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BIOACTIVES AND CO-PRODUCTS FROM ANIMAL BLOOD

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EXECUTIVE SUMMARY

This project was commissioned by **Meat & Livestock Australia** to provide information and useful insight from patent and published literature data into the structure and nature of innovation and research within the animal blood product technology field (specifically in relation to bioactive and co-products from animal blood), both from the perspective of technology and industrial applicability and in terms of the commercial sector.

This study focuses on patent and literature trends concerning bioactives and co-products of animal blood. Specifically, patent and literature material related to the animal type, specific blood components, related process, specific bioactives and the applications for bioactives and co-products. With this in mind, a collection of patent and literature documents with an earliest priority year of 2000 was searched and screened. A collection of **1489** patent invention families and **1122** published literature documents were identified for analysis in this report.

A gradual increase in patent activity has occurred over the last 14 years, with a slight decrease being observed recently. The patent family expansion rate has strongly increased however, indicating that entities are aggressively protecting their inventions globally, even with the recent small decrease in filing activity. Literature appears to be a lot more sporadic in activity than patents. Patents activity in general seems to be increasing or at least constant. Literature has distinct periods of increasing and decreasing activity. This can be explained by the academic / government sectors recently increasing their patent activity in this technology.

The Asia Pacific region is the most prominent region for inventive patent activity followed by North America and then Europe. The Asia Pacific region has shown substantial and sustained inventive activity growth. In contrast, activity in the United States and Europe has remained relatively flat until recently where a steady decline in patent activity can be observed.

China and the United States are the major sources of inventive activity. Much of China's innovation has occurred recently. South Korea also appears to be becoming a more prominent player in this technology field with an increase in activity occurring over recent years. The United States and Japan have witnessed a gradual decrease of inventive activity recently.

The United States was the major source of innovation in the early 2000's, however it has now relinquished this title to China. China and the United States comprise just over two thirds of all patented inventions in the data set. The rise of China as an economic superpower appears to be directly affecting the more established countries where innovation in this technology is

originating. More intense competition from China may be causing a decrease in patent activity in the United States and Japan. China and the United States are the leading markets in which entities choose to gain patent protection for their innovation. This means that there is a perceived business advantage in obtaining patent protection in these geographic jurisdictions.

China has achieved a significant increase of patent innovation in this technology field over the period of 2002 – 2011. Korea and India have also shown growth over this period. In contrast, most other countries in the dataset have shown no growth or a decrease in patent growth over the same period. These declines in inventive activity can potentially be explained by China, South Korea and India increasing their inventive outputs, therefore causing a more competitive environment for other countries. Costs associated with research, human capital and services are generally much lower in many Asian jurisdictions (especially China and India) than they are in North American and Europe. This could be providing these countries with a significant cost advantage over their North American and European counterparts, leading them to be more competitive and a more attractive option for investment.

Similarly with patents, the Asia Pacific has the largest volume of literature publications produced, with a little over a third of all literature originating there. Europe followed by North America are the next two top regions for literature associated with this technology. The United States is the largest individual source of published literature followed by China, Germany, Japan and the United Kingdom.

Over half of the patents in this technology field are owned by corporations. Corporate activity has been sporadic over the last fourteen years. Patent activity associated with academic/government entities however, have been steadily increasing over time. Recently, academic/government entities have overtaken corporate entities as the most active patent filers in this technology field, indicating a turn towards the fundamental research performed by academic institutions. The overwhelming majority of literature publications associated with this technology was produced by the academic/government sectors. Only a small amount of literature has been published by corporations. The reason for this could be the high cost associated with the patent process verses the much small cost associated with just publishing literature.

The top entities in this technology field for patents are **Lauridsen Group Inc** (United States) and **Toyobo KK** (Japan). Interestingly, these entities have not filed any patents recently. The majority of the top large entities in this technology field are based in Asia. Many of the top entities have a clear focus on the Chinese market alone. It can be seen that all entities with patent filings solely in China are Chinese originating entities. This phenomenon indicates that while Chinese activity has increased markedly, patent protection tends to remain local and therefore potentially has lesser impact in the global commercialization of the technology. This can be extended to an overall trend of many Asian originating entities to protect their technology locally and to largely ignore overseas markets. Potentially, these entities may only see a

commercial opportunity in their home countries for their products / services or that because of such high competition in this technology locally, these entities only protect their technology in their own jurisdiction in order to compete within their own market. Entities that originate outside of Asia (specifically the United States and Great Britain) and some larger Japanese corporate entities are pursuing a more global commercialization strategy by filing patents in multiple countries. In terms of literature, The **Chinese Academy of Science** (China) is the leading source within this field. This is followed by the **Wuhan University** (China) and the **University of Girona** (Spain).

Technology associated with animal blood products was broken down broadly. Specifically, categories related to the animal type, specific blood components, related process, specific bioactives and the applications for bioactives and co-products were utilized.

The type of animal blood utilized which was directed toward using ‘buffalo / ox / cow / bovine’ was the most populated technology category for patents. Technology involving ‘pig / porcine / swine’ was the next most populated category in relation to the specific animal utilized. As with patents, literature associated with ‘buffalo / ox / cow / bovine’ was highly represented in the dataset in terms of the animal involved. Literature directed toward ‘pig / porcine / swine’ was the next most populated category.

Patent technology directed to ‘whole blood’ and ‘serum’ were the most populated categories in relation to specific blood components. In terms of literature, publications associated with ‘serum’ or ‘plasma’ was found abundantly in the data.

In terms of the process for the extraction and analysis of animal blood, ‘collection and extraction’ and ‘centrifugation’ technology shows the highest patent activity. Process related literature did not have any exceptional stand out categories that were observed however processes directed toward ‘collection / extraction’, ‘preservation / storage’ and ‘transportation’ had the highest instances of literature for this category.

The most active patent technology areas in relation to the specific bioactives involving proteins include ‘immunoglobulins’ and ‘albumin’. Technology associated with ‘enzymes in general’ and ‘antimicrobials’ also were highly represented. Literature associated with ‘serum’ and ‘albumin’ technology was most popular in relation to bioactives. Literature associated with ‘enzymes in general’ was also well populated.

High patent filing technology area’s associated with the actual application of the animal blood technology included ‘food’ (in general), ‘laboratory research / testing’ and ‘pharmaceutical’ uses. Applications of this technology covered in the literature were directed to ‘food’ (in general), ‘laboratory research / testing’ and ‘pharmaceutical’ uses were the most active. Interestingly, the literature results mirror the patent results in this application area of this technology.

Patent innovation directed to process technology of animal blood, in particular ‘anticoagulation’ and ‘freezing’ type processes, showed the highest growth of all the technology categories.

Utilizing bioactives and co-products in animal blood for use in ‘cosmetic’ applications also observed a high growth rate. In contrast, bioactive technology involving ‘hemoglobin’, ‘prothrombin’, ‘tranglutaminase’, ‘superoxide dimutase’ and ‘opioids’ have shown the largest decrease in activity.

There appears to be multiple sectors of low patent activity which potentially could be technology areas of opportunity in this technology field. Many categories relating to specific bioactive proteins including ‘c-reactive proteins’, ‘haptoglobin’, ‘prothrombin’ and ‘chloramphenicol acetyltransferase’ have low instances of patent activity across all technology categories. Applications of blood products in ‘aquaculture’, as a ‘biopolymer’ or as a ‘fat replacer’ in food / beverages are also areas of low patent activity across this technology.

It terms of literature, opportunity appears to lay in many technology areas relating to processes associated with animal blood technology. These include ‘anticoagulation’, ‘homogenization’, ‘inspection’, ‘separation’, ‘cooling’, filtration related processes including ‘nanofiltration’ and ‘microfilitration’ membrane processing. A number of bioactive proteins and enzymes were lowly represented in the literature and therefore in low numbers when compared with other technology categories. Examples of these include ‘c-reactive proteins’, ‘transglutaminase’ and ‘superdioxide dismutase’. Animal blood product applications in which low activity was observed across all technology category areas included ‘biopolymers’ and ‘color enhancement’ in food / beverage applications.

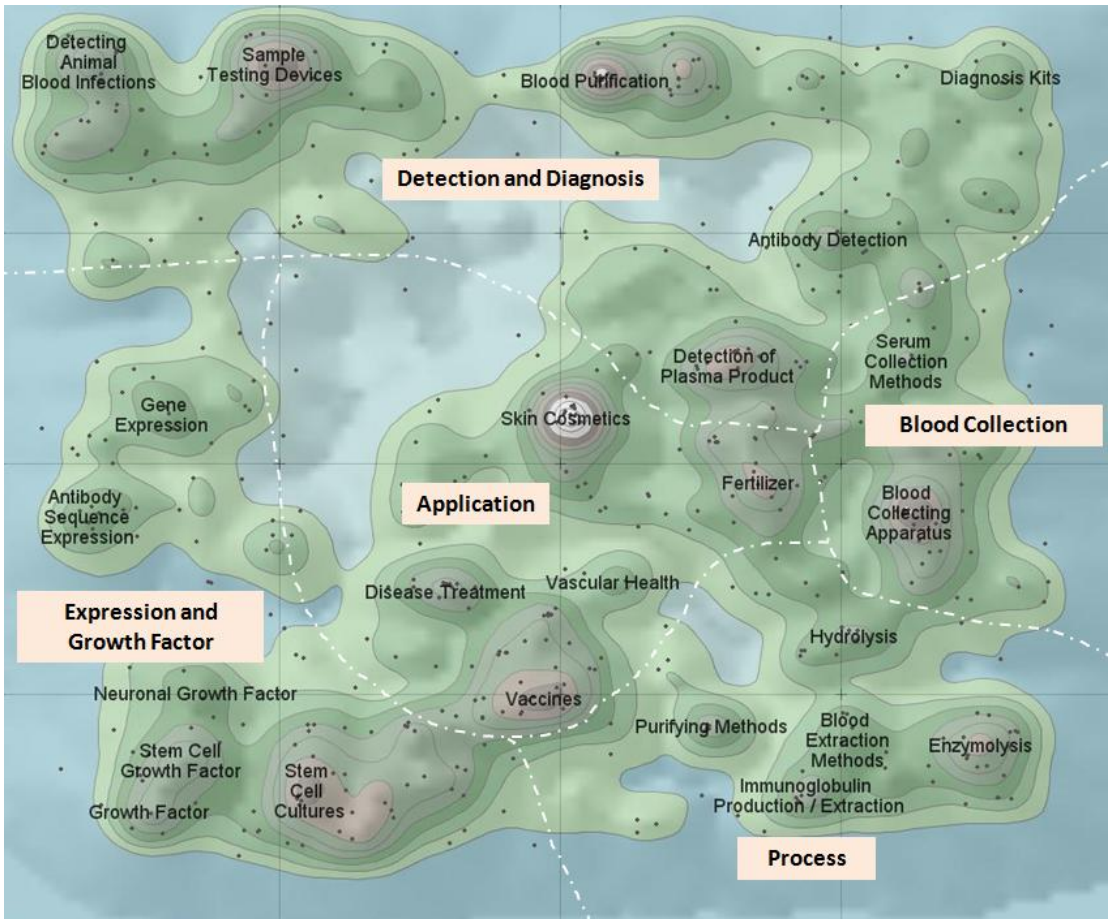
SUMMARY OF BIOACTIVES AND CO-PRODUCTS OF ANIMAL BLOOD IP

This chapter of the report introduces the patent and literature documents in the collection.

The thematic concept map has been produced using the ThemeScape algorithm from Thomson Reuters and uses advanced text analysis software to summarise the major concepts and subject matters within the **1489** documents in the patent collection and the **1122** in the literature publication collection.

Each patent family invention / literature publication is situated in a single location in the landscape map. Areas of higher density (i.e. the mountainous regions) represent technical topics shared across many inventions – and therefore of greater popularity.

PATENT LANDSCAPE



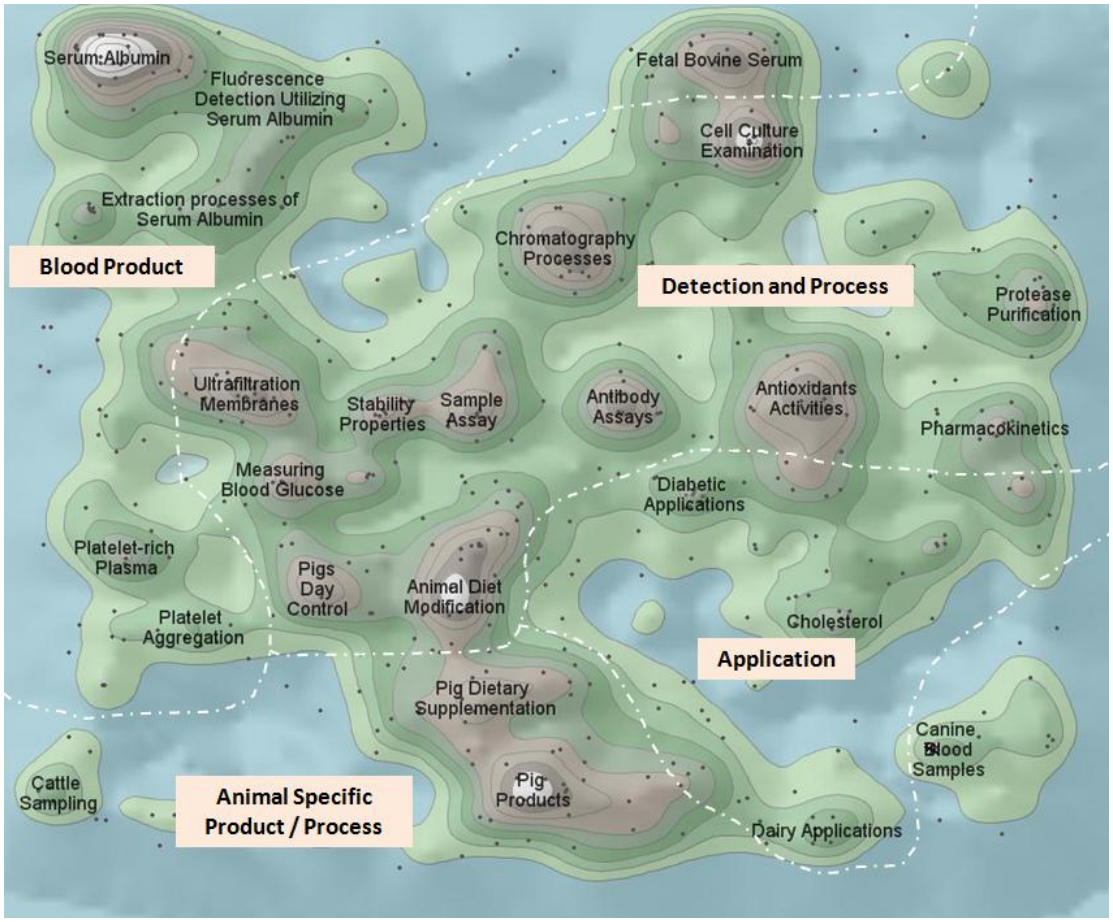
Some themes have been identified on the patent map. A large section of the map is dedicated to documents directed to ‘detection and diagnosis’ covering such themes as ‘blood purification’, ‘antibody detection’, ‘sample testing devices’, ‘diagnosis kits’ and ‘detecting animal blood infections’.

Patent documents relating to the ‘application’ of the animal blood product / co-product is located in the middle of the ThemeScape map. These documents share terms such ‘fertilizer’, ‘skin cosmetics’, ‘vaccines’ and ‘disease treatment’ and ‘vascular health’. ‘Blood Collection’ is also a prominent theme in the patent map. Patent associated with ‘blood collection apparatus’ and ‘serum collection methods’ are located here.

Patents directed around the ‘process’ associated with animal blood product / co-product technology can be located in the bottom right hand corner. Themes associated include ‘purifying methods’, ‘blood extraction methods’, ‘immunoglobulin production / extraction’, ‘hydrolysis’ and ‘enzymolysis’.

Finally, patents generally linked with ‘expression and growth factor’ can be located in the bottom left hand corner. These themes generally relate to cell and gene function associated with blood products and co-products.

LITERATURE LANDSCAPE



Some themes have been identified on the literature map. A large section of the map is dedicated to documents directed to ‘detection and process’ with literature directed to ‘purification’, ‘assays’, and ‘examination’ of blood and various detection related processes including ‘chromatography processes’ being prominent.

Literature associated with the actual ‘blood product’ can be located in the top left hand side of the map. Literature which involves ‘serum albumin’ and ‘platelet-rich plasma’ is prominent. There is also a large proportion of the literature which is associated with products and process from specific animals. ‘Pigs’, ‘cattle’ and ‘canine’ derived applications and products are located here.

Finally, literature directed to the ‘application’ of the blood product can be seen on the map. This section contains literature associated with ‘diabetic applications’, ‘cholesterol’ and general ‘dairy applications’ of animal blood.

TAXONOMY

The documents in the patent and literature collections are categorised in order to allow analysis on the technology areas. The ThemeScape map can assist in the categorisation methods.

By use of collection sub-searching, a series of technical categories was established. The taxonomy was created by analysing the collection for commonly occurring themes, using patent classification codes and constructing relevant keyword strategies. More details and analysis on the technical categorisation can be found under the relevant heading below.

