besides chlorination, other options for disinfection include the use of ultraviolet light or specialized filtration systems.

Shock Chlorination

Shock chlorination can be used in response to bacterial contamination of water to disinfect and destroy disease-causing microorganisms. This may solve the problem, but in many cases, the results are only temporary and the procedure may need to be repeated on a regular basis.

Following is a method that can be used for wells and delivery systems. Household bleach containing 5.25 to 5.5% chlorine is readily available and can be used in this process. It is sold in stores as *Clorox*, generic *Household Bleach* or similar. Confirm the chlorine content on the label. Because chlorine is irritating to skin, rubber gloves should be used when handling concentrated chlorine.

As a general thumb rule, one gallon of bleach will treat a well containing 100 ft of water 8" in diameter; most farm systems, because of the extensive barn water delivery system, will require about 25 L of household bleach. Do not pour the bleach directly into the well and ensure ammonia compounds are not present, as the two combine to produce toxic gases. As a minimum, dilute the bleach 1:20 in water. Turn on water outlets near the ends of the delivery system and let it run until a strong chlorine odour appears. If you are worried about inhaling chlorine, swimming pool supply stores sell chlorine test strips which can be used for this purpose.

Ensure all water lines are filled with the chlorinated water. The chlorinated water should also be drawn into hot water heaters, softeners and pressure tanks to achieve maximum success. Note that some filtration systems will not tolerate high levels of chlorine; it is best to check with the manufacturer or supplier before proceeding.

This water should not be consumed, so all waterers must be turned off until the system is thoroughly flushed the following day. Do not flush the system onto landscaped land, as it can be toxic to plants and grass.

NUTRIENT COMPOSITION OF SELECTED FEED INGREDIENTS

	Barley-Grain	Barley-Hulless	Canola Meal	Canola Seed	Corn	Lentils	Oat Groats
Energy, kcal/kg							
Digestible	3100[2]	3400[1]	3100	4750	3550	3500	3690
Metabolizable	2960	3210	2900	4475	3360	3315	3465
Proximate analysis, %							
Crude protein	10.6	13.7	37.7	20.7	8.5	24.6	13.9
Crude fiber	5.1	3.6	11.8	7.0	2.2	3.9	-
Acid detergent fiber	7.1	1.2	17.2	-	3.4	5.4	-
Neutral detergent fiber	17.8	10.1	2.2	-	12.0	10.1	-
Total amino acids, %							
Lysine	0.39	0.54	2.16	1.20	0.26	1.63	0.50
Threonine	0.36	0.47	1.65	1.01	0.31	0.81	0.44
Methionine	0.17	0.24	0.75	0.40	0.19	0.18	0.20
T.S.A.A.	0.40	0.47	1.79	0.85	0.37	0.45	0.42
Tryptophan	0.14	0.16	0.46	0.27	0.06	0.21	0.18
Isoleucine	0.42	0.45	1.55	0.89	0.32	1.00	0.55
Leucine	0.80	0.95	2.64	1.65	1.04	1.84	1.00
Valine	0.58	0.62	1.99	1.11	0.46	1.20	0.72
Phenylalanine	0.60	0.76	1.49	0.90	0.40	1.20	0.66
Arginine	0.50	0.64	2.26	1.43	0.45	2.00	0.85
Histidine	0.24	0.30	1.34	0.62	0.21	0.75	0.25
Apparent ileal digestible amino acids, %							
Lysine	0.27	0.37	1.60	-	0.17	1.29	0.40
Threonine	0.23	0.30	1.12	-	0.21	0.57	0.33
Methionine	0.13	0.18	0.59	-	0.16	0.14	0.17
Cystine	0.17	0.17	0.78	-	0.14	0.21	0.18
Tryptophan	0.10	0.11	0.29	-	0.04	0.15	0.14
Isoleucine	0.31	0.33	1.12	-	0.25	0.75	0.46
Valine	0.41	0.44	1.55	-	0.36	0.90	0.59

Source: Swine Nutrition Guide, 1995; NRC, 1998.

