Utrecht University

Foetal Bovine Serum
Background

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Fetal Bovine Serum (FBS)

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Fetal Calf Serum (FCS)

Culture Media

Culture media, which

> are essential for immediate cell survival *(survival media)*

> are capable of sustaining cell survival *(maintenance media)*

> supply all necessary nutrients for sustained cell growth and proliferation *(growth or proliferation media)*

> induce specific, differentiated functions *(differentiation media)*

Cell Culture Medium

Basic salt solution- *glucose – buffer - nutrients – vitamins –salts – buffers – amino acids*

- Ringer's solution
- Basal Medium Eagle (BME)
- Modified Eagle's Medium (MEM)
- Minimal Essential Medium (MEM)
- Dulbecco's Modified Eagle's Medium (DMEM)
- RPMI
- Ham's
- F-12
- DMEM/F-12

Growth supplement

To survive, grow and multiply: growth supplement

Serum

Foetal Calf Serum – Foetal Bovine Serum

Universal supplement

Serum provides

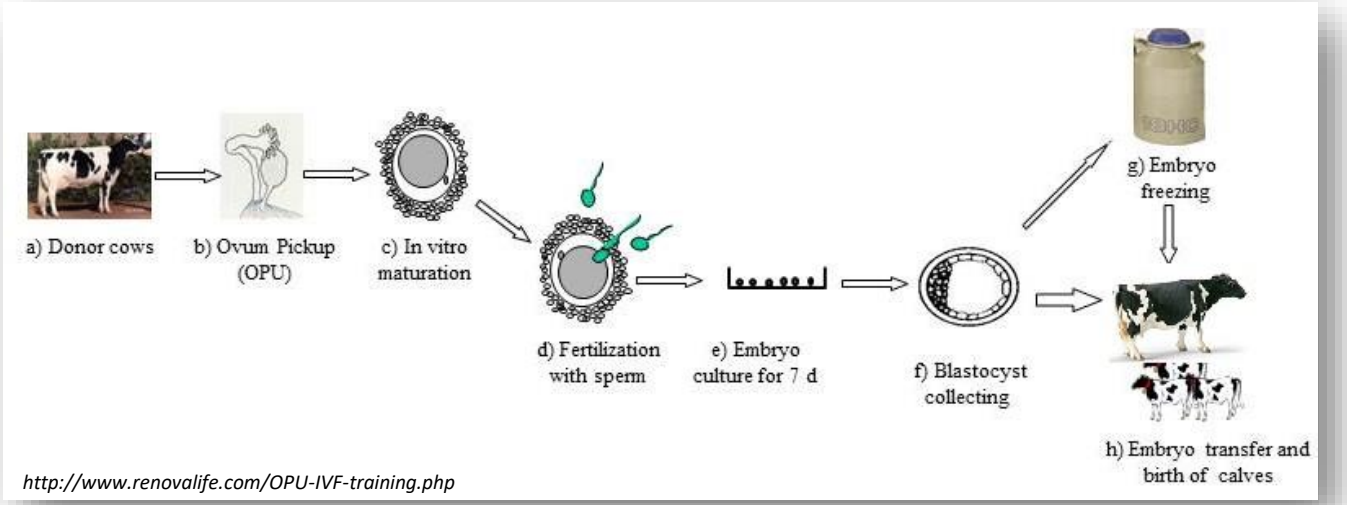
- Proteins
- Vitamins
- Hormones
- Shear force protection
- Attachment factors
- Trace elements

- Growth factors (FBS)
- Limited number of antibodies (FBS)