PATENTS

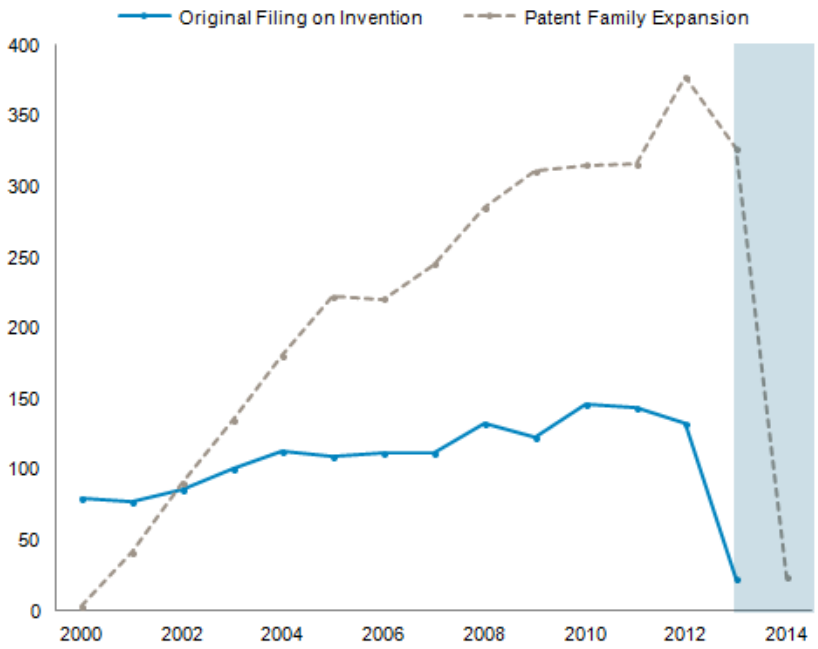
The patent collection was developed using the full patent content on Thomson Innovation®, which includes the Derwent World Patent Index® (DWPI). The use of the patent content in Thomson Innovation ensures a comprehensive collection. The patent collections were normalised on the DWPI database structure to allow for accurate analysis. Specifically, the search process returned a set of **1489** DWPI inventions over the time period of **2000** to **2014**.

ACTIVITY TIMELINES

The chart below shows the number of patent families or inventions first filed (blue) and the patent family expansion (grey) over the years **2000** to **2014**.

There is an 18-month publication delay between filing a patent application and publication of a patent application. Due to this delay, not all years of data are complete. The highlighted area (light blue) shows years in which data may not be complete.

Filing and Family Expansion



On average, there has been a gradual increase in patent activity over the last 14 years, with a slight decrease being observed during the 2010 - 2012 periods.

The patent family expansion rate has strongly increased from 2000 – 2012. This indicates that entities are aggressively protecting their inventions globally even with the recent small decrease in filing activity. If filing rates continue to decrease or decrease substantially in the future however, it is reasonable to assume that the patent family expansion will inevitably follow.

GEOGRAPHICAL ANALYSIS

THE SOURCE OF INVENTION

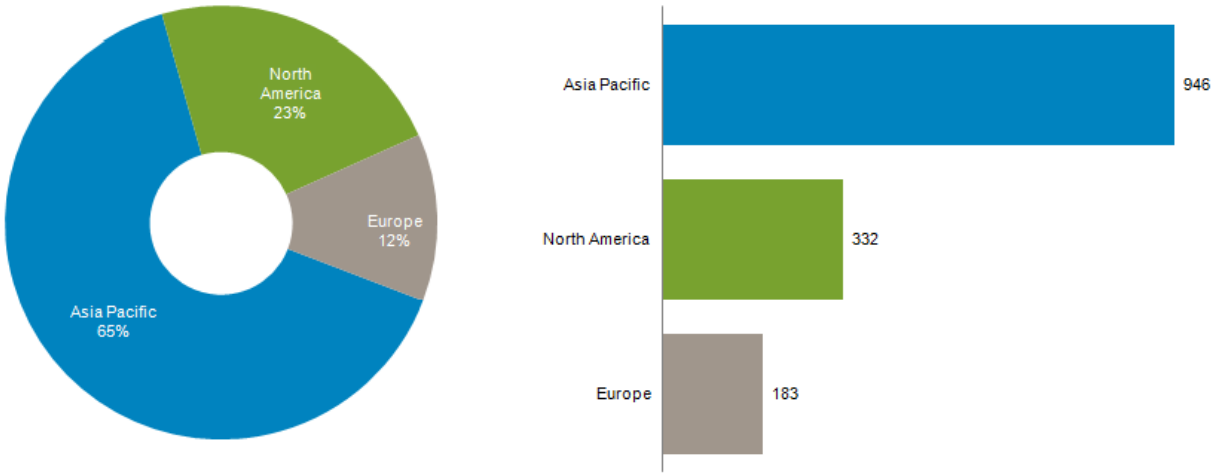
Priority filing country is often used as a proxy measurement for the geographic source of the patented invention, due to the convenience and familiarity of corresponding with a local patent office and in some cases legal restrictions requiring local initial filing.

WHERE IS THE INNOVATION GOING?

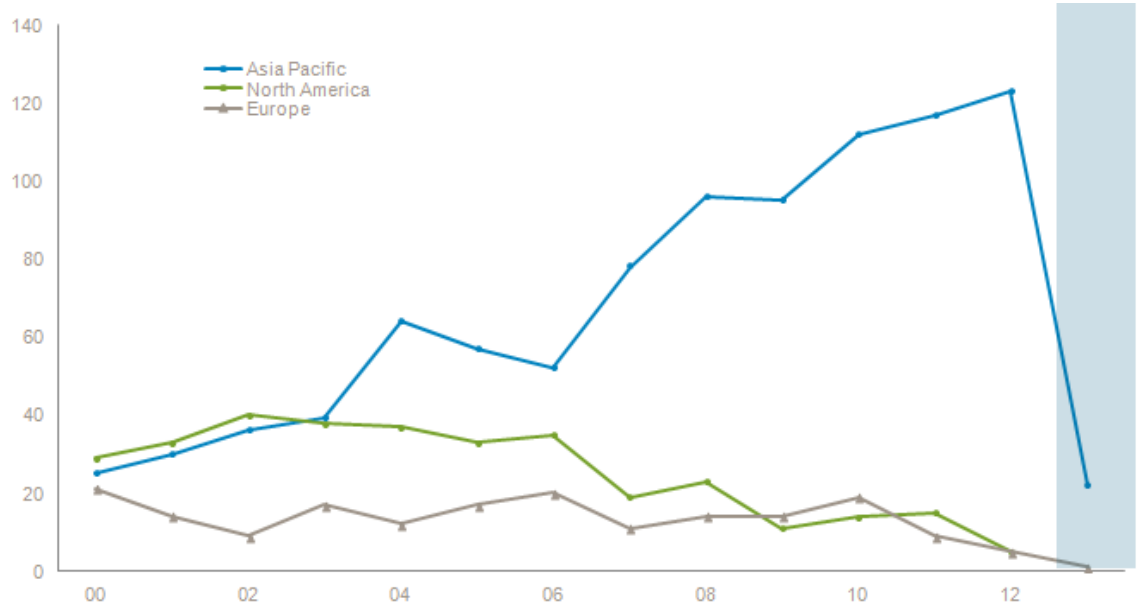
A priority patent application must be progressed through the patent system in order to secure patent protection. The following chart shows the jurisdictions in which patent protection is ultimately sought.

Earliest prioirty country based on region (excluding WIPO)

Inventive Acitivty by Region



Inventive Activity by Region - Timelines



These charts reveal that the Asia Pacific region is the most prominent region for inventive patent activity. 65% of patent activity (946 inventions) in the data set has originated from this region. North America is the next prominent region with 23% (332 inventions) followed by Europe with 12% (183 inventions).

The Asia Pacific region has shown substantial and sustained inventive activity growth from 2000 – 2012. In contrast, activity in the United States and Europe has remained relatively flat up until 2006 where a steady decline in patent activity can be observed.

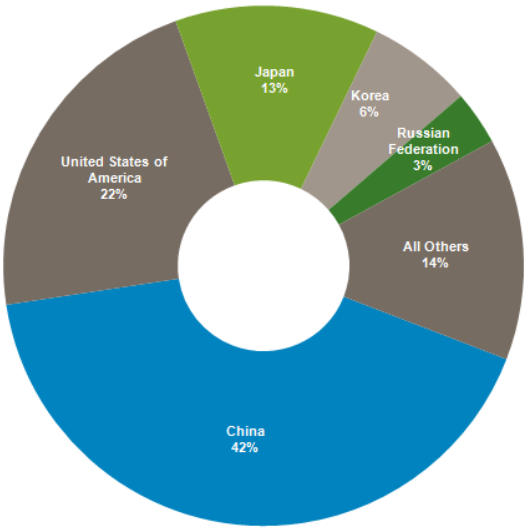
Timeline of Inventive Activity by Patent Authority

Priority Countries	00	01	02	03	04	05	06	07	08	09	10	11	12	13	Total Inventions	% Filed since 2009
China	7	15	10	15	24	26	21	56	72	66	94	96	101	19	622	60%
United States of America	27	32	38	38	36	33	35	19	23	11	14	15	5		326	14%
Japan	10	7	21	21	33	27	18	13	6	13	9	6	4	1	189	17%
Korea	3	3	4	1	4	2	7	9	15	13	7	10	17	2	97	51%
Russian Federation	2	4		2	5	3	7	2	7	3	8	4	3		50	36%
European Patent Office	3	3		2	1	5	6	5	4	2	2	1	1		35	17%
United Kingdom	2	1	3	6	1	2	3	2		2	2	1	1		26	23%
Germany	5	3		1	3		2		1	2	4				21	29%
Australia	4	2	1	1	2	1	4						1		16	6%
India	1	2			1	1	1		1	1	2	3			13	46%
All Others	11	5	8	9	3	7	4	2	4	9	3	6	0	1	72	
Total	75	77	85	96	113	107	108	108	133	122	145	142	133	23		

China and the United States are the major sources of inventive activity. The period from 2007 – 2012 has seen a surge of inventive activity coming from China. Additionally, 60% of all patent activity originating from China has occurred recently since 2009. This is the largest recently filed % of any country in the data set. Korea (south) also appears to be becoming a more prominent player in this technology field, with patent activity increasing from 2008 onwards.

The United States and Japan have seen a gradual decrease of inventive activity from the 2005 - 2006 periods. The United States was the major source of innovation from 2000 – 2006, however it has now relinquished this title to China. Only 14% of all patent activity emanating from the United States and 17% emanating from Japan has occurred since 2009. The rise of China as an economic superpower appears to be directly affecting the more established countries where innovation in this technology is originating. More intense competition from China may be causing a decrease in patent activity in the United States and Japan.

Inventive Activity by Priority Country



Of all patent inventions in the patent data set (2000 onwards), China (42%) and the United States (22%) comprise just over 2/3 of all patented inventions in the data set. Chinese innovation appears to have occurred in more recent years (2007 – 2012), whereas much of the United States patent innovation has occurred over the 2000 – 2006 periods.

Annual % Growth or Decline

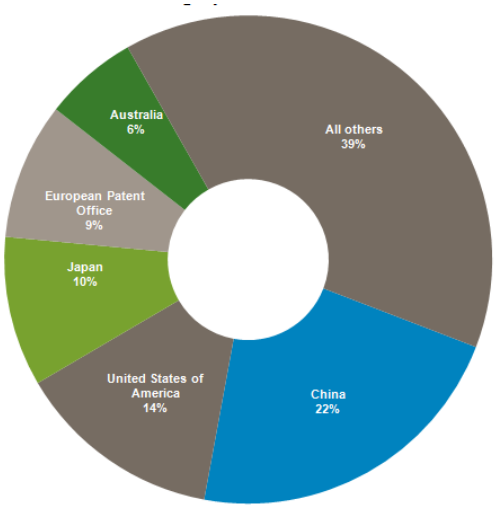
Priority Countries	Average Annual Growth Rate (2001-2011)
China	20%
Korea	13%
India	4%
Russian Federation	0%
United Kingdom	0%
Japan	-2%
United States of America	-7%
European Patent Office	-10%
Germany	-100%
Australia	-100%

The average annual growth rate (AAGR) shows the increase or decrease of patent innovation originating from a country over a specific time period. This data reveals that China has achieved a 20% increase of patent innovation from 2002 – 2011. This is very high result when compared to other countries listed. Much of this innovation has occurred recently. South Korea (13%) and India (4%) have also shown growth over this period.

In contrast, all other countries have shown no growth or a decrease in patent innovation in over the 2002 – 2011 periods. Japan (-2%), the United States (-7%) and EPO applications (-10%) showed a substantive decline. These declines in inventive activity can potentially be explained by China, South Korea and India increasing their inventive outputs, therefore causing a more competitive environment for other countries. Costs associated with research, human capitol and services are generally much lower in many Asian jurisdictions (especially China and India) than they are in North American and Europe. This could be providing these countries with a significant cost advantage over their North American and European counterparts leading them to be more competitive and a more attractive option for investment.

It should be noted that Germany and Australia have witnessed a 100% decline in patent activity over the 2001 – 2011 periods. This is a very large decline however the total patent invention count for each of these countries over this period was low to start with.

Geographic Protection



China and the United States are the leading markets in which entities choose to gain patent protection for their innovation. This means that there is a perceived business advantage in obtaining patent protection in these geographic jurisdictions.

Traditionally popular jurisdictions which include Japan (10%), Europe (9%), and Australia (6%) make up a smaller yet still significant portion of this landscape. Interestingly, 39% of the landscape is comprised of ‘other’ countries. This reveals that a significant proportion of inventions are being protected in a geographically broad manner and that many different countries around the world are being targeted for protection of innovation.

SUCCESS

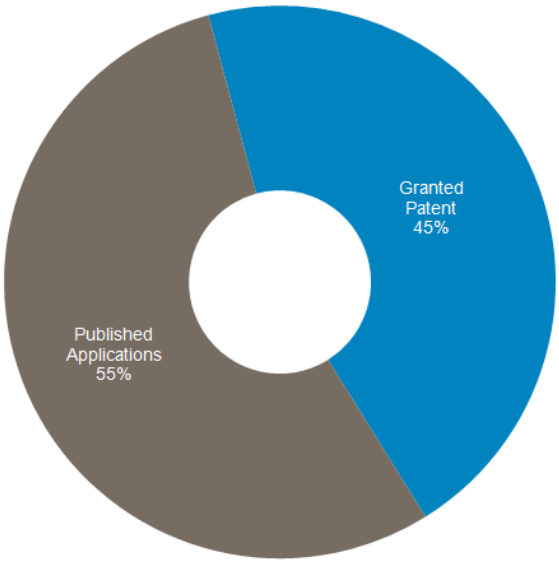
Success according to this report is determined by measuring the patent grant to patent application ratio. Basically, if one member of a patent family has achieved grant anywhere following substantive examination, that invention is considered a “success”.

Thomson Reuters believes that the total number of “successful” inventions as a function of the total number of inventions lodged in the patent system gives a fuller picture of innovation than patent volumes alone. When considering this metric, it should be borne in mind that there is a bias against younger patent portfolios because they have had less time to become successful.

Granted Patent Activity – Country

Priority Country of the Family	Family has Granted Patent in any Country	Family has only Published Applications	All families	% Families with at least one Granted Patent
China	250	372	622	40%
United States of America	154	172	326	47%
Japan	74	115	189	39%
Korea, Republic of	56	41	97	58%
Russian Federation	48	2	50	96%
All Others	93	112	205	45%

Granted Patent Activity – Published Applications Vs Granted Patents



The graph above shows that 45% of patent families in the collection are considered “successful”. This means that 45% of the inventions in the collection have achieved at least one granted and enforceable patent family member. This indicates that this technology on the whole only has a ‘fair’ success rate.

Russia has the highest level of success regarding patented innovation with 96%. South Korea is also quite high with a 58% success rate. This can indicate that the novel, commercial and inventive aspects of many of these patents are quite high and marketable.

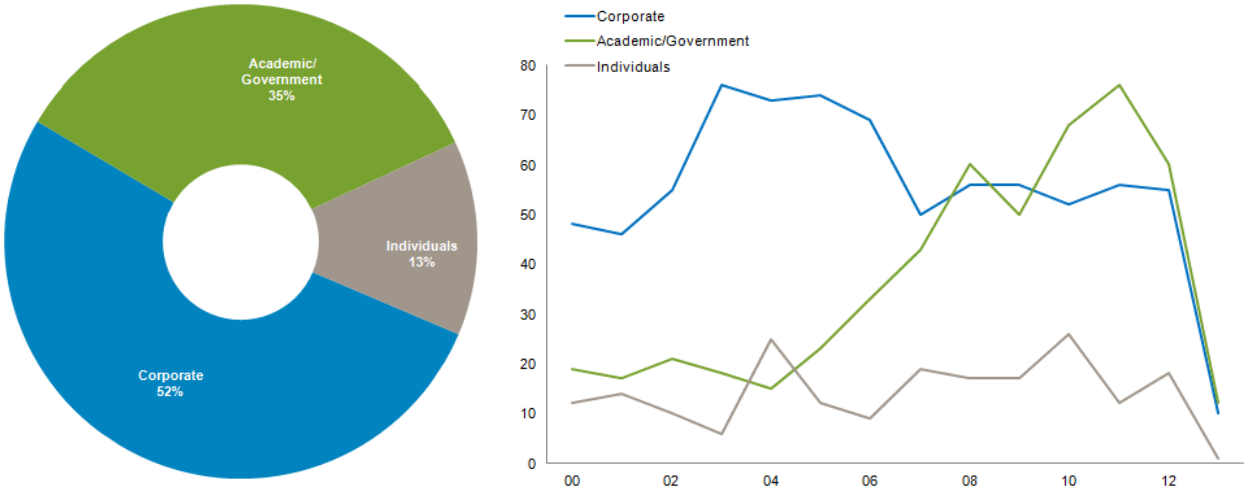
PATENT ENTITY ANALYSIS

The names of entities listed on the patent documents in the collection have been cleaned for typographical errors and researched for subsidiaries or name changes, so that a more accurate picture of the true level of activity for each listed entity is presented.