[1]Assume all hulls absent; for every 10% of kernels with hulls reduce DE by ~35 kcal/kg.

[2] For every 1 percentage point increase in ADF, DE declines by 95 kcal/kg. For every 1 percentage point decline in ADF, DE rises by 95 kcal/kg.

NUTRIENT COMPOSITION OF SELECTED FEED INGREDIENTS

	Oats-Naked	Peas-Chickpeas	Peas-Field peas	Soybean meal 44%	Soybean meal 47%	Wheat-Grain
Energy, kcal/kg						
Digestible	3600	3490	3400	3500	3675	3425
Metabolizable	3420	3300	3175	3190	3380	3240
Proximate analysis, %						
Crude protein	12.2	21.5	22.01	44.3	47.5	13.5
Crude fiber	3.6	6.3	5.5	6.9	3.9	2.7
Acid detergent fiber	3.7	-	8.2	8.3	7.4	3.5
Neutral detergent fiber	9.9	-	14.7	12.0	9.3	10.8
Total amino acids, %						
Lysine	0.50	1.38	1.39	2.86	3.10	0.40
Threonine	0.40	0.74	0.73	1.70	1.85	0.40
Methionine	0.20	-	0.20	0.65	0.64	0.24
T.S.A.A.	0.54	-	0.49	1.30	1.40	0.57
Tryptophan	0.15	0.19	0.24	0.58	0.62	0.16
Isoleucine	0.50	-	0.77	2.00	2.30	0.53
Leucine	0.90	-	1.36	3.55	3.68	0.89
Valine	0.70	-	0.93	2.17	2.69	0.56
Phenalalinine	0.65	-	1.51	2.17	2.44	0.56
Arginine	0.80	-	1.42	3.35	3.49	0.61
Histidine	0.27	-	0.43	1.14	1.26	0.26
Apparent ileal digestible amino acids, %						
Lysine	0.35	-	1.17	1.09	2.64	0.29
Threonine	0.24	-	0.53	0.50	1.44	0.28
Methionine	0.16	-	0.16	0.15	0.54	0.20
Cystine	0.27	-	0.33	0.23	0.62	0.27
Trytophan	0.11	-	0.19	0.16	0.50	0.13
Isoleucine	0.40	-	0.61	0.60	1.91	0.44
Valine	0.55	-	0.71	0.73	2.18	0.44

Source: Swine Nutrition Guide, 1995; NRC, 1998.

TYPICAL MACROMINERAL AND VITAMIN COMPOSITION OF FEEDS

	Barley Grain	Barley-Hulless	Canola Meal	Canola Seed	Chick-peas	Corn	Field Peas
Macrominerals, %							
Calcium	0.07	0.24	0.63	0.39	0.15	0.02	0.09
Phosphorus	0.35	0.37	1.01	0.64	0.35	0.25	0.50
Avail. phosphorus	0.11	0.12	0.21	0.13	0.12	0.03	0.15
Magnesium	0.11	0.21	0.51	0.38	-	0.11	0.12
Potassium	0.55	0.44	1.22	0.73	-	0.30	1.01
Sodium	0.03	0.02	0.07	-	-	0.01	0.04
Chloride	0.13	0.10	0.11	-	-	0.04	0.05
Vitamins, mg/kg							
Vitamin B_6	5.0	5.6	7.2	-	-	5.0	1.0
Vitamin E[1]	7.4	6.0	13.4	-	-	8.3	0.2
B-carotene	4.1	-	-	-	-	0.8	1.0
Biotin	0.14	0.07	0.98	-	-	0.06	0.15
Choline	1,034	-	6,700	-	-	620	547
Folacin	0.31	0.62	0.83	-	-	0.15	0.20
Niacin	55	48	160	-	-	24	31
Pantothenic acid	8.0	6.8	9.5	-	-	6.0	18.7
Riboflavin	1.8	1.8	5.8	-	-	1.2	1.8
Thiamine	4.5	4.3	5.2	-	-	3.5	4.6

Source: Swine Nutrition Guide, 1995; NRC, 1998.
NB: The niacin in corn, oats and wheat is totally unavailable.
[1] As α-tocopherol; units areµg/kg.