Foetal Bovine Serum - Use

In vitro research

Development in vitro meat



In Vitro Fertilization

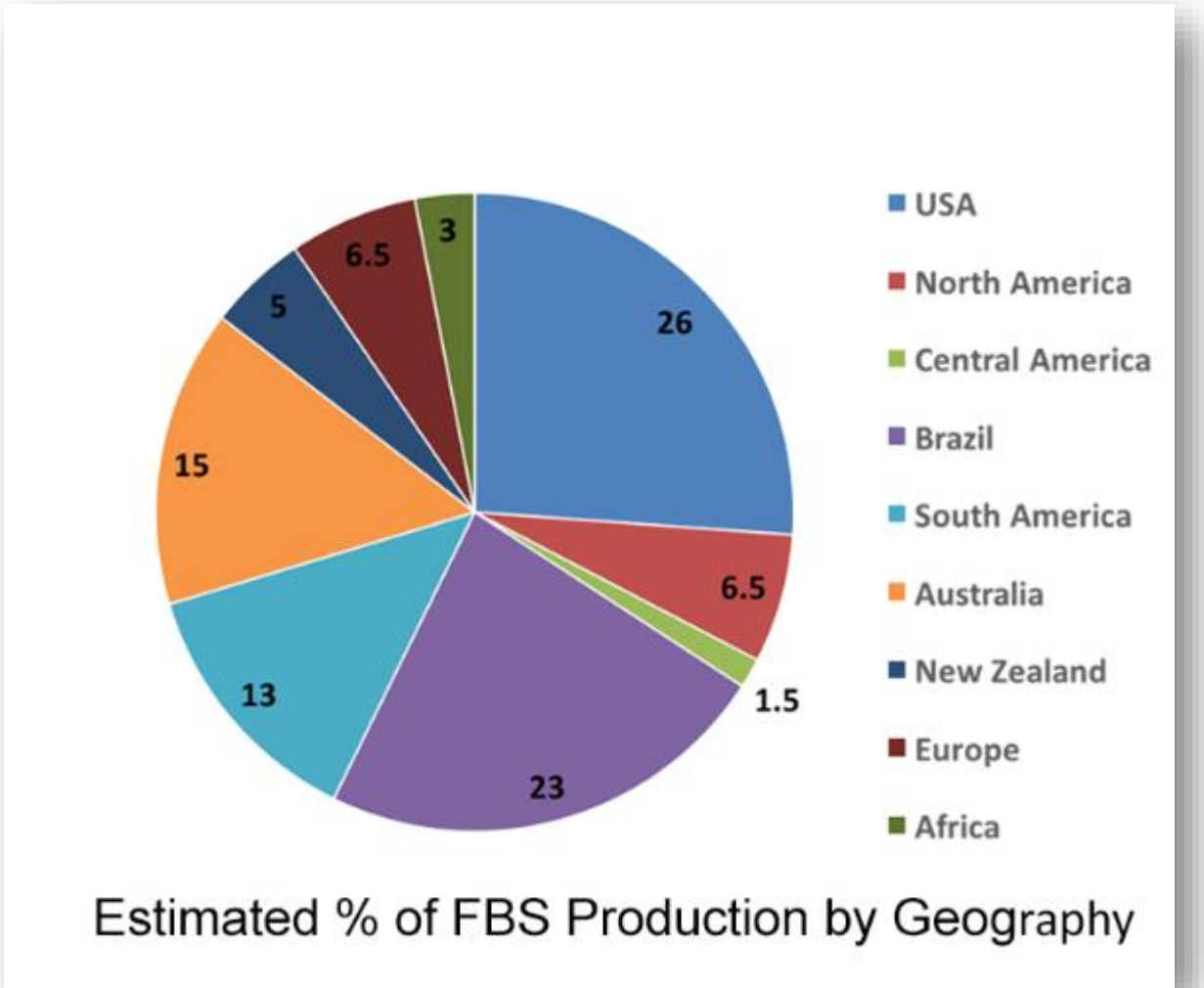
Origin

Foetal bovine blood that is to be processed to serum is collected from animals at the time of slaughter.

USA, Australia, Mexico, Brazil, Canada, New Zealand, Europe, Africa, Central America, Russia, Bangladesh, France, Iran, Germany, Kazakistan, Nepal, Qatar, Sri Lanka, United Arab Emirates, Chile, Colombia, Urugay.

30 countries

Source: INTERNATIONAL SERUM INDUSTRY ASSOCIATION



Source: Serumindustry.org

Numbers statistics

- 1 full grown foetus = 1 litre blood = ½ litre serum
- It has been estimated that around half a million liters of raw FCS is produced each year worldwide which equates to the harvesting of more than one million bovine fetuses annually.
- Some sources have suggested that the actual figure may be closer to two million fetuses per year.
- 2008: 700.0000 liters FCS

http://www.humaneresearch.org.au/campaigns/fetal_calf_serum

Demand > supply

Since the demand is greater than the supply, prices have gone up by 300%.

In the EU, welfare standards prevent the transport of animals in the last tenth of pregnancy .....