ANALYSIS OF PATENT LANDSCAPE BY ENTITY SECTOR

The entities in the landscape have been divided into three categories: corporations (and for-profit entities); academic and government institutions (and other not-for-profit entities); and patents assigned to individuals, where the individual could not be identified as an associate of an organisation elsewhere in the collection.

Patent Entity Sector



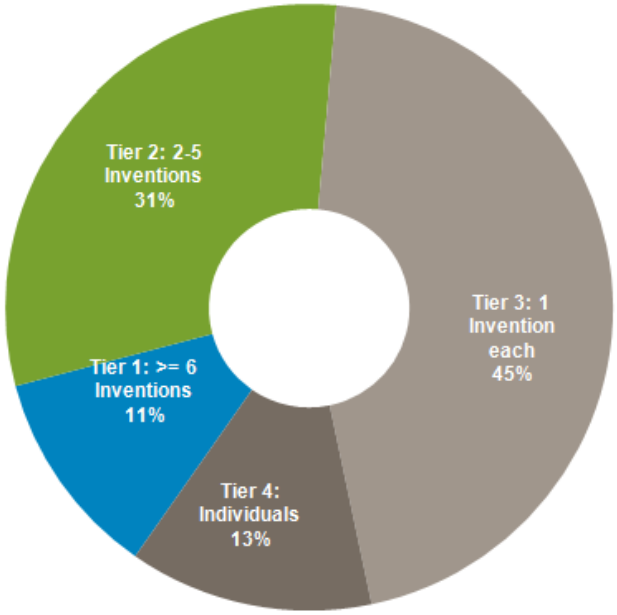
The graph (above-left) shows that most of the IP in the collection is owned by corporations (52%).The graph (above-right) shows that since 2000 corporate activity has been sporadic increasing from 2002 before witnessing a sharp drop in 2006. Academic/Government activity (35%) has been steadily increasing over time. Recently, Academic/Government entities have overtaken corporate entities as the most active patent filers in this technology field. Individuals filing patents (13%) has remained constant over this period.

PORTFOLIO SIZE ANALYSIS

The entities in the patent dataset were separated into four tiers based on the number of patent families they each have, i.e. those entities with 6 or more inventions (Tier 1); those with between 2 and 5 inventions (Tier 2) and those with 1 invention each (Tier 3). “Individuals” also form a single tier (Tier 4).

% Landscape by Entity Tier

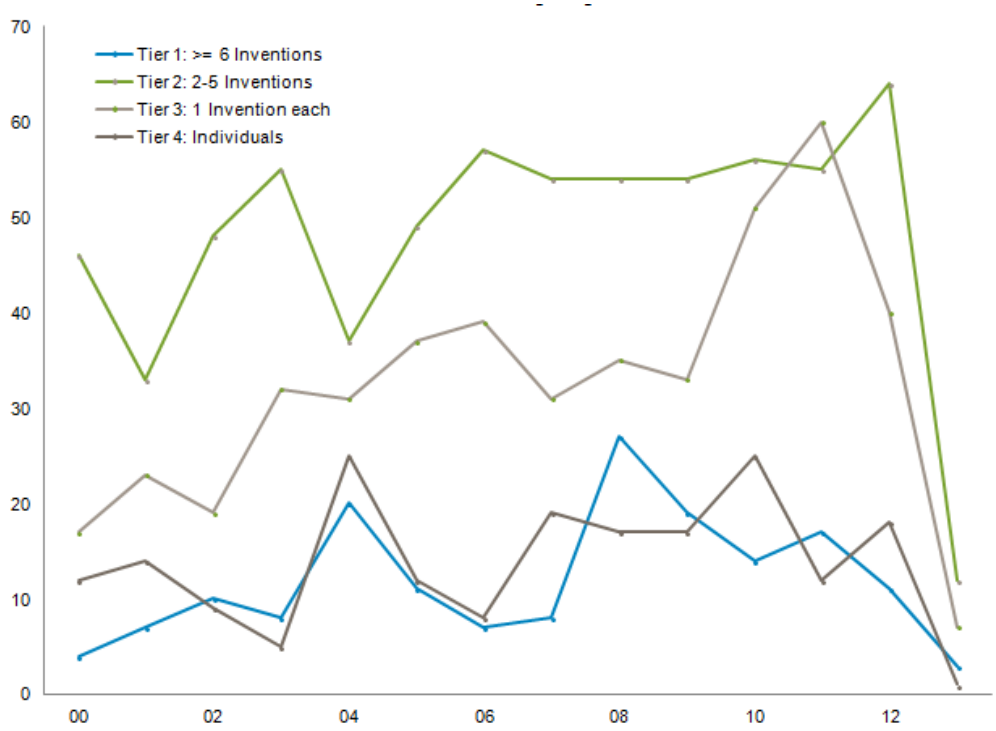
Tier	Total Inventions	Number of Entities
Tier 1: >= 6 Inventions	166	19
Tier 2: 2-5 Inventions	455	173
Tier 3: 1 Invention each	674	674
Tier 4: Individuals	194	



Tiers	00	01	02	03	04	05	06	07	08	09	10	11	12	13	Total Inventions
Tier 1: >= 6 Inventions	4	7	10	8	20	11	7	8	27	19	14	17	11	3	166
Tier 2: 2-5 Inventions	17	23	19	32	31	37	39	31	35	33	51	60	40	7	455
Tier 3: 1 Invention each	46	33	48	55	37	49	57	54	54	54	56	55	64	12	674
Tier 4: Individuals	12	14	9	5	25	12	8	19	17	17	25	12	18	1	194

There are 19 entities that hold 6 or more patent inventions. These relatively large entities hold just over a tenth (11%) of the patent landscape. Medium sized entities (173 in total) that hold between 2 and 5 inventions comprise 31% of the patent technology landscape. Additionally, there are a large number of entities (674 in total) that hold only 1 invention (45% of the landscape). This indicates that there is a significantly large number of 'small players' undertaking patenting activity in this technology field, since larger entities tend to have larger patent portfolios. Overall, this picture would appear to show a highly competitive sector, in which no one company controls a high proportion of the IP rights, and therefore a sector of high opportunity. A small portion of the collection belongs to individuals. There are 194 patent documents in the name of at least one individual which accounts for 13% of the collection.

Timeline of Activity by Tier



TIER 1 ENTITIES (GREATER THAN 6 INVENTIONS)

The table below lists the entities in tier 1 of the collection. There are total of 19 entities that fit the criteria of greater than 6 inventions.

The table shows the total number of patent inventions associated with these entities, as well as the number of inventions first filed each year that have progressed through the patent system (patent data from recent years may be incomplete due to publication lag).

Tier 1 Entities – Timeline and Total Activity

Tier 1 Entities	00	01	02	03	04	05	06	07	08	09	10	11	12	13	Total Inventions	% Filed Since 2009
LAURIDSEN GROUP INC	2	4	3	2	3				1						15	0%
TOYOBO KK				2	8	2			1						13	0%
UNIV TIANJIN					1			3	3	1	1	1		1	11	36%
UNIV ZHEJIANG					1				4	1	3	1			10	50%
UNIV SHANGHAI JIAOTONG				1			3	2		2			2		10	40%
TIANJIN BAODI AGRIC TECHNOLOGY CO LTD										1	4	3	1		9	100%
UNIV JILIN									1	2	2	3	1		9	89%
UNIV NORTHEAST AGRIC						1		1		1	2		3	1	9	78%
DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH		1		2	2	1			1	2					9	22%
SHENYANG SIJIA TECHNOLOGY DEV CO LTD					1	1			3			3			8	38%
FUJI FILM CORP			2		2	1	1		1	1					8	13%
MARUZEN PHARM CO LTD			1		1	2	1	1	1	1					8	13%
OWEN HOLDING LTD	1			1		3			2	1					8	13%
UNIV SUN YET-SEN												4	3		7	100%
LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI								1	1	2		1	1	1	7	71%
TIANJIN SHENGJI GROUP CO LTD									6	1					7	14%
CHINESE ACAD INSPECTION & QUARANTINE									1	3	2				6	83%
US DEPT HEALTH & HUMAN SERVICES	1		1		1		1		1			1			6	17%
ASAHI KASEI CORPORATION		2	3				1								6	0%

Tier 2: 2-5 Inventions	17	23	19	32	31	37	39	31	35	33	51	60	40	7	455
Tier 3: 1 Invention each	46	33	48	55	37	49	57	54	54	54	56	55	64	12	674
Tier 4: Individuals	12	14	9	5	25	12	8	19	17	17	25	12	18	1	194

The top entities in this technology field show an interesting picture. **Lauridsen Group Inc** (United States) and **Toyobo KK** (Japan) have the highest numbers of patents related to this technology. Interestingly, none of these have been filed recently. Both entities have no patent activity occurring from 2009 onwards. Additionally, **Asahi Kasei Corporation** (Japan) also has none of its patent filing occurring recently. This entity has much few patents than those of the top filers however.

Tianjin Baodi Agriculture and Technology Co Ltd (China) and the **University Sun Yet-Sen** (China) both have 100% of the patent filings occurring since 2009, highlighting that these entities are both relatively new players in this technology.

Interestingly, the majority of the top entities in this technology field are based in Asia with the exception of **Lauridsen Group Inc** (United States), **Owen Holding Limited** (Great Britain) and the **US Department of Health and Human Services** (Unites States). This helps highlight that much of the innovation surrounding this technology from tier 1 entities has originated in Asia.

FILING STRATEGIES

The table below shows a partial list of the countries that tier 1 entities are interested in for patent protection. The complete list of countries can be viewed in the corresponding excel work sheet.

Tier 1 Entities – Geographic Protection Analysis

Tier 1 Entities	China	USA	PCT	Japan	EPO	Australia	Korea	Canada	Germany	India	Russian Federation	Spain	Mexico	Brazil	Singapore	Taiwan	Poland
LAURIDSEN GROUP INC		12	9		6	7			3			4	2	3			3
TOYOBO KK				13													
UNIV TIANJIN	11																
UNIV SHANGHAI JIAOTONG	10		1														
UNIV ZHEJIANG	10																
DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH		1	1	9		1											
TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	9																
UNIV JILIN	9																
UNIV NORTHEAST AGRIC	9																
FUJI FILM CORP	3	6	1	8	6		3									2	
MARUZEN PHARM CO LTD	1	1	1	8	1		1										
OWEN HOLDING LTD	1	4	5	1	6	2		1	1	3	1		1	1			
SHENYANG SIJIA TECHNOLOGY DEV CO LTD	8																
LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	7																
TIANJIN SHENGJI GROUP CO LTD	7																
UNIV SUN YET-SEN	7																
ASAHI KASEI CORPORATION	2	3	3	6	3	3	1	1		1			1				
CHINESE ACAD INSPECTION & QUARANTINE	6																
US DEPT HEALTH & HUMAN SERVICES		6	2			1		1									

Many tier 1 entities have a clear focus on the Chinese market alone. On further investigation it can be seen that all these entities with patent filings solely in China are Chinese originating entities. The **University of Tianjin, University of Zhejiang, Tianjin Baodi Agriculture and Technology Co Ltd, University of Jilin, University Northeast Agriculture, Shenyang Sijia Technology Development Co Ltd, Lanzhou Research Institute Veterinary Science Chinese Academy Agricultural Science, Tianjin Shengji Group Co Ltd, University Sun Yet-Sen** and the **Chinese Academy Inspection & Quarantine** all have 100% of their patent filings occurring in China. The **University Shanghai Jiaotong** has a filing strategy that heavily favors patent filing in China, however this entity also has one PCT patent filing. **Toyobo KK** (Japan) mirrors its Chinese counterparts by only filing its patents locally in Japan.

This shows that overall trend of many Asian originating entities is to protect their technology locally and to largely ignore overseas markets. Potential explanations for this could include that these entities only see a commercial opportunity in their home countries for their products / services or that because of such high competition in this technology locally, these entities only protect their technology here in order to compete within their own market.

Lauridsen Group Inc (United States), **Dokuritsu Gyosei Hojin Nogyu Siebutsu SH** (Japan), **Fuji Film Corporation** (Japan), **Maruzen Pharm Co Ltd** (Japan), **Owen Holding Limited** (Great Britain), **Asahi Kasei Corporation** (Japan) and the **US Department of Health and**

Human Services (Unites States) appear to have a boarder filing strategy for their technology as they have applied for patent protection in multiple countries.

Interestingly, this data implies that companies that originate outside of Asia (specifically the United States and Great Britain) and some larger Japanese corporate entities are perusing a more global commercialization strategy by filing patents in multiple countries. Chinese originating entities appear to prefer to file locally and are less concerned with commercializing their patent portfolio's by filing globally.

QUADLATERAL FILINGS

Geographic filing breadth is a measure of intent to commercialise. Quadlateral filing countries represent United States, Europe, China and Japan whereas trilateral filings represent the same countries with the exception of China.

Interestingly, only four of the tier 1 entities have trilaterial / quadlateral patent filings. **Fuji Film Corporation** (Japan) and **Asahi Kasei Corporation** (Japan) lead the field in quadlaterial patent filings. Interestingly, all of the China originating entities do not feature in the list. This data supports the previous statement that entities in this region (generally) only file patents locally and so far, have not been concerned with commercialisation globally.

Tier 1 Entities – Trilateral Vs Quadlateral Filings.

Tier 1 Entities	Trilateral Filings	Quadlateral Filings
FUJI FILM CORP	6	3
ASAHI KASEI CORPORATION	3	2
MARUZEN PHARM CO LTD	1	1
OWEN HOLDING LTD	1	1

STRENGTH ANALYSIS

A strength analysis can be performed in order to determine the quality and influence of IP. Quality and influence in patent portfolios can be measured by metrics including:

- Volume (number of inventions held)
- Remaining life (i.e. remaining patent term)
- Geographic filing breadth as a measure of intent to commercialise (in particular quadrilateral filings in US, EP, CN and JP)
- Grant success
- High technical breadth as an indicator of fundamental innovation
- Citation frequency statistics as a measure of impact in the field (older patents have more opportunity to be cited, so the statistic is adjusted to correct for patent age)

An overall strength score can be calculated based on these aggregated measurements. The strength score is a unit-less value that allows individual inventions or entire patent portfolios to be ranked relative to one another.

The table below lists a selection of the corporate entities in tier 1 that have the highest strength scores.

Ranking of Tier 1 Entities

Tier 1 Entity Rankings	Total Inventions	Average Remaining Life	Quad Filings	Novelty based on Grants	Average Family Citations	Average Age Weighted	Thomson Reuters IP Analytics
LAURIDSEN GROUP INC	15	8.7		12	4.4	0.4	2.8
TOYOBO KK	13	10.7		5	1.3	0.1	1.8
UNIV TIANJIN	11	14.7		1	0.2	0.0	1.7
UNIV SHANGHAI JIAOTONG	10	14.2		4	0.3	0.0	2.0
UNIV ZHEJIANG	10	15.0		7	1.0	0.2	2.5
DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	9	11.5		5	2.4	0.2	2.3
TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	9	16.9		2	0.1	0.0	2.1
UNIV JILIN	9	16.7		1	0.0	0.0	1.9
UNIV NORTHEAST AGRIC	9	16.4		3	0.1	0.0	2.1
FUJI FILM CORP	8	11.3	3	3	1.9	0.2	2.7
MARUZEN PHARM CO LTD	8	12.0	1	7	2.1	0.2	2.8
OWEN HOLDING LTD	8	11.7	1	4	0.8	0.1	2.3
SHENYANG SIJIA TECHNOLOGY DEV CO LTD	8	14.8		5	0.5	0.1	2.3
LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	7	16.1		1	0.0	0.0	1.9
TIANJIN SHENGJI GROUP CO LTD	7	14.4			0.1	0.0	1.6
UNIV SUN YET-SEN	7	17.8		3	0.0	0.0	2.4
ASAHI KASEI CORPORATION	6	8.8	2	3	2.0	0.2	2.6
CHINESE ACAD INSPECTION & QUARANTINE	6	15.4		4	0.3	0.1	2.4
US DEPT HEALTH & HUMAN SERVICES	6	11.5		2	1.3	0.1	1.9

- **Lauridsen Group Inc** (United States) has the equal top strength score (2.8) of all tier 1 entities. This is due to a high novelty based on grant (12) and a high average of patent family citations (4.4).
- **Maruzen Pharmaceutical Co Ltd** (Japan) also has a strength score of 2.8 due its relatively high remaining patent life (12 years), one quadlateral filing and a moderate average of patent family citations (2.1)

Interestingly, there are no real stand-out tier 1 entities for this technology. Most have a strength score hovering around the 2.0 mark. This is mostly due to many entities having a moderately high remaining patent life, little to no quadlateral patent filings and the majority of entities having small values of average family citations for each of its patented inventions.

TECHNICAL BREADTH

Another indicator of patent quality is the breadth of technology each patent covers. Patents covering a broader technical range have a higher chance of being infringed or required for licensing by a third party – thus increasing the value of the patent.

Technical breadth was measured using the technical classifications in this report. A full breakdown of technical breadth for all tier 1 entities is show below.