TYPICAL MACROMINERAL AND VITAMIN COMPOSITION OF FEEDS

	Lentils	Oat Groats	Oats-Naked	SBM		Wheat HRS
				44%	47%	
Macrominerals, %						
Calcium	0.10	0.08	0.12	0.29	0.29	0.04
Phosphorus	0.38	0.41	0.40	0.61	0.60	0.34
Avail. phosphorus	0.18	0.07	0.07	0.19	0.14	0.16
Magnesium	0.12	0.11	0.11	0.26	0.30	0.14
Potassium	0.89	0.38	0.45	1.90	2.10	0.32
Sodium	0.02	0.05	0.05	0.04	0.01	0.02
Chloride	0.03	0.09	0.08	0.03	0.03	0.05
Vitamins, mg/kg						
Vitamin B_6	5.5	1.1	9.6	6.0	6.4	3.6
Vitamin E[1]	-	-	2.0	2.3	2.3	-
B-carotene	1.0	-	-	0.2	0.2	-
Biotin	0.13	0.20	0.12	0.27	0.26	0.11
Choline	-	1,139	1,240	2,794	2,731	1,026
Folacin	0.70	0.50	0.50	1.37	1.37	0.44
Niacin	22	14	20	34	22	56
Pantothenic acid	14.9	13.4	7.1	16.0	15.0	12.5
Riboflavin	2.4	1.5	1.3	2.9	3.1	1.3
Thiamine	3.9	6.5	5.2	4.5	3.2	5.1

Source: Swine Nutrition Guide, 1995; NRC, 1998.

NB: The niacin in corn, oats and wheat is totally unavailable.

[1] As α-tocopherol; units areμg/kg.

COMMON MINERAL SUPPLEMENT SOURCES

Nutrient	Common Source	Typical composition
Calcium	Limestone	38.5% calcium
	Dicalcium phosphate	20 to 24% calcium
	Monocalcium phosphate	17% calcium
Copper	Copper sulphate	25% copper
Iodine	Calcium iodate	63.5% iodine
	Copper iodide	66.5% iodine
	Potassium iodide	68.5% iodine
	EDDI	79.5% iodine
Iron	Ferrous sulphate (monohydrate)	30% iron
	Ferrous sulphate (heptahydrate)	20% iron
Manganese	Manganous oxide	60% manganese
	Manganous sulphate	29.5% manganese
Phosphorus	Dicalcium phosphate	18.5% phosphorus
	Monocalcium phosphate	21.1% phosphorus
Selenium	Sodium selenate	21.5% selenium
	Sodium selenite	45% selenium
Zinc	Zinc sulphate (monohydrate)	35% zinc
	Zinc oxide	72% zinc

NB: All of the above mineral sources are considered to be of high quality. The selection of supplemental source is often based on economics, availability and ease of handling.

FATS AND OILS

Source	D.E.	M.E.	Saturated	Unsaturated
	- kcal/kg -		- % -	
Beef tallow	8,200	7,900	51	49
Canola oil	8,800	8,450	7	93
Pork Lard	8,300	8,000	40	60
Poultry Grease	8,600	8,200	29	71
Soybean oil	8,800	8,450	15	85
Sunflower oil	8,800	8,450	10	90

Source: Swine Nutrition Guide, 1995; NRC, 1998.