Given the quantity of FBS produced globally, it is likely that heavily pregnant animals are routinely transported and slaughtered in countries where no such controls apply.

Processed FBS

- Charcoal-stripped Fetal Bovine Serum
- Heat inactivated
- Pre-selected high quality Fetal Bovine Serum
- Gamma-irradiated serum
- Certified serum
- Qualified serum

Variable composition

Biological product, dependent on geographical and seasonal origin.

TABLE I. Comparison of 32 Parameters in Various Commercial Lots of Fetal Bovine Serum

Profile parameters	Hyland	Gibco Lot A	Gibco Lot B	Gibco Lot C	MBA Lot A	MBA Lot B	MBA Lot C	Mean ± SD
Osmolarity (mosmol)	390	358	340	366	352	327.5	337	353 ± 20.8
K^+ [a]	23	11.9	6.6	5.6	11.8	1.8	7.2	9.7 ± 6.8
Na^+ [a]	111.2	112.3	106.1	111.0	102.5	109.7	105.9	108 ± 3.4
Cl^- [a]	163	147.6	134.7	149.3	137.4	130.1	136	142 ± 11.4
Ca^{+2} [a]	12.4	9.4	15.1	14.7	14.9	15.4	15.5	13.9 ± 2.2
PO_4^{-3} [a]	10.0	6.3	10.0	9.0	9.0	9.7	10.1	9.2 ± 1.3
Uric acid[b]	2.71	3.04	3.52	4.16	4.58	11.76	3.57	4.8 ± 3.2
BUN[b]	15.5	12.6	16.1	18.4	15.8	13.1	20.4	15.9 ± 2.7
Total bilirubin[b]	0.25	0.10	0.25	0.24	0.24	0.08	0.11	0.18 ± 0.08
Creatinine[b]	1.40	1.15	3.48	3.48	3.12	0.6	2.32	2.36 ± 1.25
Glucose[b]	353	382	322	353	316	256	249	318 ± 50
Cholesterol[b]	148	165	48	47	42	29	46	75 ± 56
Total protein[c]	7.97	8.49	3.79	3.87	3.81	3.04	3.70	4.95 ± 2.26
Albumin[c]	2.75	2.15	1.28	1.30	1.19	1.01	1.21	1.55 ± 0.63
ALK phosphatase[d]	140	37	147	175	205	138	177	146 ± 54
CPK[d]	417	283	118	164	99	77	152	187 ± 121
LDH[d]	598	598	460	615	71	132	588	437 ± 236
SGOT[d]	85	93	39	47	7	2	44	45 ± 35
T_4[e]	6.5	3.3	8.9	9.5	8.9	8.0	9.5	7.8 ± 2.2
Total cortisol[e]	12.5	14.0	7.2	7.7	9.3	9.7	7.0	9.6 ± 2.7
Free cortisol[e]	3.4	1.8	1.0	0.4	0.8	1.4	0.4	1.31 ± 1.04
Corticosterone[e]	2.5	0	0	0	0	0.1	0	0.37 ± 0.94
Testosterone[f]	80	35	47	56	79	32	45	53 ± 19
Insulin[g]	15.0	18.0	8.0	6.0	8.0	8.5	7.0	10.1 ± 4.5
Total glucagon[h]	730	845	80	185	70	20	70	286 ± 348
Pancreatic glucagon[h]	258	192	40	48	80	20	42	97 ± 91
ACTH[h]	11.0	48.0	6.0	11.0	11.0	11.0	6.0	14.9 ± 14.8
TSH[i]	1.0	<1.0	1.5	1.25	<1.0	<1.0	<1.0	1.1 ± 0.17
GH (bovine)[j]	70.8	23.2	114.9	140.3	88.6	4.1	167	87 ± 59
FSH[k, l]	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56
LH[k]	4	2.5	1.5	1.5	1.0	1.0	1.0	1.78 ± 1.1
Prolactin (bovine)[j]	136	21.3	8.2	4.3	15.7	7.5	1.5	27.7 ± 48

Fetal Bovine Serum variability in commercial lots

From: Fetal Bovine Serum: A Multivariate Standard, Horn Singley and Chavin (1975)
https://doi.org/10.3181/00379727-149-38804

Issues with the use of FBS

1. Animal welfare issues when transported and when blood is collected
2. Fraud
3. Scientific issues