Tier 1 Entities – Technical Breadth

Tier 1 Entity	Average of Technical Breadth (Based on Technical Categories)	Total Inventions
LAURIDSEN GROUP INC	9.5	15
TOYOBO KK	3.2	13
UNIV TIANJIN	9.3	11
UNIV SHANGHAI JIAOTONG	6.0	10
UNIV ZHEJIANG	8.7	10
DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	7.3	9
TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	10.8	9
UNIV JILIN	8.4	9
UNIV NORTHEAST AGRIC	10.3	9
FUJI FILM CORP	5.0	8
MARUZEN PHARM CO LTD	4.4	8
OWEN HOLDING LTD	8.3	8
SHENYANG SIJIA TECHNOLOGY DEV CO LTD	7.9	8
LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	6.4	7
TIANJIN SHENGJI GROUP CO LTD	9.6	7
UNIV SUN YET-SEN	5.0	7
ASAHI KASEI CORPORATION	6.0	6
CHINESE ACAD INSPECTION & QUARANTINE	7.0	6
US DEPT HEALTH & HUMAN SERVICES	7.5	6

Tianjin Baodi Agriculture Technology Co Ltd (China) and **University Northeast Agriculture** (China) have the highest technical breadth (on average) related to their patent portfolio's. This means that their inventions cover a broad number of technical categories that are highlighted in this report. **Toyobo KK** (Japan) and **Maruzen Pharm Co Ltd** (Japan) are both shown to have the lowest average technical breadth associated with their patent portfolios. This means that these entities appear to have more focus on specific technical areas of this technology field rather than the broader technology field as a whole.

GRANT SUCCESS

Success according to this report is determined by measuring the patent grant to patent application ratio. Basically, if one member of a patent family had achieved grant anywhere following substantive examination, that invention is considered a “success”.

Thomson Reuters believes that the total number of “successful” inventions as a function of the total number of inventions lodged in the patent system gives a greater picture of innovation that patent volumes alone. When considering this metric, it should be borne in mind that there is a bias against younger patent portfolios because they have had less time to become successful.

Grant success for all tier 1 entities is shown below. The **Maruzen Pharm Co Ltd** (Japan) is by far the most successful, with 88% of its patent families containing patents that have been granted. Entities with more global patent filing strategies including **Lauridsen Group Inc** (80%), **Fuji Film** (38%), **Owen Holding Ltd** (50%) and **Asahi Kasei Corporation** (50%) have all experienced different levels of grant success. Interestingly, **Tianjin Shengji Group Co Ltd** (China) has none (0%) of its patented inventions granted. All patents associated with this entity have just been filed in China, no other patent filings worldwide have been achieved or observed.

Tier 1 Entities – Grant Success

Tier 1 Entity	Grants	Apps	Total	% Granted
LAURIDSEN GROUP INC	12	3	15	80%
TOYOBO KK	5	8	13	38%
UNIV TIANJIN	1	10	11	9%
UNIV SHANGHAI JIAOTONG	4	6	10	40%
UNIV ZHEJIANG	7	3	10	70%
DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	5	4	9	56%
TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	2	7	9	22%
UNIV JILIN	1	8	9	11%
UNIV NORTHEAST AGRIC	3	6	9	33%
FUJI FILM CORP	3	5	8	38%
MARUZEN PHARM CO LTD	7	1	8	88%
OWEN HOLDING LTD	4	4	8	50%
SHENYANG SIJIA TECHNOLOGY DEV CO LTD	5	3	8	63%
LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	1	6	7	14%
TIANJIN SHENGJI GROUP CO LTD		7	7	0%
UNIV SUN YET-SEN	3	4	7	43%
ASAHI KASEI CORPORATION	3	3	6	50%
CHINESE ACAD INSPECTION & QUARANTINE	4	2	6	67%
US DEPT HEALTH & HUMAN SERVICES	2	4	6	33%

TIER 2 ENTITIES (2 TO 5 INVENTIONS)

The table below lists the top entities in tier 2 of the collection. There are total of 173 entities that fit the criteria of between 2 and 5 inventions. Only the top entities are shown. The full list can be viewed in the corresponding excel work sheet.

Tier 2 Entities – Timeline

Tier 2 Entities	Total Inventions
AIMSCO LIMITED	5
BAXTER AG	5
CAMBRIDGE SCIENTIFIC PTY LTD	5
DELISI GROUP CO LTD	5
MITSUBISHI CHEM CORP	5
MORINAGA & CO LTD	5
TORAY IND INC	5
UNIV CHINA AGRIC	5
UNIV HUNAN	5
UNIV SICHUAN	5
UNIV SOUTH CHINA NORMAL	5
BEIJING AGRIC&FORESTRY SCI ACAD	4
BIO SPECTRUM INC	4
CHINESE ACAD SCI DALIAN CHEM PHYS INST	4
COUNCIL SCI & IND RES INDIA	4
KAO CORP	4
KOSE KK	4
PEPSICO INC	4
SAMSUNG ELECTRONICS CO LTD	4
SNU R & DB FOUND	4
SYSMEX CORP	4
UNIV CALIFORNIA	4
UNIV CHINA OCEAN	4
UNIV GUIZHOU	4
UNIV HUAZHONG AGRIC	4
UNIV JIANGNAN	4
UNIV KONKUK IND COOP CORP	4

There are many tier 2 entities that share the title of top tier 2 entity based on patent filings. These include **Aimsco Limited** (Great Britain), **Baxter AG** (United States), **Cambridge Scientific Pty Ltd** (Australia), **Delisi Group Co Ltd** (China), **Mitsubishi Chemical Corporation** (Japan), **Morinaga & Co Ltd** (Japan) **Toray Industries Inc** (Japan), **University China Agriculture** (China), **University Hunan** (China), **University Sichuan** (China) and the **University South China Normal** (China).

FILING STRATEGIES

The table below shows a partial list of the countries that the top tier 2 entities are interested in for patent protection. The table is sorted based on the most prominent filing country based on patent activity.

Tier 2 Entities – Geographic Protection Analysis

Tier 2 Entities	China	USA	PCT	Japan	EPO	Australia	Korea	Canada	Germany	India	Russian Federation	Spain	Mexico	Brazil	South Africa	Singapore	New Zealand	Taiwan	Hong Kong	Israel	France	United Kingdom	Norway	Vietnam	Philippines	Poland	Czech Republic	Hungary	Belgium	Slovakia	Romania
AIMSCO LIMITED	3	3	5	3	3	3	2	2	3	3		3	3	3	3	2	3		2	3					2	1		1			
BAXTER AG	1	3	4	3	3	3	1	1					1			1		1	1				1								
CAMBRIDGE SCIENTIFIC PTY LTD		5	4	1	4	4		3		4					3		4		1												
DELISI GROUP CO LTD	5																														
MITSUBISHI CHEM CORP	2	2	1	4	2				1																						
MORINAGA & CO LTD				5																											
TORAY IND INC	1	1	1	5	1		1	1																							
UNIV CHINA AGRIC	5																														
UNIV HUNAN	5																														
UNIV SICHUAN	5																														
UNIV SOUTH CHINA NORMAL	5																														
BEIJING AGRIC&FORESTRY SCI ACAD	4																														
BIO SPECTRUM INC							4																								
CHINESE ACAD SCI DALIAN CHEM PHYS INST	4																														
COUNCIL SCI & IND RES INDIA	1	2	2	1	1	2		1		1						1		1													
KAO CORP		1		4	1																										
KOSE KK				4																											
PEPSICO INC	2	4	4		2	3	2				1																				
SAMSUNG ELECTRONICS CO LTD		1	1	1			4	1								1															
SNU R & DB FOUND		1	2				4																								
SYSMEX CORP	2	4		4	1				1																						
UNIV CALIFORNIA		4	4	1	4	1																									
UNIV CHINA OCEAN	4		1																												
UNIV GUIZHOU	4																														
UNIV HUAZHONG AGRIC	4																														
UNIV JIANGNAN	4																														
UNIV KONKUK IND COOP CORP			1	1	1		4		1																						

Tier 2 entities such as **Aimsco Limited** (Great Britain), **Baxter AG** (United States), **Cambridge Scientific Pty Ltd** (Australia) exhibit a broad worldwide patent filing strategy indicated by the large filing breadth shown in different countries. This helps highlight the high level of investment that these entities have committed to their patents in order to commercialise their portfolios.

Other entities such as **Delisi Group Co Ltd** (China), **Morinaga & Co Ltd** (Japan), **University China Agriculture** (China), **University Hunan** (China), **University Sichuan** (China) and the **University South China Normal** (China) all have a more narrow patent filing strategy. These entities have only filed in their home jurisdictions i.e. China or Japan. No other patent applications anywhere around the world have been filed by these entities in this technology field. One potential explanation for this could include that these entities' primary business focus is their own country and therefore they do not see a need to protect their inventions anywhere else.

STRENGTH

The table below lists a selection of the top corporate entities in tier 2 based on number of total inventions. The complete list can be viewed in the corresponding excel work file.

Ranking of Tier 2 Entities

Tier 2 Entity Rankings	Total Inventions	Average Remaining Life	Quad Filings	Novelty based on Grants	Average Family Citations	Average Age Weighted Citation Impact	Thomson Reuters IP Analytics Strength Index
AIMSCO LIMITED	5	10.4	3	3	5.8	0.5	4.7
BAXTER AG	5	9.4	1	3	5.0	0.6	3.2
CAMBRIDGE SCIENTIFIC PTY LTD	5	11.6		5	2.2	0.2	3.4
DELISI GROUP CO LTD	5	16.6		3	0.2	0.0	2.4
MITSUBISHI CHEM CORP	5	11.7	2	2	2.2	0.2	2.7
MORINAGA & CO LTD	5	9.8		2	2.6	0.3	2.0
TORAY IND INC	5	9.6	1	3	0.6	0.1	2.2
UNIV CHINA AGRIC	5	16.3		5	0.4	0.1	2.9
UNIV HUNAN	5	16.5		4	0.2	0.0	2.6
UNIV SICHUAN	5	15.8		1	0.2	0.0	2.0
UNIV SOUTH CHINA NORMAL	5	16.3		1	0.4	0.1	2.1
BEIJING AGRIC&FORESTRY SCI ACAD	4	16.5		2	0.3	0.0	2.3
BIO SPECTRUM INC	4	17.5		4	0.3	0.1	3.0
CHINESE ACAD SCI DALIAN CHEM PHYS INST	4	14.9		3	0.0	0.0	2.4
COUNCIL SCI & IND RES INDIA	4	8.9		1	1.0	0.1	1.7
KAO CORP	4	11.5		2	4.0	0.4	2.6
KOSE KK	4	9.9		2	3.0	0.3	2.2
PEPSICO INC	4	15.5		2	2.5	0.4	3.0
SAMSUNG ELECTRONICS CO LTD	4	15.6		2	0.3	0.2	2.4
SNU R & DB FOUND	4	17.1		2	0.0	0.0	2.4
SYSMEX CORP	4	12.3	1	3	0.3	0.0	2.7
UNIV CALIFORNIA	4	11.1		2	2.3	0.2	2.4
UNIV CHINA OCEAN	4	15.0		2	0.5	0.1	2.2
UNIV GUIZHOU	4	17.4		0	0.0	0.0	1.9
UNIV HUAZHONG AGRIC	4	13.8		2	1.3	0.1	2.2
UNIV JIANGNAN	4	16.6		1	0.3	0.0	2.1
UNIV KONKUK IND COOP CORP	4	14.8		4	1.0	0.2	2.9

Aimsco Limited (Great Britain) has an IP Analytics score of 4.7 due to high average family citations (5.8) and high number of quadlateral filings (when compared to other tier 2 entities). In contrast, the **Council Scientific and Industrial Research India** (India) has one of the lowest strength index values in the above list with a score of 1.7. This is due to having no quadlateral filings, low average remaining patent life and low average family citations (1.0)

Interestingly, most Chinese based entities have received a relatively low Thomson Reuters IP analytics score. Reasons for this include few quadlateral filings and few average family citations. This highlights that patent portfolios originating from China, generally are of less strength and potentially less novel than those from other jurisdictions such as the North America and Europe.

QUADLATERAL FILINGS

Geographic filing breadth represents a measure of intent to commercialise. Quadlateral filing countries represent United States, Europe, China and Japan.

Aimsco Limited (Great Britain) is the stand out performer here with a substantial proportion of their patent portfolio filed in at least the United States, Europe, China and Japan. **DSM IP Assets BV** (Netherlands) is also another strong strong quadlateral performer.

Tier 2 Entities – Quadlateral Filings

Tier 2 Entities	Quadlateral Filings
AIMSCO LIMITED	3
DSM IP ASSETS BV	3
MITSUBISHI CHEM CORP	2
ARKRAY INC	2
BAXTER AG	1
TORAY IND INC	1
SYSMEX CORP	1
UNIV SEOUL NAT HOSPITAL	1
AJINOMOTO CO INC	1
BIO-RAD INNOVATIONS	1
BIOMASTER INC	1
GRADIPORE LTD	1
HANMI PHARM CO LTD	1
IKOR INC.	1
LAB FR DU FRACTIONNEMENT & BIOTECHNOLO(	1
NESTEC SA	1
NOVO NORDISK AS	1
PFIZER INC	1
RES DEV FOUND	1
TURZI ANTOINE	1
UK SEC FOR DEFENCE	1
UNIV PUTRA MALAYSIA	1

TECHNICAL BREDTH

A breakdown of technical filing breadth for the top tier 2 entities (based on total inventions) is show below. Patent portfolios of potential interest include those who have a high average technical breadth based on the technical categories for this technology. The complete list for all tier 2 entities is located in the corresponding excel work sheet. **Cambridge Scientific Pty Ltd** (Australia) is the stand out performer of the tier 2 entities shown.

Tier 2 Entities – Technical Breadth Vs Filing Breadth

Tier 2 Entity	Average of Technical Breadth (Based on Technical Categories)	Total Inventions
AIMSCO LIMITED	8.0	5
BAXTER AG	7.4	5
CAMBRIDGE SCIENTIFIC PTY LTD	12.8	5
DELISI GROUP CO LTD	7.6	5
MITSUBISHI CHEM CORP	6.2	5
MORINAGA & CO LTD	5.2	5
TORAY IND INC	5.4	5
UNIV CHINA AGRIC	7.0	5
UNIV HUNAN	8.4	5
UNIV SICHUAN	7.0	5
UNIV SOUTH CHINA NORMAL	7.0	5
BEIJING AGRIC&FORESTRY SCI ACAD	7.0	4
BIO SPECTRUM INC	4.5	4
CHINESE ACAD SCI DALIAN CHEM PHYS INST	8.0	4
COUNCIL SCI & IND RES INDIA	6.0	4
KAO CORP	5.0	4
KOSE KK	5.0	4
PEPSICO INC	7.0	4
SAMSUNG ELECTRONICS CO LTD	6.8	4
SNU R & DB FOUND	5.3	4
SYSMEX CORP	4.8	4
UNIV CALIFORNIA	5.8	4
UNIV CHINA OCEAN	8.3	4
UNIV GUIZHOU	9.8	4
UNIV HUAZHONG AGRIC	2.3	4
UNIV JIANGNAN	6.8	4
UNIV KONKUK IND COOP CORP	4.5	4

ACADEMIC AND GOVERNMENT ENTITIES (all tiers)

The following table highlights the top academic and government entities across all entity tiers of the patent data. Academic and government entities comprise 35% of all patent data associated with this technology. This shows that corporate entities (comprising 52% of the patent data) have a high interest in this technology and in general, have invested heavily in it. The **University Tianjin** (China) is the stand out performer for the academic and government sector.

Academic & Government Entities (all tiers)

Academic and Government Entities	Inventions
UNIV TIANJIN	11
UNIV SHANGHAI JIAOTONG	10
UNIV ZHEJIANG	10
UNIV JILIN	9
UNIV NORTHEAST AGRIC	9
LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	7
UNIV SUN YET-SEN	7
CHINESE ACAD INSPECTION & QUARANTINE	6
US DEPT HEALTH & HUMAN SERVICES	6
UNIV CHINA AGRIC	5
UNIV HUNAN	5
UNIV SICHUAN	5
UNIV SOUTH CHINA NORMAL	5
SNU R & DB FOUND	4
UNIV HUAZHONG AGRIC	4
UNIV CALIFORNIA	4
UNIV KONKUK IND COOP CORP	4
UNIV JIANGNAN	4
UNIV GUIZHOU	4
BEIJING AGRIC&FORESTRY SCI ACAD	4
UNIV CHINA OCEAN	4
CHINESE ACAD SCI DALIAN CHEM PHYS INST	4
COUNCIL SCI & IND RES INDIA	4

TIER 3 ENTITIES (1 INVENTION) AND INDIVIDUALS

Due to the small number of patents associated with tier 3 entities and Individuals in the data set, constructing meaningful patent metrics around such small patent numbers is difficult and has not been undertaken. The patent records associated with these entities and individuals can be viewed in the accompanying ‘raw’ data with this report.

PATENT TECHNICAL ANALYSIS

This chapter of the report focuses on the technical attributes of the inventions in the collection. The patent documents in the collection were aggregated into the following technical categories.