RELATIVE STABILITY OF DIFFERENT VITAMINS

	Stability				
	Very High	High	Moderate	Low	Very Low
Vitamin	Choline chloride	Riboflavin	Thiamine mono-hydrate	Thiamine	Menadione
	Vitamin B_{12}	Biotin	Pyridoxine		Ascorbic acid
		Niacin	Folic acid		
		Pantothenic acid	Vitamin A		
		Vitamin E	Vitamin D_3		

Source: BASF Canada Inc., 1995.

AVERAGE VITAMIN LOSSES PER MONTH

	Very High	High	Moderate	Low	Very Low
	- losses/month (%) -				
Premixes without choline and trace minerals	0	< 0.5	0.5	1	2
Premixes with choline	< 0.5	2	3	6	10
Premixes with choline and trace minerals	2	8	9	15	30
Pelleting	3	8	11	16	50
Extrusion	4	15	18	25	60

Source: BASF Canada, 1995.
Refer to previous table to determine the stability of each vitamin.

RECOMMENDED FLOOR SPACE ALLOWANCE FOR GROWING PIGS

Body weight	Fully slatted ($0.035xBW^{.667}$)		Partial slats ($0.039xBW^{.667}$)		Solid bedded ($0.045xBW^{.667}$)	
kg	m^2	ft^2	m^2	ft^2	m^2	ft^2
10	0.16	1.7	0.18	1.9	0.21	2.2
20	0.26	2.8	0.29	3.1	0.33	3.5
50	0.48	5.2	0.53	5.7	0.61	6.6
75	0.62	6.7	0.70	7.5	0.80	8.6
90	0.70	7.5	0.78	8.4	0.91	9.7
100	0.76	8.2	0.85	9.1	0.97	10.4
110	0.81	8.7	0.90	9.7	1.03	11.1

Source: Recommended Code of Practice for the Care and Handling of Farm Animals, Agriculture and Agri-Food Canada, 1993.

Example calculations:
Area = $0.035 \times BW^{.667}$
Space requirement for a 50 kg pig on a fully slatted floor = $0.035 \times 50\ kg^{.667} = 0.48\ m^2$
or 50 kg pig on partial slats = $0.039 \times 50\ kg^{.667} = 0.53\ m^2$.

RECOMMENDED FLOOR SPACE ALLOWANCE FOR REPLACEMENT GILTS AND SOWS

Body Weight	Partial slats ($0.054xBW^{.667}$)		Solid bedded ($0.059xBW^{.667}$)	
kg	m^2	ft^2	m^2	ft^2
100-150	1.5	16	1.7	18
150-200	1.8	19	2.0	22
200-250	2.1	23	2.3	25
>250	2.3	25	2.6	28

Source: Recommended Code of Practice for the Care and Handling of Farm Animals, Agriculture and Agri-Food Canada, 1993.

What happens when pigs are crowded?
GENERAL RULE OF THUMB: For every 3% reduction in pen space, expect a 1% reduction in feed intake and growth rate.

RECOMMENDED MINIMUM WIDTH AND LENGTH OF INDIVIDUAL STALLS FOR SOWS OF VARIOUS SIZES

Sow weight		Sow parity	Interior width		Effective length	
kg	lb	#	cm	in	cm	in
125 - 175	278 - 389	1 - 2	60	24	180	72
175 - 225	389 - 500	3 - 5	65	26	195	78
225 - 275	500 - 611	6 - 8	70	28	210	84

Source: Recommended Code of Practice for the Care and Handling of Farm Animals, Agriculture and Agri-Food Canada, 1993.
NB: Effective length is the distance from the feeder to the rear gate of the holding unit. Some sows may require extra length.

RECOMMENDED DIMENSIONS FOR FEEDERS

Type of Production	Depth (cm)	Width (cm)
Finisher only (60-100kg or 132-220 lb)	30 - 35	35 - 40
Grow/finish (25-110 kg or 55-242 lb)	25 - 30	32
Wean to finish (8-110 kg or 18-242 lb)	25 - 30	32

NB: Depth refers to the distance from the lip of the feeder to point of feed access.

CAPACITIES OF DIFFERENT FEEDER TYPES

Feeder	Eating Time (min/day)	Estimated Stocking Rate
Single-space, dry	92	12
Single-space,dry	98	11
Two-space, dry	99	22
Two-space,dry	101	22
Single-space, wet/dry	73	15
Single-space, wet/dry	75	15
Single-space, wet/dry	81	14
Two-space, wet/dry	79	28
Two-space, wet/dry	98	22
Two-space, wet/dry	110	20

NB: Feeder types refer to the commercial feeders used in the study.

HEATING/VENTILATION GUIDELINES FOR SWINE HOUSING

Swine	Ventilation Requirements (L/s per pig)		
	Summer	Winter	Heating required (W/pig)
Dry sow	96	3.0	300
Farrowing	144	7.0	700
Weanling			
7 kg	12	0.4	70
25 kg	16	0.7	50
Grower/finisher			
Continuous			
25-60 kg	32	1.3	30
60-100 kg	40	2.0	35
25-100 kg	35	1.6	35
all-in-all-out			
25 kg	36	1.2	60
40 kg	45	1.5	40
60 kg	54	1.8	30
80 kg	60	2.1	30
100 kg	60	2.4	30

Sources: Canada Plan Service M-7000, 1987; ASAE Handbook, 1991; Swine Building Ventilation, 1994.
NB: The minimum ventilation rates listed in this table are guidelines only. You should consult an engineer for ventilation requirements for a specific barn. Ventilation graphs and the heat deficit temperature should also be considered when trying to determine heating/ventilation requirements. A ventilation graph depicts the minimum ventilation rates required to maintain an acceptable indoor environment, plotted against outside temperatures. Heat deficit temperature is an outside temperature below which supplemental heat is required to maintain an acceptable relative humidity level or air quality in the building.

RECOMMENDED SETPOINT TEMPERATURES FOR VARIOUS AGES OF PIGS

Room and Body Mass (kg)	Setpoint Temperature (°C)[1]					
	Heating season[2]			Cooling season[3]		
	Solid floor	Slatted floor	Solid floor with straw	Solid Floor	Slatted floor	Solid floor with straw
Dry sows	17	19	15	19	21	18
Farrowing	16	18	14	18	20	17
Weanling						
7 kg	26	28	25	27	29	26
20 kg	23	24	22	24	26	22
Grower/finisher (continuous)						
25-60 kg	18	20	16	19	21	18
60-100 kg	14	16	12	16	17	15
25-100 kg	18	19	17	19	21	18
(all-in-all-out)						
25 kg	21	23	20	22	24	22
30 kg	20	22	18	21	22	20
35 kg	19	20	17	19	21	18
40 kg	17	19	16	18	20	17
45 kg	16	17	15	17	18	16
50 kg	15	16	14	16	17	15
55 kg	14	15	13	16	17	15
60 kg	14	15	12	16	17	15
70 kg	14	15	11	16	17	15
80 kg	14	15	10	16	17	15
90 kg	14	15	10	16	17	15

Source: Swine Building Ventilation, 1994.