Taxonomy – Technology Categories

Technical Categories			Inventions
01 Animals		01.01 Cat / Feline	73
		01.02 Dogs / Canine	96
		01.03 Duck	41
		01.04 Turkey	10
		01.05 Chicken	104
		01.06 Pig / Porcine / Swine	316
		01.07 Sheep	168
		01.08 Goat	128
		01.09 Buffalo / Ox / Cow / Bovine	641
		01.10 Camel	5
		01.11 Deer / Cervidae	58
		01.12 Horse	105
		01.13 Rabbit	138
		01.14 Other Animals	423
02 Blood Components		02.01 Erythrocyte	162
		02.02 Leukocytes	150
		02.03 Platelets	89
		02.04 Plasma	160
		02.05 Whole Blood	385
		02.06 Serum	376
03 Process		03.01 Collection / Extraction	395
		03.02 Transportation	59
		03.03 Anticoagulation	134
		03.04 Homogenization	34
		03.05 Inspection	21
		03.06 Separation	262
		03.07 Centrifugation	394
		03.08 Cooling	130
		03.09 Freezing	228
		03.10 Heating - Temperature Regulation	178
	03.11 Filtration	03.11.01 Ultra-filtration Membrane Processing	85
		03.11.02 Nanofiltration Membrane Processing	13
		03.11.03 Microfilteration Membrane Processing	17
		03.11.04 Membrane Filtration in General	16
		03.11.05 Reverse Osmosis	7
	03.12 Drying	03.12.01 Spray Drying	60
		03.12.02 Other Drying Methods	245
		03.13 Decoloration Process	26
		03.14 Preservation / Storage	289
		03.15 Sterilization	228

04 Bioactives	04.01 Proteins	04.01.01 Plasma Proteins	218
		04.01.02 Serum	344
		04.01.03 Immunoglobulin	442
		04.01.04 Fibrinogen	51
		04.01.05 Albumin	322
		04.01.06 Lipoproteins	45
		04.01.07 C-reactive Protein	4
		04.01.08 Transferrin	113
		04.01.09 Globulin	66
		04.01.10 Hemoglobin	11
		04.01.11 Haptoglobin	2
		04.01.12 Glycoprotein	61
		04.01.13 Prothrombin	1
		04.01.14 Plasminogen	19
		04.01.15 Interferon	38
		04.01.16 Proteins in General	143
	04.02 Enzymes	04.02.01 Transglutaminase	7
		04.02.02 Superoxide Dismutase	19
		04.02.03 Thrombin	45
		04.02.04 Catalase	5
		04.02.05 Chloramphenicol Acetyltransferase	2
		04.02.06 Enzymes in General	401
		04.03 Opioid	10
		04.04 Fatty Acids	70
		04.05 Lipids	75
		04.06 Oligosaccharides / Polysaccharides	53
		04.07 Antioxidants	52
		04.08 Antimicrobials	190
		04.09 Growth Stimulating	12
		04.10 Mineral Binding Peptides	2
		04.11 Heme Iron	8
		04.12 Other Bioactives	25
05 Applications	05.01 Food / Beverages	05.01.01 Color Enhancement	4
		05.01.02 Emulsifier	15
		05.01.03 Fat Replacer	1
		05.01.04 Curing Agent	11
		05.01.05 Binder	15
		05.01.06 Food In General	320
		05.02 Animal Feed	41
		05.03 Aquaculture	4
		05.04 Nutraceuticals	31
		05.05 Fertilizers	31
		05.06 Cosmetics	66
		05.07 Laboratory Research / Testing	256
		05.08 General Health Care	17
		05.09 Pharmaceutical	451
		05.10 Biopolymers	3

The technical categories are not mutually exclusive – multiple categories can be applied to a single invention if warranted. The technical categorisation is performed using keywords and various patent classifications (IPC, CPC, ECLA, and Derwent Manual Codes) to separate the patent documents in the collection into groups.

Breaking the technology categories down broadly, bioactive and co-products technology of animal blood involving ‘buffalo / ox / cow / bovine’ was the most populated technology category. Technology involving ‘pig / porcine / swine’ was the next most populated category in relation to the specific animal utilized.

Patent technology directed to 'whole blood' and 'serum [1]' were the most populated categories in relation to specific blood components. In terms of the process for the extraction and analysis of animal blood, 'collection and extraction' and 'centrifugation' technology shows the highest patent activity.

The most active technology areas in relation to the specific bioactives involving proteins include 'immunoglobulins' and 'albumin'. Technology associated with 'enzymes in general' and 'antimicrobials' also were highly represented. High filing activity associated with the actual application of animal blood technology included 'food in general', 'laboratory research / testing' and 'pharmaceutical' uses.

TIMELINE

The table below shows the timelines of filing activity for all entities together with the percentage filed since 2009.

Technology Category Timeline and Technology Category Growth Rate

		Technical Categories	00	01	02	03	04	05	06	07	08	09	10	11	12	13	Average Annual Growth Rate (2001-2011)	% Filed from 2009
01 Animals		01.01 Cat / Feline	4	3	7	10	4	12	8	8	4	4	2	3	3	1	0%	18%
		01.02 Dogs / Canine	4	4	8	7	11	11	13	9	6	4	7	7	3	2	6%	24%
		01.03 Duck		2	2	1		4	3	4	4	1	9	2	7	2	0%	51%
		01.04 Turkey	1	1				2	1	2	1		1	1			0%	20%
		01.05 Chicken	3	7	8	3	3	12	7	7	15	7	9	9	12	2	3%	38%
		01.06 Pig / Porcine / Swine	16	14	19	16	22	15	22	15	36	26	37	32	39	7	9%	45%
		01.07 Sheep	10	11	11	11	9	16	16	13	17	11	15	12	9	7	1%	32%
		01.08 Goat	5	5	5	8	10	10	6	6	9	13	23	16	9	3	12%	50%
		01.09 Buffalo / Ox / Cow / Bovine	34	20	35	51	52	55	49	42	64	54	55	69	49	12	13%	37%
		01.10 Camel	1			1			1	1		1					NA	20%
		01.11 Deer / Cervidae	1	3	1	4	5	3	3	6	6	5	4	7	9	1	9%	45%
		01.12 Horse	4	2	8	8	8	8	10	2	5	14	8	14	9	5	21%	48%
		01.13 Rabbit	6	6	6	6	5	4	10	12	15	14	19	15	16	4	10%	49%
		01.14 Other Animals	28	35	28	32	39	29	41	34	24	34	41	27	29	2	-3%	31%
02 Blood Components		02.01 Erythrocyte	8	12	15	11	15	10	11	16	17	9	12	12	13	1	0%	29%
		02.02 Leukocytes	11	10	11	7	20	8	13	15	8	11	9	10	16	1	0%	31%
		02.03 Platelets	12	7	5	6	9	7	9	8	7	6	4	6	3		-2%	21%
		02.04 Plasma	20	12	10	11	18	12	17	14	11	10	13	6	5	1	-7%	22%
		02.05 Whole Blood	23	18	19	25	39	23	26	23	37	37	45	33	27	10	6%	39%
		02.06 Serum	19	20	22	21	24	34	27	27	41	30	36	39	31	5	7%	38%
03 Process		03.01 Collection / Extraction	15	20	18	24	27	26	23	30	33	38	51	39	45	6	7%	45%
		03.02 Transportation		3	3	6	6	4	5	4	6	6	5	6	3	2	7%	37%
		03.03 Anticoagulation	8	2	4	7	8	6	9	9	16	5	24	17	17	2	24%	49%
		03.04 Homogenization	2	2	2	1	2	2	2	3	2	7	3	2	3	1	0%	47%
		03.05 Inspection				1		2	1		4	1	1	3	7	1	NA	62%
		03.06 Separation	14	13	13	18	17	14	19	14	28	24	25	29	31	3	8%	43%
		03.07 Centrifugation	12	14	21	22	20	21	17	27	36	45	57	45	48	9	12%	52%
		03.08 Cooling	6	5	5	2	6	6	5	11	12	13	21	11	18	9	8%	55%
		03.09 Freezing	6	4	9	12	14	17	8	18	23	21	34	32	26	4	23%	51%
		03.10 Heating - Temperature Regulation	6	6	9	9	10	14	7	15	14	15	17	20	30	6	13%	49%
		03.11.01 Ultra-filtration Membrane Processing	4	3	3	2	10	8	6	2	9	2	9	10	16	1	13%	45%
	03.11 Filtration	03.11.02 Nanofiltration Membrane Processing				1	1	1	1		1	1	1	3	2	1	NA	62%
		03.11.03 Microfilteration Membrane Processing		1			2	1			5	2	2	1	3		0%	47%
		03.11.04 Membrane Filtration in General					3		1			2	4	1	5		NA	75%
		03.11.05 Reverse Osmosis					2	1	1						3		NA	43%
	03.12 Drying	03.12.01 Spray Drying	2	3	7	5	4	3	1		3	3	8	10	9	2	13%	53%
		03.12.02 Other Drying Methods	8	12	5	7	18	9	13	26	25	29	32	23	31	7	7%	50%
		03.13 Decoloration Process	1				1	5	1	2	3	2	2	2	6	1	NA	50%
		03.14 Preservation / Storage	7	10	10	14	10	13	17	22	33	37	44	36	31	5	14%	53%
		03.15 Sterilization	5	12	14	12	17	20	16	10	27	22	17	28	21	7	9%	42%

[1] 'Serum' associated technology is represented in both the 'blood components' and 'bioactives' technology categories as it was found to be prominent when referred to in each category's context.

		Technical Categories	00	01	02	03	04	05	06	07	08	09	10	11	12	13	Average Annual Growth Rate (2001-2011)	% Filed from 2009
04 Bioactives	04.01 Proteins	04.01.01 Plasma Proteins	9	12	9	11	12	22	9	23	18	11	28	29	23	2	9%	43%
		04.01.02 Serum	15	18	19	17	19	28	25	27	39	29	36	39	29	4	8%	40%
		04.01.03 Immunoglobulin	23	22	30	27	26	32	27	30	47	42	45	46	39	6	8%	40%
		04.01.04 Fibrinogen	3	2	3	1	5	3	6	5	6	2	5	7	2	1	13%	33%
		04.01.05 Albumin	13	10	14	33	22	24	14	24	24	30	35	39	35	5	15%	45%
		04.01.06 Lipoproteins	5	2	5	9	1	2	5	3	6	3		3	1		4%	16%
		04.01.07 C-reactive Protein	1							1			2				NA	50%
		04.01.08 Transferrin	5	3	5	10	8	2	9	6	7	13	10	17	13	5	19%	51%
		04.01.09 Globulin	2	2	2	2	7	3	2	3	9	6	9	10	9		17%	52%
		04.01.10 Hemoglobin	1	1	3				2		1		1		2		-100%	27%
		04.01.11 Haptoglobin								1					1		NA	50%
		04.01.12 Glycoprotein	4	2	3	5	3	5	5	7	7	4	4	6	6		12%	33%
		04.01.13 Prothrombin		1													-100%	0%
		04.01.14 Plasminogen	4	2	1			3	3	2	1	1	1	1			-7%	16%
		04.01.15 Interferon	6	3	3	2	3	2	3	5	4	1	2	1	3		-10%	18%
		04.01.16 Proteins in General	8	11	7	12	16	9	12	6	9	13	17	7	13	3	-4%	37%
	04.02 Enzymes	04.02.01 Transglutaminase		1			1	1			3		1				-100%	14%
		04.02.02 Superoxide Dismutase	2	1	2	1	1		2	3	3	1	1		2		-100%	21%
		04.02.03 Thrombin	4	3	2	1	4	5	6	6	2		5	4	2	1	3%	27%
		04.02.04 Catalase			2				1		1			1			NA	20%
		04.02.05 Chloramphenicol Acetyltransferase			1					1							NA	0%
		04.02.06 Enzymes in General	17	14	15	32	19	22	25	29	41	44	42	47	47	7	13%	47%
		04.03 Opioid	1	1		1	2	1		2	2						-100%	0%
		04.04 Fatty Acids	2	6	7	9	3	8	2	4	4	11	4	6	3	1	0%	36%
		04.05 Lipids	11	7	5	10	5	5	9		3	8	2	6	4		-2%	27%
		04.06 Oligosaccharides / Polysaccharides	6	3	1	9	3	1	2	1	11	5	1	5	4	1	5%	30%
		04.07 Antioxidants	3	2	7	2	3	3	5	5	4	4	3	5	6		10%	35%
		04.08 Antimicrobials	15	15	16	14	13	13	17	13	25	12	12	10	13	2	-4%	26%
		04.09 Growth Stimulating		1	1	2	1		1	1	1			2	2		7%	33%
		04.10 Mineral Binding Peptides					1				1						NA	0%
		04.11 Heme Iron				1					1	1	2		3		NA	75%
		04.12 Other Bioactives	2	1	1		3	2	2	3	3	3		2	2	1	7%	32%
05 Applications	05.01 Food / Beverages	05.01.01 Color Enhancement			1	2				1							NA	0%
		05.01.02 Emulsifier								4	3	1	3	1	3		NA	53%
		05.01.03 Fat Replacer								1							NA	0%
		05.01.04 Curing Agent			1				1	2	3		2	1	1		NA	36%
		05.01.05 Binder				1	2	4		1	3	2	1	1			NA	27%
		05.01.06 Food In General	17	16	18	28	21	21	19	22	26	27	34	39	29	3	9%	41%
		05.02 Animal Feed	3	4	3	4	5	2	4			2	5	4	4	1	0%	39%
		05.03 Aquaculture	1			1						1	1				NA	50%
		05.04 Nutraceuticals	3	3	1	4	4	2	2	2	2	4	1	3			0%	26%
		05.05 Fertilizers	1	2		1		3	3	1	4	4	2	4	3	3	7%	52%
		05.06 Cosmetics	3	1	4	7	7	10	5	4	3	4	5	7	5	1	21%	33%
		05.07 Laboratory Research / Testing	19	15	21	20	23	21	21	19	20	27	20	20	9	1	3%	30%
		05.08 General Health Care		1		1	2	1	1		4	4	1	1	1		0%	41%
		05.09 Pharmaceutical	31	32	34	38	37	45	38	30	35	39	37	25	26	4	-2%	29%
		05.10 Biopolymers			2		1										NA	0%

75% of the ‘membrane filtration’ process has been filed since 2009. Additionally, 75% of the ‘heme iron’ bioactives have also been filed since 2009. These two categories have the highest % of recently filed patents in all technology areas. Many technologies have witnessed no recent patent activity. These categories are identified in the above table by having 0% growth recorded since 2009. include patents related to ‘prothrombin’, ‘chloramphenicol acetyltransferase’, ‘opiods’, ‘mineral binding peptides’, applications related to ‘colour enhancement’ and ‘fat replacers’ in food and finally use as a ‘biopolymer’.

The table above also highlights the annual growth rate for each technology field over the 2001 – 2011 periods. Technology related to ‘anticoagulation’ (24%) and ‘freezing’ (23%) process showed the highest growth of all the technology categories. Utilizing bioactives and co-products in animal blood for use in ‘cosmetic’ applications also observed a high growth rate (21%). In contrast, bioactive technology involving ‘heamoglobin’, ‘prothrombin’, ‘tranglutaminase’, ‘superoxide dimutase’ and ‘opioids’ have shown the largest decrease in activity (100%) of all technology categories in the patent dataset. Categories represented by N/A (not available) show categories in which the activity was too low in order to obtain a meaningful result.

TIER 1 – TECHNICAL CATEGORISATION

The table below shows the technology categorisation of all patent portfolios of tier 1 entities. Totals that are highlighted in a 'darker' shade of blue reveal entities which have high activity in a technical category. For example, **Lauridsen Group Inc** (United States) has the highest activity recorded in using 'pig / porcine / swine' blood technology (13 inventions). Categories shown in the table that are blank have no results. For example, none of the top tier entities have inventions related to 'reverse osmosis' filtration technology.