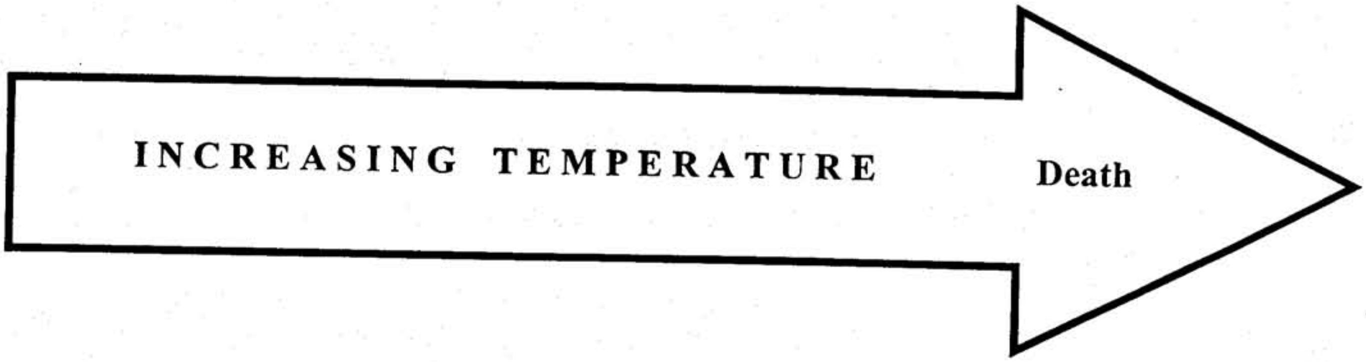
NB: For newly farrowed sows, newly weaned piglets and grower pigs moved from the nursery, it is recommended that the setpoint temperature be 1-2°C higher than the values in the table for the first couple of days. When pigs change their housing status (i.e., newborn, weaned or new in grower barn), they are subjected to stresses of adjusting to the new environment and new diet. Stress will usually cause a reduction in feed intake and thus a reduction in internal body heat. Therefore, a warmer room temperature is desirable.

[1] Increase in setpoint temperature from heating seasons to cooling seasons must be accompanied by minimum ventilation adjustment(s) whenever such an adjustment is allowed. Refer to minimum ventilation recommendations.

[2] Heating season: outside temperature is below the heat deficit temperature.

[3] Cooling season: outside temperature is above the heat deficit temperature. For those rooms which have very low heat deficit temperatures, e.g., rooms housing near-market finisher pigs, the season can be considered a cooling one when the outside temperature is above 0°C. These recommendations are for ventilation cooling only. For rooms with supplemental cooling systems, e.g., ground water cooling, setpoint temperatures should be modified depending on the cooling capacity and efficiency.

THE PIG'S RESPONSE TO TEMPERATURE



Lower Critical Temperature LCT	Thermal Comfort Zone	Evaporative Critical Temperature ECT	Upper Critical Temperature UCT
Cold	**Comfortable**	**Hot**	**Overheated**
Huddling	Normal contact with other pigs	Spread out	
Less floor contact		Increased floor contact	
Stable body temperature 39°C	Stable body temperature 39°C	Increasing body temperature	Dramatic rise in body temperature, death likely at > 43°C
Increasing feed intake	Normal feed intake	Decreasing feed and water intake	
Shivering	Normal behaviour	Increasing pen fouling Increasing splashing, and wallowing	
	20 - 30	Increasing respiration rate 50 - 80	

- breaths per minute -

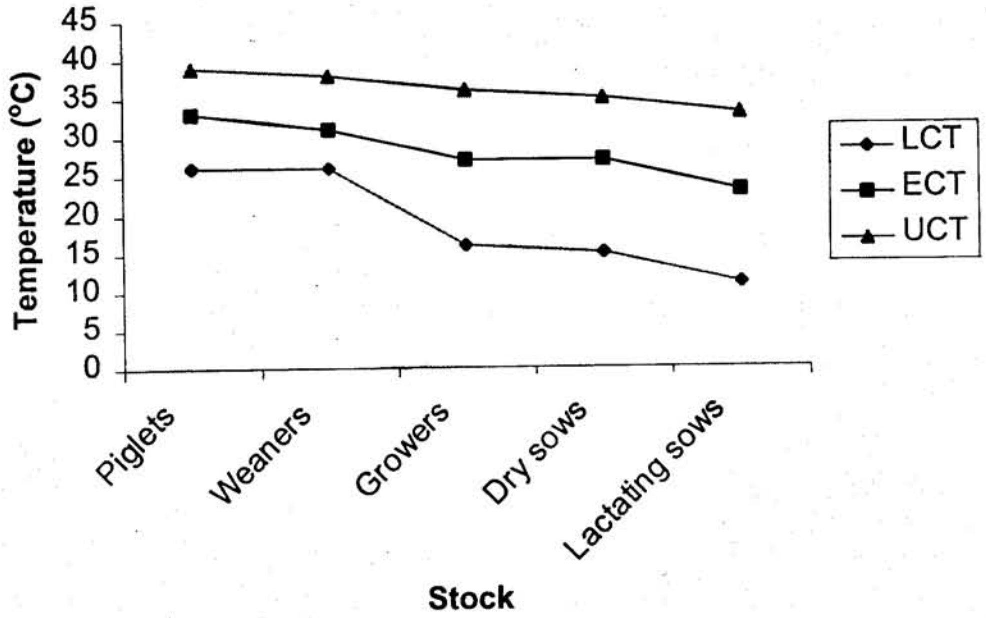
Adapted from Kruger et al., 1992. Australian Pig Housing Series - Summer Cooling, New South Wales Agriculture, Tamworth, Australia.