Tier 1 Entities by Technical Category

		Technical Categories	LAURIDSEN GROUP INC	TOYOBO KK	UNIV TIANJIN	UNIV SHANGHAI JIAOTONG	UNIV ZHEJIANG	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	UNIV JILIN	UNIV NORTHEAST AGRIC	FUJI FILM CORP	MARUZEN PHARM CO LTD	OWEN HOLDING LTD	SHENYANG SUJIA TECHNOLOGY DEV CO LTD	LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	TIANJIN SHENGJI GROUP CO LTD	UNIV SUN YET-SEN	ASAHI KASEI CORPORATION	CHINESE ACAD INSPECTION & QUARANTINE	US DEPT HEALTH & HUMAN SERVICES
01 Animals		01.01 Cat / Feline	1			1		2													1
		01.02 Dogs / Canine	1					2									1				1
		01.03 Duck	1				1		2					2		1					1
		01.04 Turkey	1											1							
		01.05 Chicken	3			1	2	3	3		1		1	5			2				1
		01.06 Pig / Porcine / Swine	13		1	3	2	5	6	6	7				7	2	3				1
		01.07 Sheep	1		1	1		5	2			1				3	1				
		01.08 Goat						5			1	1				2				4	1
		01.09 Buffalo / Ox / Cow / Bovine	9	10	7	6	5	3	1	3	3	1	8		6	2	5	2	3	2	5
		01.10 Camel																			
		01.11 Deer / Cervidae				2		4		2											
		01.12 Horse	1		3	2		3			1	1		1		2		3			1
		01.13 Rabbit			8	2	1	1		2	3					3				3	1
		01.14 Other Animals	2	3			1	3	3			6		2				2	3	1	1
02 Blood Components		02.01 Erythrocyte	2		1	2	1				1										1
		02.02 Leukocytes	1			1	2	1		1							3	1	2		1
		02.03 Platelets		2		1	1						2						1		2
		02.04 Plasma	12				1	1	1		1	1							3	1	1
		02.05 Whole Blood	5	8	3	3	3	1	1	1	3	3			4	4	4		3		3
		02.06 Serum	4			2	2	1		1	4	3		8		3	3		1	4	3
03 Process		03.01 Collection / Extraction	3		7	2	3	3	5		3	3		1	3	4	4		1	1	1
		03.02 Transportation	1																		
		03.03 Anticoagulation			2		3		7	2	1						3				1
		03.04 Homogenization							1		1				3						
		03.05 Inspection				1			1												
		03.06 Separation	4	3	7	1	2	1	7	3	1	2		2			3		2	1	
		03.07 Centrifugation	1		10	4	7		7	8	5			2	2	1	3	2	1	1	
		03.08 Cooling			1	1	3	1	2	2	2				1					1	
		03.09 Freezing	1		4	2	3		4	3	5		2	1	5			1			1
		03.10 Heating – Temperature Regulation	1				4	1	3	2	3				1				1	2	
	03.11 Filtration	03.11.01 Ultra-filtration Membrane Processing			1				1						5						
		03.11.02 Nanofiltration Membrane Processing							1												
		03.11.03 Microfilteration Membrane Processing					1			1	1										
		03.11.04 Membrane Filtration in General		1						1											
		03.11.05 Reverse Osmosis																			
	03.12 Drying	03.12.01 Spray Drying	10						5	1	1				1			2			
		03.12.02 Other Drying Methods		1	6	2	3		2	1	5		1	1	2	1		1	1		
		03.13 Decoloration Process					2		3		1										
		03.14 Preservation / Storage			4	1	5	2	1	2	2			7	1		3			2	
		03.15 Sterilization		1		1	2		2	1	3	1		8	5	1	4		2		

		Technical Categories	LAURIDSEN GROUP INC	TOYOBO KK	UNIV TIANJIN	UNIV SHANGHAI JIAOTONG	UNIV ZHEJIANG	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	UNIV JILIN	UNIV NORTHEAST AGRIC	FUJI FILM CORP	MARUZEN PHARM CO LTD	OWEN HOLDING LTD	SHENYANG SUJIA TECHNOLOGY DEV CO LTD	LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	TIANJIN SHENGJI GROUP CO LTD	UNIV SUN YET-SEN	ASAHI KASEI CORPORATION	CHINESE ACAD INSPECTION & QUARANTINE	US DEPT HEALTH & HUMAN SERVICES
04 Bioactives	04.01 Proteins	04.01.01 Plasma Proteins	8	4	2	1	2		3	2	6	1			7	1			2	1	
		04.01.02 Serum	2			2	2	1		1	4	3		7		3	3		1	4	3
		04.01.03 Immunoglobulin	8		9	3	2	1	2	3	4	1				3	4	2	3	5	2
		04.01.04 Fibrinogen	1		1		1			1	1				2				1		
		04.01.05 Albumin	4	5	6	3	2	1		3	4		1				1	2	1	2	2
		04.01.06 Lipoproteins	2																		1
		04.01.07 C-reactive Protein																			
		04.01.08 Transferrin				2	2			1								1		1	
		04.01.09 Globulin	2	2	1				4	2							3	4	1		
		04.01.10 Hemoglobin			1																
		04.01.11 Haptoglobin																			
		04.01.12 Glycoprotein					1							1				1			
		04.01.13 Prothrombin																			
		04.01.14 Plasminogen																	1		
		04.01.15 Interferon						2									3				
		04.01.16 Proteins in General	2	2		1	3		2	2				1				1			1
	04.02 Enzymes	04.02.01 Transglutaminase											1								
		04.02.02 Superoxide Dismutase					1														
		04.02.03 Thrombin							1	2	2										
		04.02.04 Catalase																			
		04.02.05 Chloramphenicol Acetyltransferase																			
		04.02.06 Enzymes in General			9	3	4	3	2	6	4			1		5	4			2	3
		04.03 Opioid												2							
		04.04 Fatty Acids					1					1			1					1	
		04.05 Lipids	1						1									1		1	1
		04.06 Oligosaccharides / Polysaccharides								1	1				1		1				
		04.07 Antioxidants							1		3		3						1		
		04.08 Antimicrobials	6				1							1			6	1			
		04.09 Growth Stimulating																			
		04.10 Mineral Binding Peptides																			
		04.11 Heme Iron							1												
		04.12 Other Bioactives						2							1						
05 Applications	05.01 Food / Beverages	05.01.01 Color Enhancement	1																		
		05.01.02 Emulsifier			1	1			1		1										
		05.01.03 Fat Replacer																			
		05.01.04 Curing Agent													2						
		05.01.05 Binder												5							
		05.01.06 Food In General	10		4	1	1	5	6	3	2	3	6					3			
		05.02 Animal Feed	8					1	2		1										
		05.03 Aquaculture	1																		
		05.04 Nutraceuticals	1										1								
		05.05 Fertilizers																3			
		05.06 Cosmetics											7								
		05.07 Laboratory Research / Testing					1	2		4	1	5	1	1		4				2	1
		05.08 General Health Care										1									
		05.09 Pharmaceutical	7		2	1	3			2		2	1	6	3			2			3
		05.10 Biopolymers																	1		

TOP 5 ENTITIES BY CATEGORY

The following tables show the Top 5 entities in each technology category covering all entity tiers.

A percentage has been a located based on the following contributions:

- **Top 5** - The total % in which the Top 5 entities shown contribute to the overall total number of invention's in that category
- **Other Entities** - The total % in which entities appear whom are not in the Top 5 or are Individuals in that category.
- **Individuals** - The total % of invention's which appear in an Individual's name for that category.

Technical Category	Top 5 Entities	Inventions	Percentage Contribution		
			TOP 5	Other entities	INDIVIDUALS
01.01 Cat / Feline	CAMBRIDGE SCIENTIFIC PTY LTD	4	17.8%	74.0%	8.2%
	LIFE FORCE GROUP PLC	3			
	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	2			
	IDEXX LAB INC	2			
	OLYMPUS CORPORATION	2			
01.02 Dogs / Canine	CAMBRIDGE SCIENTIFIC PTY LTD	5	13.5%	77.1%	9.4%
	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	2			
	IDEXX LAB INC	2			
	OLYMPUS CORPORATION	2			
	SEVENTH SENSE BIOSYSTEMS INC	2			
01.03 Duck	UNIV NANCHANG	3	24.4%	46.3%	29.3%
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	2			
	OWEN HOLDING LTD	2			
	BEIJING AGRIC&FORESTRY SCI ACAD	2			
	LAURIDSEN GROUP INC	1			
01.04 Turkey	STRECK INC	2	60.0%	30.0%	10.0%
	OWEN HOLDING LTD	1			
	LAURIDSEN GROUP INC	1			
	VALNEVA	1			
	CANADA AGRIC & AGRI-FOOD CANADA	1			
01.05 Chicken	OWEN HOLDING LTD	5	15.4%	65.4%	19.2%
	LAURIDSEN GROUP INC	3			
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	3			
	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	3			
	STRECK INC	2			
01.06 Pig / Porcine / Swine	LAURIDSEN GROUP INC	13	12.3%	75.6%	12.0%
	UNIV NORTHEAST AGRIC	7			
	SHENYANG SIJIA TECHNOLOGY DEV CO LTD	7			
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	6			
	UNIV JILIN	6			
01.07 Sheep	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	5	11.9%	76.8%	11.3%
	CAMBRIDGE SCIENTIFIC PTY LTD	5			
	UNIV GUIZHOU	4			
	SEVENTH SENSE BIOSYSTEMS INC	3			
	LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	3			
01.08 Goat	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	5	17.2%	75.8%	7.0%
	AIMSCO LIMITED	5			
	UNIV GUIZHOU	4			
	UNIV CHINA OCEAN	4			
	CHINESE ACAD INSPECTION & QUARANTINE	4			

01.09 Buffalo / Ox / Cow / Bovine	TOYOBO KK	10	6.2%	83.0%	10.8%
	LAURIDSEN GROUP INC	9			
	MARUZEN PHARM CO LTD	8			
	UNIV TIANJIN	7			
	UNIV SHANGHAI JIAOTONG	6			
01.10 Camel	AIMSCO LIMITED	1	100.0%	0.0%	0.0%
	LACTIVE BV	1			
	ARCHER-DANIELS MIDLAND CO	1			
	ATLANTIC BIOPHARMACEUTICALS INC	1			
	MERRIMACK PHARM INC	1			
01.11 Deer / Cervidae	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	4	20.7%	44.8%	34.5%
	CHINESE ACAD SCI DALIAN CHEM PHYS INST	3			
	UNIV SHANGHAI JIAOTONG	2			
	UNIV JILIN	2			
	AIMSCO LIMITED	1			
01.12 Horse	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	3	14.3%	76.2%	9.5%
	UNIV TIANJIN	3			
	CAMBRIDGE SCIENTIFIC PTY LTD	3			
	UNIV SUN YET-SEN	3			
	SEVENTH SENSE BIOSYSTEMS INC	3			
01.13 Rabbit	UNIV TIANJIN	8	14.5%	76.1%	9.4%
	SEVENTH SENSE BIOSYSTEMS INC	3			
	LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	3			
	NAT CONTROLINST VETERINARY BIOPRODUCTS P	3			
	UNIV NORTHEAST AGRIC	3			
01.14 Other Animals	FUJI FILM CORP	6	5.0%	79.2%	15.8%
	MITSUBISHI CHEM CORP	5			
	BIO SPECTRUM INC	4			
	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	3			
	MORINAGA & CO LTD	3			
02.01 Erythrocyte	SYSMEX CORP	3	9.3%	75.3%	15.4%
	BIONUTRITIONAL LLC	3			
	SHENZHEN MINDRAY BIO MEDICAL ELECTRONICS	3			
	UNIV GUIZHOU	3			
	STRECK INC	3			
02.02 Leukocytes	AIMSCO LIMITED	4	10.7%	78.7%	10.7%
	SYSMEX CORP	3			
	BIONUTRITIONAL LLC	3			
	SHENZHEN MINDRAY BIO MEDICAL ELECTRONICS	3			
	STRECK INC	3			
02.03 Platelets	MEDTRONIC INC	3	12.4%	69.7%	18.0%
	SYSMEX CORP	2			
	TURZI ANTOINE	2			
	US DEPT HEALTH & HUMAN SERVICES	2			
	TOYOBO KK	2			
02.04 Plasma	LAURIDSEN GROUP INC	12	15.6%	74.4%	10.0%
	CAMBRIDGE SCIENTIFIC PTY LTD	5			
	ASAHI KASEI CORPORATION	3			
	ONCOMEDX INC.	3			
	TURZI ANTOINE	2			
02.05 Whole Blood	TOYOBO KK	8	6.8%	80.0%	13.2%
	LAURIDSEN GROUP INC	5			
	MITSUBISHI CHEM CORP	5			
	TIANJIN SHENGJI GROUP CO LTD	4			
	LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	4			
02.06 Serum	OWEN HOLDING LTD	8	6.6%	79.3%	14.1%
	AIMSCO LIMITED	5			
	LAURIDSEN GROUP INC	4			
	UNIV NORTHEAST AGRIC	4			
	CAMBRIDGE SCIENTIFIC PTY LTD	4			

03.01 Collection / Extraction	UNIV TIANJIN	7	6.3%	78.2%	15.4%
	UNIV CHINA AGRIC	5			
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	5			
	TIANJIN SHENGJI GROUP CO LTD	4			
	LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	4			
03.02 Transportation	SEVENTH SENSE BIOSYSTEMS INC	2	13.6%	66.1%	20.3%
	HEILONGJIANG WANGTU FERTILIZER CO LTD	2			
	IKOR INC.	2			
	LAURIDSEN GROUP INC	1			
	LIFE FORCE GROUP PLC	1			
03.03 Anticoagulation	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	7	14.2%	67.2%	18.7%
	LIFE FORCE GROUP PLC	3			
	ANHUI BAODI MEAT FOOD CO LTD	3			
	UNIV CHINA AGRIC	3			
	TIANJIN SHENGJI GROUP CO LTD	3			
03.04 Homogenization	UNIV NANCHANG	3	32.4%	47.1%	20.6%
	SHENYANG SIJIA TECHNOLOGY DEV CO LTD	3			
	HEBI PULETAI BIOTECHNOLOGY CO LTD	2			
	BEIJING APIS BIOTECHNOLOGY CO LTD	2			
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	1			
03.05 Inspection	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	1	23.8%	71.4%	4.8%
	UNIV HEFEI TECHNOLOGY	1			
	SHENZHEN MINDRAY BIO MEDICAL ELECTRONICS	1			
	BIOLIFE SOLUTIONS INC	1			
	SHANGHAI SUN BIO TECH CO LTD	1			
03.06 Separation	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	7	9.5%	73.7%	16.8%
	UNIV TIANJIN	7			
	DELISI GROUP CO LTD	4			
	LAURIDSEN GROUP INC	4			
	UNIV HEFEI TECHNOLOGY	3			
03.07 Centrifugation	UNIV TIANJIN	10	9.4%	76.4%	14.2%
	UNIV JILIN	8			
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	7			
	UNIV ZHEJIANG	7			
	UNIV NORTHEAST AGRIC	5			
03.08 Cooling	UNIV ZHEJIANG	3	8.5%	76.9%	14.6%
	UNIV JILIN	2			
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	2			
	UNIV NORTHEAST AGRIC	2			
	LIAOYUAN QIMING BIOLOGICAL TECHNOLOGY DEV CO LTD	2			
03.09 Freezing	UNIV NORTHEAST AGRIC	5	9.2%	74.6%	16.2%
	SHENYANG SIJIA TECHNOLOGY DEV CO LTD	5			
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	4			
	UNIV TIANJIN	4			
	UNIV ZHEJIANG	3			
03.10 Heating - Temperature Regulation	UNIV ZHEJIANG	4	9.6%	70.8%	19.7%
	CAMBRIDGE SCIENTIFIC PTY LTD	4			
	UNIV NORTHEAST AGRIC	3			
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	3			
	LIAOYUAN QIMING BIOLOGICAL TECHNOLOGY DEV CO LTD	3			
03.11.01 Ultra-filtration Membrane Processing	SHENYANG SIJIA TECHNOLOGY DEV CO LTD	5	15.3%	64.7%	20.0%
	LIAOYUAN QIMING BIOLOGICAL TECHNOLOGY DEV CO LTD	2			
	UNIV NANCHANG	2			
	I CO LTD AB	2			
	JINZHOU AOHONG PHARM CO LTD	2			
03.11.02 Nanofiltration Membrane Processing	SHANGHAI GENON BIOLOGICAL PROD CO LTD	2	46.2%	53.8%	0.0%
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	1			
	HEILONGJIANG DILONG PHARM CO LTD	1			
	DELISI GROUP CO LTD	1			
	ZHAOFENG KEDA PHARM CO LTD HEFEI	1			
03.11.03 Microfilteration Membrane Processing	UNIV HEFEI TECHNOLOGY	1	29.4%	47.1%	23.5%
	WUHAN PUSAITE MEMBRANE TECHNOLOGY CYCLIC	1			
	JINZHOU AOHONG PHARM CO LTD	1			
	WUHAN RENFU PHARM CO LTD	1			
	SHICHUAN SIHAI FOOD CO LTD	1			

03.11.04 Membrane Filtration in General	UNIV JILIN	1	31.3%	25.0%	43.8%
	JIANGSU WEISAI TECHNOLOGY BIOLOGICAL DEV CO LTD	1			
	DERBIOTEK SL	1			
	WUHAN SHUANGBOYA AGRIC BIOTECHNOLOGY CO LTD	1			
	ZHENGZHOU HOUYI PHARM CO LTD	1			
03.11.05 Reverse Osmosis	UNIV NANCHANG	2	85.7%	14.3%	0.0%
	ZHAOFENG KEDA PHARM CO LTD HEFEI	1			
	CARGILL INC	1			
	I CO LTD AB	1			
	UNIV BEIHUA	1			
03.12.01 Spray Drying	LAURIDSEN GROUP INC	10	38.3%	55.0%	6.7%
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	5			
	UNIV NANCHANG	3			
	SHANGHAI GENON BIOLOGICAL PROD CO LTD	3			
	HEBI PULETAI BIOTECHNOLOGY CO LTD	2			
03.12.02 Other Drying Methods	UNIV TIANJIN	6	8.6%	73.1%	18.4%
	UNIV NORTHEAST AGRIC	5			
	CHINESE ACAD SCI DALIAN CHEM PHYS INST	4			
	DELISI GROUP CO LTD	3			
	UNIV ZHEJIANG	3			
03.13 Decoloration Process	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	3	42.3%	53.8%	3.8%
	UNIV NANCHANG	3			
	UNIV ZHEJIANG	2			
	HANMI PHARM CO LTD	2			
	UNIV NORTHEAST AGRIC	1			
03.14 Preservation / Storage	OWEN HOLDING LTD	7	7.6%	76.8%	15.6%
	UNIV ZHEJIANG	5			
	UNIV TIANJIN	4			
	UNIV CHINA OCEAN	3			
	LIFE FORCE GROUP PLC	3			
03.15 Sterilization	OWEN HOLDING LTD	8	9.6%	74.6%	15.8%
	SHENYANG SIJIA TECHNOLOGY DEV CO LTD	5			
	TIANJIN SHENGJI GROUP CO LTD	4			
	UNIV NORTHEAST AGRIC	3			
	UNIV ZHEJIANG	2			
04.01.01 Plasma Proteins	LAURIDSEN GROUP INC	8	13.3%	77.1%	9.6%
	SHENYANG SIJIA TECHNOLOGY DEV CO LTD	7			
	UNIV NORTHEAST AGRIC	6			
	TOYOBO KK	4			
	PEPSICO INC	4			
04.01.02 Serum	OWEN HOLDING LTD	7	6.1%	79.9%	14.0%
	UNIV NORTHEAST AGRIC	4			
	CHINESE ACAD INSPECTION & QUARANTINE	4			
	UNIV SOUTHWEST NATIONALITIES	3			
	LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	3			
04.01.03 Immunoglobulin	UNIV TIANJIN	9	7.0%	83.7%	9.3%
	LAURIDSEN GROUP INC	8			
	CHINESE ACAD INSPECTION & QUARANTINE	5			
	AIMSCO LIMITED	5			
	UNIV NORTHEAST AGRIC	4			
04.01.04 Fibrinogen	OMRIX BIOPHARMACEUTICALS INC	2	17.6%	74.5%	7.8%
	TURZI ANTOINE	2			
	SHENYANG SIJIA TECHNOLOGY DEV CO LTD	2			
	MEDTRONIC INC	2			
	UNIV TIANJIN	1			
04.01.05 Albumin	UNIV TIANJIN	6	7.1%	85.1%	7.8%
	TOYOBO KK	5			
	LAURIDSEN GROUP INC	4			
	UNIV NORTHEAST AGRIC	4			
	PEPSICO INC	4			
04.01.06 Lipoproteins	LAURIDSEN GROUP INC	2	22.2%	71.1%	6.7%
	NOVO NORDISK AS	2			
	SEROLOGICALS INVESTMENT CO INC	2			
	FRAUNHOFER GES FOERDERUNG ANGEWANDTEN EV	2			
	SPECTRACELL LAB INC	2			