LCT is at the lower end of the thermal comfort zone. Temperatures at or below the LCT result in an increase in heat production by shivering and an increase in feed intake.

ECT is the ambient temperature at which evaporative heat loss increases dramatically.

UCT is the temperature at which the animal's maximum rate of heat loss coincides with the maximum rate of evaporative heat loss through respiration. At UCT, food intake is minimal and further rises in ambient temperature cannot be accounted for.

CRITICAL AIR TEMPERATURES

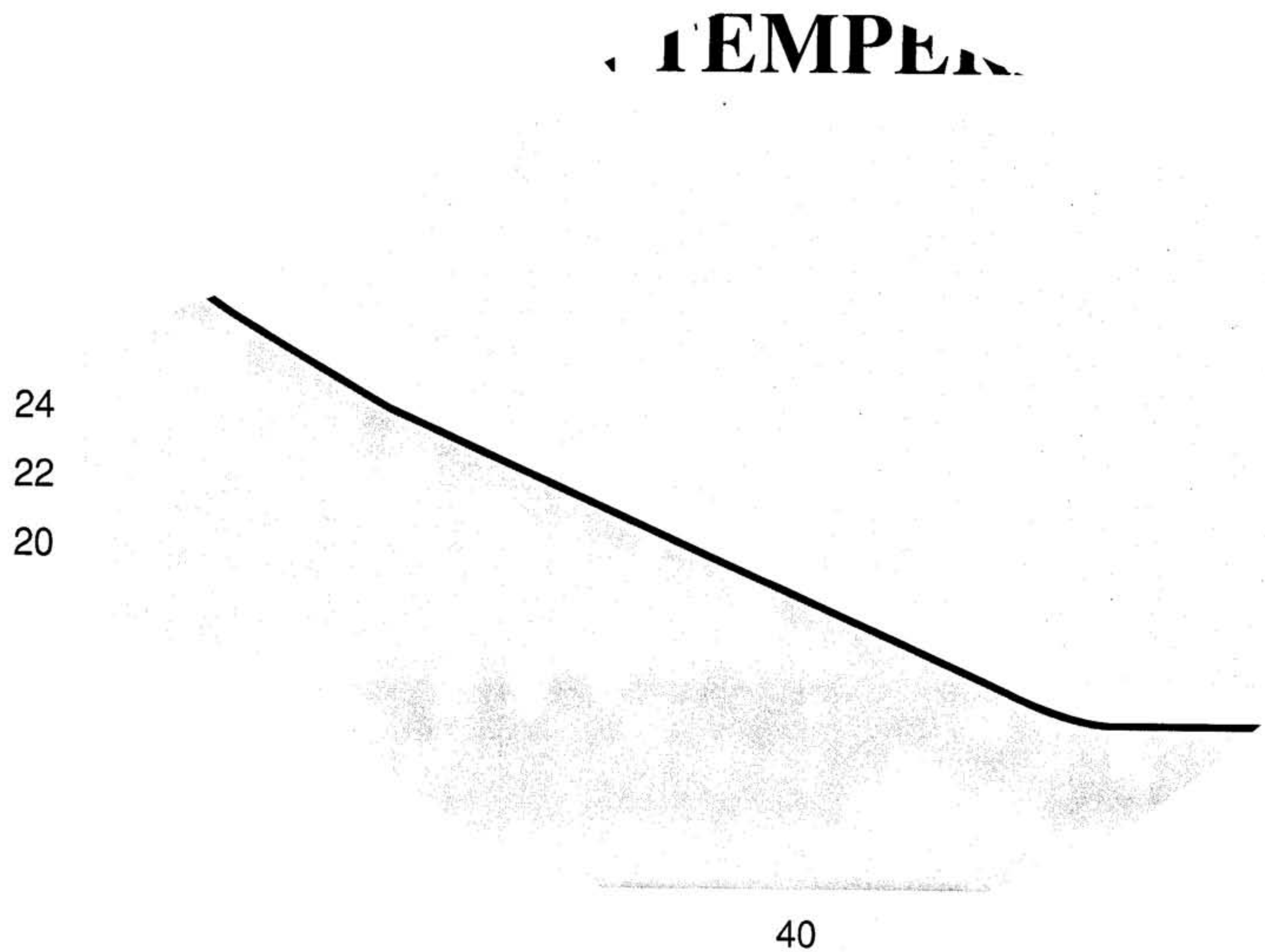


NB: The above values refer to pigs housed in still air conditions and are to serve as guidelines only. Critical temperatures will vary with the age of pig, floor type, air speed, energy intake and the degree of skin wetness.

CONDITIONS ALTERING "EFFECTIVE" AMBIENT TEMPERATURE

Environmental Factors	Deviance from Ambient Temperature (°C)
Flooring	0
Dry slats	-5
Wet slats	-5 to -10
Straw	+4
Air Movement	
0.2 m/sec	-4
0.5 m/sec	-7
1.5 m/sec	-10
Air-to-wall temperature gradient	
1 °C	-0.5
3 °C	-1.5
13 °C	-7

Adapted from Straw and Wilson, 1985.


EMPE
24
22
20
40

MANURE PRODUCTION BY VARIOUS CLASSES OF SWINE

Type of Pig	Daily Manure Production for Storage Structures			