04.01.07 C-reactive Protein	BIO ART BVBA	1	75.0%	0.0%	25.0%
	SHENZHEN GOLDSITE DIAGNOSTICS INC	1			
	WANHUA PUMAN BIOLOGICAL ENG CO LTD	1			
04.01.08 Transferrin	BIOE INC	3	11.5%	74.3%	14.2%
	LIFE FORCE GROUP PLC	3			
	UNIV QINGDAO AGRIC	3			
	UNIV SHANGHAI JIAOTONG	2			
	UNIV ZHEJIANG	2			
04.01.09 Globulin	UNIV SUN YET-SEN	4	22.7%	62.1%	15.2%
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	4			
	TIANJIN SHENGJI GROUP CO LTD	3			
	UNIV JILIN	2			
	LAURIDSEN GROUP INC	2			
04.01.10 Hemoglobin	IKOR INC.	2	54.5%	36.4%	9.1%
	UNIV TIANJIN	1			
	EXPONENTIAL BIOTHERAPIES INC	1			
	UNIV HUNAN	1			
	ZHEJIANG WANLI COLLEGE	1			
04.01.11 Haptoglobin	SHANGHAI RAAS BLOOD PROD CO LTD	1	100.0%	0.0%	0.0%
	UNIV PEKING	1			
04.01.12 Glycoprotein	HANMI PHARM CO LTD	2	9.8%	77.0%	13.1%
	SHANGHAI RAAS BLOOD PROD CO LTD	1			
	UNIV PEKING	1			
	UNIV SUN YET-SEN	1			
	BAXTER AG	1			
04.01.13 Prothrombin	ENTEROMED INC	1	100.0%	0.0%	0.0%
04.01.14 Plasminogen	CAMBRIDGE SCIENTIFIC PTY LTD	5	52.6%	42.1%	5.3%
	OMRIX BIOPHARMACEUTICALS INC	2			
	BUEHLMANN LAB AG	1			
	LEUVEN RES&DEV	1			
	ASAHI KASEI CORPORATION	1			
04.01.15 Interferon	TIANJIN SHENGJI GROUP CO LTD	3	23.7%	60.5%	15.8%
	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	2			
	COUNCIL SCI & IND RES INDIA	2			
	ELI LILLY AND COMPANY	1			
	LIPID SCI INC	1			
04.01.16 Proteins in General	UNIV ZHEJIANG	3	8.4%	75.5%	16.1%
	DELISI GROUP CO LTD	3			
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	2			
	UNIV JILIN	2			
	LAURIDSEN GROUP INC	2			
04.02.01 Transglutaminase	SHANGHAI PINE & POWER BIOTECH CO LTD	1	71.4%	28.6%	0.0%
	UNIV HENAN TECHNOLOGY	1			
	NOVOZYMES AS	1			
	NANOBAC LIFE SCI INC	1			
	MARUZEN PHARM CO LTD	1			
04.02.02 Superoxide Dismutase	UNIV ZHEJIANG	1	26.3%	52.6%	21.1%
	BEIJING HUACHUANG YUANHANG SCI&TECHNOLOGY CO LTD	1			
	DATIAN HUACAN BIOTECHNOLOGY CO LTD	1			
	CHINESE ACAD SCI DALIAN CHEM PHYS INST	1			
	QINGHAI PLATEAU MEDICINE SCI INST	1			
04.02.03 Thrombin	CAMBRIDGE SCIENTIFIC PTY LTD	5	26.7%	62.2%	11.1%
	UNIV JILIN	2			
	UNIV NORTHEAST AGRIC	2			
	MEDTRONIC INC	2			
	SUZHOU JINGAO MEDICAL APPLIANCE CO LTD	1			
04.02.04 Catalase	EXPONENTIAL BIOTHERAPIES INC	1	40.0%	0.0%	60.0%
	STROX BIOPHARMACEUTICALS LLC	1			
04.02.05 Chloramphenicol Acetyltransferase	SUZHOU JINGAO MEDICAL APPLIANCE CO LTD	1	100.0%	0.0%	0.0%
	MUSC FOUND RES DEV	1			

04.02.06 Enzymes in General	UNIV TIANJIN	9	7.0%	81.3%	11.7%
	UNIV JILIN	6			
	LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	5			
	UNIV NORTHEAST AGRIC	4			
	UNIV ZHEJIANG	4			
04.03 Opioid	OWEN HOLDING LTD	2	60.0%	0.0%	40.0%
	TAKEDA CHEM IND LTD	1			
	BUEHLMANN LAB AG	1			
	CAMBRIDGE SCIENTIFIC PTY LTD	1			
	AIMSCO LIMITED	1			
04.04 Fatty Acids	CAMBRIDGE SCIENTIFIC PTY LTD	3	15.7%	71.4%	12.9%
	PEPSICO INC	3			
	DSM IP ASSETS BV	2			
	NOVO NORDISK AS	2			
	UNIV ZHEJIANG	1			
04.05 Lipids	PEPSICO INC	2	12.0%	77.3%	10.7%
	NOVO NORDISK AS	2			
	ELI LILLY AND COMPANY	2			
	UNIV VANDERBILT	2			
	DSM IP ASSETS BV	1			
04.06 Oligosaccharides / Polysaccharides	LIFE FORCE GROUP PLC	3	17.0%	66.0%	17.0%
	SHAANXI DAQINHAN GROUP CO LTD	2			
	AGDIA INC	2			
	TOKIWA YAKUHIN KOGYO KK	1			
	HEMOTEQ AG	1			
04.07 Antioxidants	UNIV NORTHEAST AGRIC	3	26.9%	57.7%	15.4%
	KOSE KK	3			
	UNIV NANCHANG	3			
	MARUZEN PHARM CO LTD	3			
	PEPSICO INC	2			
04.08 Antimicrobials	TIANJIN SHENGJI GROUP CO LTD	6	10.5%	74.2%	15.3%
	LAURIDSEN GROUP INC	6			
	LIFE FORCE GROUP PLC	3			
	AIMSCO LIMITED	3			
	COUNCIL SCI & IND RES INDIA	2			
04.09 Growth Stimulating	HEFEI YONGSHENG POULTRY IND CO LTD	1	41.7%	8.3%	50.0%
	UNIV LEIPZIG	1			
	AM BIOSOLUTIONS	1			
	UNIV CHANGWON NAT IND & ACAD COOP	1			
	VEIJLEN LTD	1			
04.10 Mineral Binding Peptides	NANOBAC LIFE SCI INC	1	100.0%	0.0%	0.0%
	BIONEL CO LTD	1			
04.11 Heme Iron	UNIV NANCHANG	2	75.0%	25.0%	0.0%
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	1			
	GUANGDONG SIRIO PHARMA CO LTD	1			
	I CO LTD AB	1			
	CIE GEN DIETETIQUE	1			
04.12 Other Bioactives	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	2	24.0%	60.0%	16.0%
	SHENYANG SIJIA TECHNOLOGY DEV CO LTD	1			
	BEIJING AGRIC&FORESTRY SCI ACAD	1			
	DELISI GROUP CO LTD	1			
	UNIV BEIJING NORMAL	1			
05.01.01 Color Enhancement	UNIV ILLINOIS	1	100.0%	0.0%	0.0%
	LAURIDSEN GROUP INC	1			
	BUEHLMANN LAB AG	1			
	RIGEL TECHNOLOGY CORP	1			
05.01.02 Emulsifier	BUEHLMANN LAB AG	1	33.3%	60.0%	6.7%
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	1			
	UNIV SOUTHWEST NATIONALITIES	1			
	GUILIN MEDICAL COLLEGE	1			
	UNIV NORTHEAST AGRIC	1			

05.01.03 Fat Replacer	ARCHER-DANIELS MIDLAND CO	1	100.0%	0.0%	0.0%
05.01.04 Curing Agent	SHENYANG SIJIA TECHNOLOGY DEV CO LTD	2	54.5%	18.2%	27.3%
	JIANGSU ENTRY EXIT INSPECTION & QUARANTI	1			
	AQUATROVE BIOSCIENCES INC	1			
	PHARMA PACIFIC PTY LTD	1			
	ZHENJIANG ENTRY EXIT INSPECTION&QUARAN	1			
05.01.05 Binder	OWEN HOLDING LTD	5	60.0%	20.0%	20.0%
	ARCHER-DANIELS MIDLAND CO	1			
	INTELLECTUAL VENTURES	1			
	PRONOTA NV	1			
	ABOGEN INC	1			
05.01.06 Food In General	LAURIDSEN GROUP INC	10	10.0%	75.6%	14.4%
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	6			
	MARUZEN PHARM CO LTD	6			
	DOKURITSU GYOSEI HOJIN NOGYO SEIBUTSU SH	5			
	DELISI GROUP CO LTD	5			
05.02 Animal Feed	LAURIDSEN GROUP INC	8	39.0%	56.1%	4.9%
	TIANJIN BAODI AGRIC TECHNOLOGY CO LTD	2			
	SHANGHAI GENON BIOLOGICAL PROD CO LTD	2			
	HEBI PULETAI BIOTECHNOLOGY CO LTD	2			
	UNIV FLORIDA STATE RES FOUND INC	2			
05.03 Aquaculture	LAURIDSEN GROUP INC	1	100.0%	0.0%	0.0%
	NATURALLY RECYCLED PROTEINS	1			
	HANGZHOU NANKAI RIXIN BIOTECHNOLOGY CO L	1			
	FLUIDIGM CORP	1			
05.04 Nutraceuticals	BIONUTRITIONAL LLC	3	25.8%	54.8%	19.4%
	NESTEC SA	2			
	LAURIDSEN GROUP INC	1			
	TZUF GLOBUS LTD	1			
	MARUZEN PHARM CO LTD	1			
05.05 Fertilizers	UNIV SUN YET-SEN	3	32.3%	41.9%	25.8%
	SFINC NV	2			
	BIG BIOGEN CO LTD	2			
	HEILONGJIANG WANGTU FERTILIZER CO LTD	2			
	MEDIGEN BIOTECHNOLOGY CORP	1			
05.06 Cosmetics	MARUZEN PHARM CO LTD	7	31.8%	63.6%	4.5%
	BIO SPECTRUM INC	4			
	KOSE KK	4			
	NARISU KESHOHIN KK	3			
	POLA CHEM IND INC	3			
05.07 Laboratory Research / Testing	FUJI FILM CORP	5	7.8%	83.2%	9.0%
	UNIV JILIN	4			
	LANZHOU RES INST VETERINARY SCI CHINESE ACAD AGRIC SCI	4			
	UNIV GUIZHOU	4			
	POLA CHEM IND INC	3			
05.08 General Health Care	DELISI GROUP CO LTD	2	35.3%	47.1%	17.6%
	FUJI FILM CORP	1			
	UNIV JIANGNAN	1			
	AQUATROVE BIOSCIENCES INC	1			
	IST NAZ MALATTIE INFETTIVE	1			
05.09 Pharmaceutical	LAURIDSEN GROUP INC	7	6.0%	82.5%	11.5%
	OWEN HOLDING LTD	6			
	BAXTER AG	5			
	CAMBRIDGE SCIENTIFIC PTY LTD	5			
	BIO SPECTRUM INC	4			
05.10 Biopolymers	JANUSZ	2	100.0%	0.0%	0.0%
	ASAHI KASEI CORPORATION	1			

Due to the lower total amounts of inventions associated with entities in the dataset, it is difficult to highlight stand out performers. What can be said however is that technologies in which low patent activity and low entity interest are occurring may represent potential technology areas in which to conduct further investigations into (for R&D purposes) because of this perceived low interest.

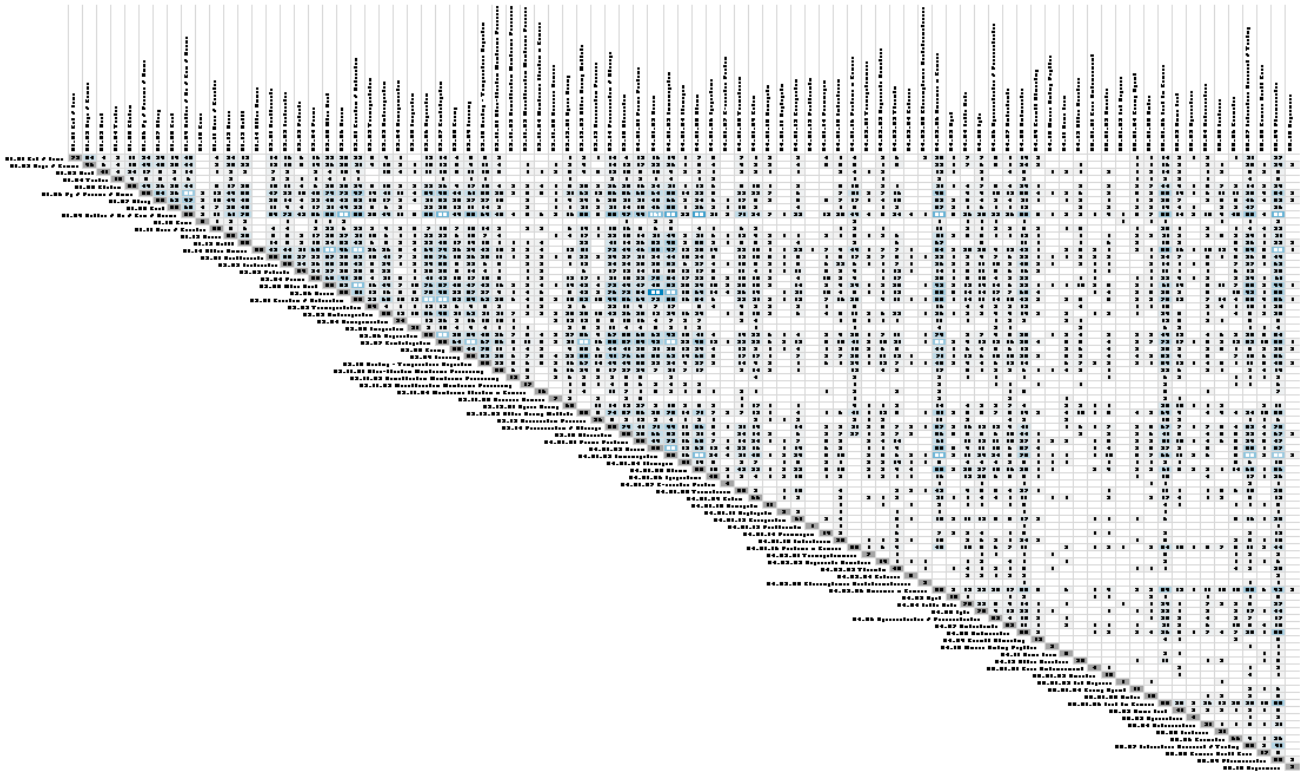
CROSS TECHNOLOGY CHARTS

The matrix on the next page shows a cross-correlation of all technical categories in the data set, with the heat-map showing highly correlated categories. The matrix suggests there could be a “patent gap” (areas in a lighter shade of blue or white) in technology areas where there is little or no activity, but where **Meat & Livestock Australia** experts may consider having potential. Please note that due to the number of technology categories and large size of the cross technology chart, this table has not been placed in the report. The full cross technology table can be viewed in the corresponding excel work file under the tab **‘Technology Analysis – Matrices’.**