	Solid		Liquid	
	- lb/animal/day -	- kg/animal/day -	- gal/animal/day -	- L/animal/day -
Boars/gestating sows (150 kg)	46.6	21.1	3.5	15.9
Nursing sows (150 kg)	63.8	29.0	4.8	21.8
Gilts (125 kg)	37.2	16.9	2.8	12.7
Feeder pigs (100 kg)	24.9	11.3	1.9	8.5
Weanling pigs (16 kg)	4.6	2.1	0.4	1.6

Adapted from the Manual for Developing a Manure and Dead Animal Management Plan, Saskatchewan Agriculture and Food, Regina, SK.

NUTRIENT COMPOSITION OF SWINE MANURE

Nutrient	Liquid Manure	
	Mean	Range
	- kg/1000 L -	
Nitrogen (N)	3.0	0.3 - 5.8
Phosphorus (P)	0.9	0.04 - 2.9
Potassium (K)	1.0	0.4 - 1.9
Sulphur (S)	0.4	0.08 - 0.7
Sodium (Na)	-	0.2 - 1.3
Ammonia (NH_4)	-	0.2 - 4.0
Dry Matter	-	5.0 - 130

Adapted from Saskatchewan Agriculture and Food, Regina, SK.
NB: The nutrient composition values are based on a 1999 Saskatchewan data survey including 5 farrowing, 4 nursery and 7 finishing units. Nutrient composition may differ among operations due to variations in climate and differences in production practices, rations and manure storage methods. Site-specific nutrient analysis should be conducted in order to receive an accurate assessment of the nutrient value of manure for individual swine operations.