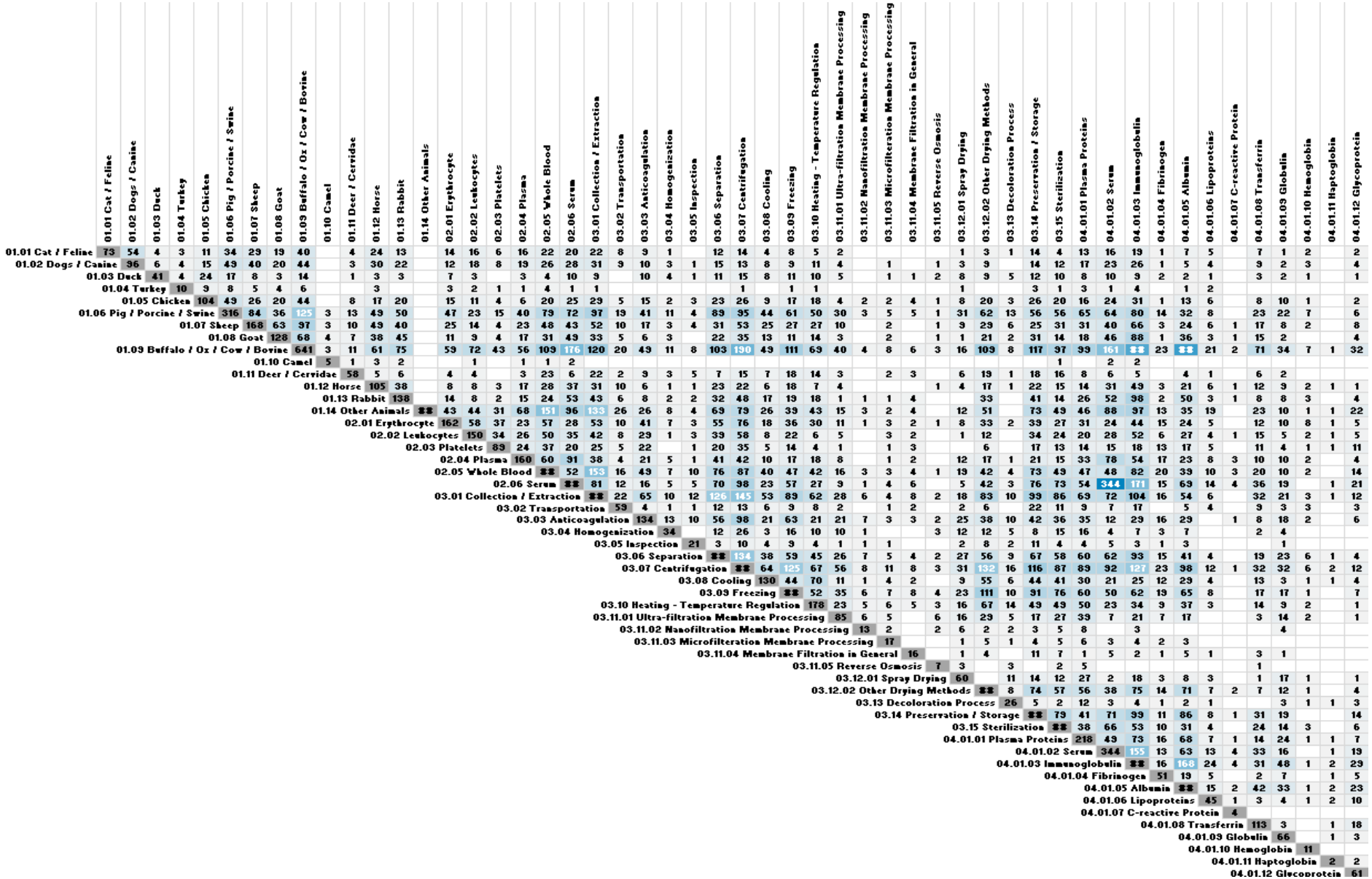
There appears to be multiple areas of low patent activity. Many categories relating to specific bioactive proteins including ‘c-reactive proteins’, ‘haptoglobin’, ‘prothrombin’ and ‘Chloramphenicol Acetyltransferase’ have low instances of patent activity across all technology catagories. Applications of blood products in ‘Aquaculture’, as a ‘biopolymer’ or as a ‘fat replacer’ in food / beverages are also areas on low patent activity across this technology.

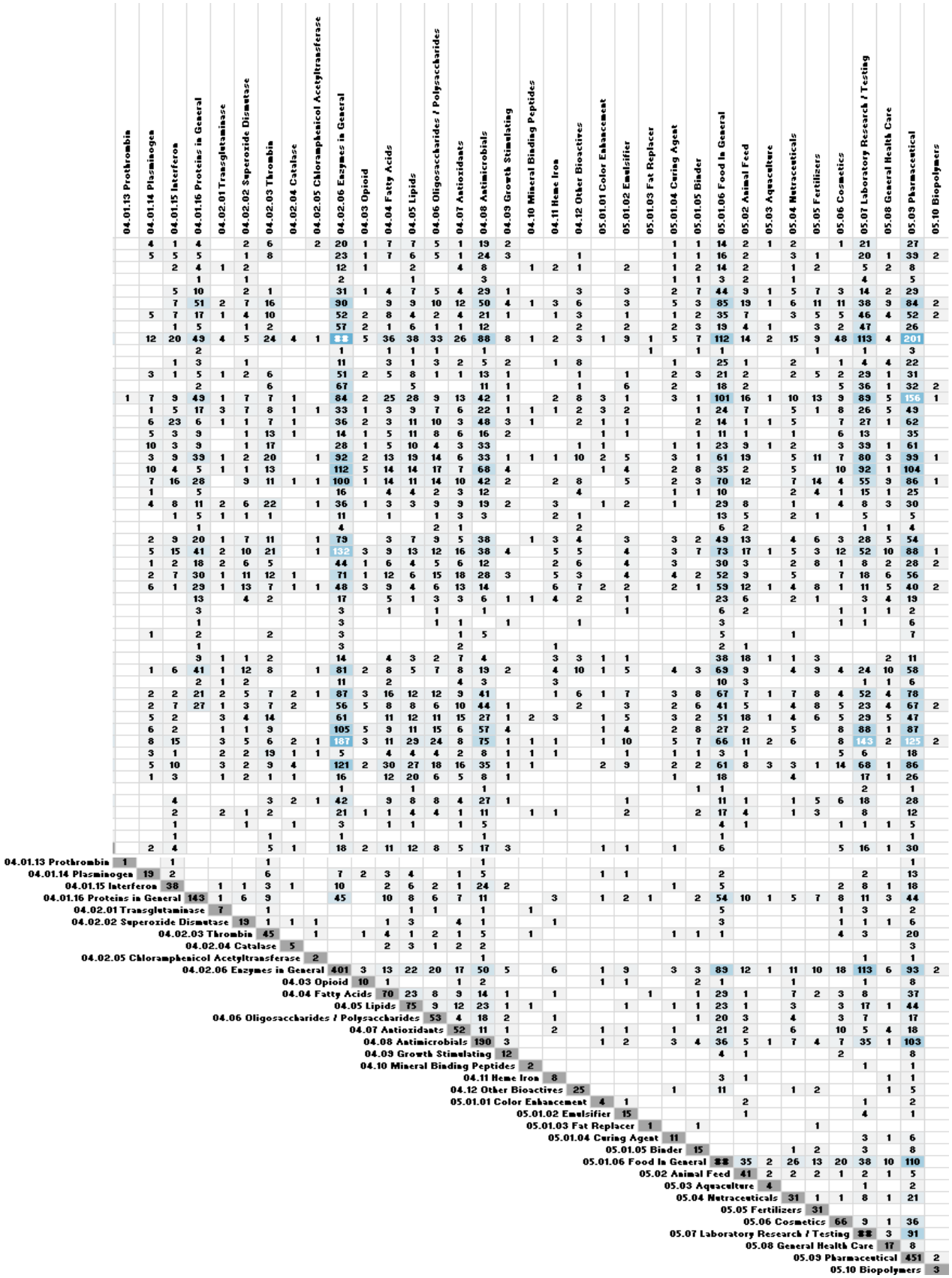
The full patent cross technology chart is represented below. Please note that this cross technology chart is very large due to the numerous technologies involved. This chart has can be viewed in sections over the next few pages of this report. The full chart can be viewed in its entirety (more easily) in the corresponding excel work file that is provided with this report.

Patent Cross Technology Chart (Total Chart View)



(Table expanded on pages 49 & 50)


01.01 Cat / Feline
01.02 Dogs / Canine
01.03 Duck
01.04 Turkey
01.05 Chicken
01.06 Pig / Porcine / Swine
01.07 Sheep
01.08 Goat
01.09 Buffalo / Ox / Cow / Bovine
01.10 Camel
01.11 Deer / Cervidae
01.12 Horse
01.13 Rabbit
01.14 Other Animals
02.01 Erythrocyte
02.02 Leukocytes
02.03 Platelets
02.04 Plasma
02.05 Whole Blood
02.06 Serum
03.01 Collection / Extraction
03.02 Transportation
03.03 Anticoagulation
03.04 Homogenization
03.05 Inspection
03.06 Separation
03.07 Centrifugation
03.08 Cooling
03.09 Freezing
03.10 Heating - Temperature Regulation
03.11.01 Ultra-filtration Membrane Processing
03.11.02 Nanofiltration Membrane Processing
03.11.03 Microfilteration Membrane Processing
03.11.04 Membrane Filtration in General
03.11.05 Reverse Osmosis
03.12.01 Spray Drying
03.12.02 Other Drying Methods
03.13 Decoloration Process
03.14 Preservation / Storage
03.15 Sterilization
04.01.01 Plasma Proteins
04.01.02 Serum
04.01.03 Immunoglobulin
04.01.04 Fibrinogen
04.01.05 Albumin
04.01.06 Lipoproteins
04.01.07 C-reactive Protein
04.01.08 Transferrin
04.01.09 Globulin
04.01.10 Hemoglobin
04.01.11 Haptoglobin
04.01.12 Glycoprotein


04.01.13 Prothrombin
04.01.14 Plasminogen
04.01.15 Interferon
04.01.16 Proteins in General
04.02.01 Transglutaminase
04.02.02 Superoxide Dismutase
04.02.03 Thrombin
04.02.04 Catalase
04.02.05 Chloramphenicol Acetyltransferase
04.02.06 Enzymes in General
04.03 Opioid
04.04 Fatty Acids
04.05 Lipids
04.06 Oligosaccharides / Polysaccharides
04.07 Antioxidants
04.08 Antimicrobials
04.09 Growth Stimulating
04.10 Mineral Binding Peptides
04.11 Heme Iron
04.12 Other Bioactives
05.01.01 Color Enhancement
05.01.02 Emulsifier
05.01.03 Fat Replacer
05.01.04 Curing Agent
05.01.05 Binder
05.01.06 Food In General
05.02 Animal Feed
05.03 Aquaculture
05.04 Nutraceuticals
05.05 Fertilizers
05.06 Cosmetics
05.07 Laboratory Research / Testing
05.08 General Health Care
05.09 Pharmaceutical
05.10 Biopolymers

HIGH SCORING INVENTIONS

High scoring inventions ranked by Thomson Reuters IP Analytics Strength™ Index are shown in a partial list below and the complete list of the top 50 inventions is available in the accompanying excel file.

The **University of Minnesota** (United States) has the highest scoring invention. This specific patent relates to 'An isolated multipotent adult stem cell (MASC), which has the capacity to be induced to differentiate to form at least one differentiated cell type of mesodermal, ectodermal or endodermal origin'.

High Scoring Inventions	Thomson Reuters IP Analytics Strength Index™
WO2002064748A2 **UNIV MINNESOTA** 2001-02-14 New multipotent adult stem cells that can be induced to differentiate to form a cell type of mesodermal, ectodermal or endodermal origin, useful for treating e.g. cancer, diabetes, hepatitis, hemophilia, ischemia or inflammation	**14.3**
WO2004078140A2 **DELIATROPH PHARM INC** 2003-03-05 Novel purified glycoprotein, having neutral active soluble hyaluronidase polypeptide and N-linked sugar moiety, useful for treating pathologic accumulation of glycosaminoglycans in cardiovascular, paraphimosis, myxedema, and lymphedema	**12.4**
WO2002000272A2 **UNIV MCGILL** 2000-06-29 Repairing tissue e.g. bone tissue, comprises introducing a temperature-dependent polymer gel composition optionally mixed with blood component(s) such that the composition adheres to tissue and promotes support for cell proliferation	**10.0**
WO2006091871A1 **DELFMEMS** 2005-02-23 New substantially purified glycoprotein comprises neutral active soluble hyaluronidase glycoprotein (sHASEGP) and N-linked sugar moiety, useful for treating or preventing tumors and cardiovascular disorders	**9.9**
WO2003064472A2 **AIMSCO LIMITED** 2002-01-28 Use of a serum composition containing anti-human leukocyte antigen antibody, for palliative improvement of a condition, i.e. improves the skin, memory or energy, of an animal, or for treating inflammatory disease, e.g. HIV or diabetes	**9.5**
US7179226B2 **ANIMAS CORP** 2001-06-21 Diabetes management system for managing blood glucose level of diabetes patient comprises portable electronic device and database including stored patient-inputted data having time/date stamp	**8.8**
WO2005042730A2 **BIOMASTER INC** 2003-11-04 Preparing a stem cell comprises obtaining an aspirate from liposuction, subjecting the aspirate from liposuction to centrifugation to obtain a cell fraction, subjecting the cell fraction to centrifugation by specific gravity	**8.3**
US20030195154A1 **AMGEN INC** 2002-04-04 Increasing serum half-life of biologically active agent involves fusing biologically active agent to transthyretin or a transthyretin variant	**8.1**

TOP CITED INVENTIONS

The influence of a patent document can be measure by looking at how frequently an invention is cited again another patent case pending in the system. Citations can come from many sources including by the applicant themselves during patent drafting or prosecution, citation by Examiners during patent examination or citation by other during their own patenting processes.

The following are the most highly cited documents of relevance in the collection. The most highly cited patent is from the **University of Minnesota** (United States) and **Guangdong Sirio Pharmaceutical Co Ltd** (China). A partial list is shown below and the complete list of the top 50 cited patent inventions is available in the accompanying excel file.

High Citation Impact Inventions	Age-weighted Citation Impact
WO2002064748A2 **UNIV MINNESOTA** 2001-02-14 New multipotent adult stem cells that can be induced to differentiate to form a cell type of mesodermal, ectodermal or endodermal origin, useful for treating e.g. cancer, diabetes, hepatitis, hemophilia, ischemia or inflammation	**5.3**
CN101810336A **GUANGDONG SIRIO PHARMA CO LTD** 2010-04-30 Chewable soft capsule comprises inner substance filled in capsule shell, which comprises gelatin, thickener, plasticizer, water, and sweetener, where inner substance is liquid or mixed suspended substance having e.g. health function	**5.3**
WO2004078140A2 **DELIATROPH PHARM INC** 2003-03-05 Novel purified glycoprotein, having neutral active soluble hyaluronidase polypeptide and N-linked sugar moiety, useful for treating pathologic accumulation of glycosaminoglycans in cardiovascular, paraphimosis, myxedema, and lymphedema	**3.8**
US20030195154A1 **AMGEN INC** 2002-04-04 Increasing serum half-life of biologically active agent involves fusing biologically active agent to transthyretin or a transthyretin variant	**3.6**
US7179226B2 **ANIMAS CORP** 2001-06-21 Diabetes management system for managing blood glucose level of diabetes patient comprises portable electronic device and database including stored patient-inputted data having time/date stamp	**3.2**
US20060276697A1 **CHEMIMAGE TECHNOLOGIES LLC** 2005-06-07 Assessment method for blood component of animal involves assessing irradiated regions on vascularized surface of animal to identify at least one region that exhibits optical characteristic of blood	**3.2**
WO2006091871A1 **DELFMEMS** 2005-02-23 New substantially purified glycoprotein comprises neutral active soluble hyaluronidase glycoprotein (sHASEGP) and N-linked sugar moiety, useful for treating or preventing tumors and cardiovascular disorders	**3.1**
US20060064250A1 **BIONUTRITIONAL LLC** 2004-09-17 Providing nutraceutical program for animal involves comparing blood test score to corresponding parameter; if score falls outside normal, identifying nutraceutical and calculating dosage on score and deviation of score from optimal range	**2.7**

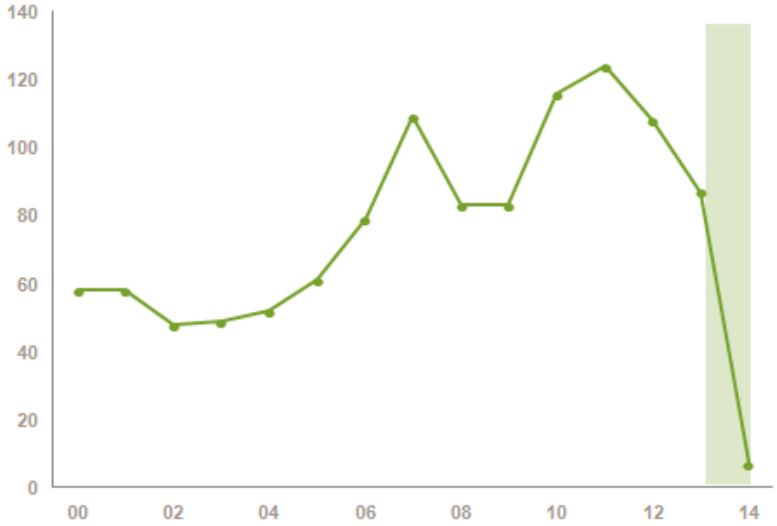
LITERATURE

The Literature collection was also developed using the full content literature coverage on Thomson Innovation®, which includes Web of Science, Conference proceedings, Current Contents Connect and Inspec. There were **1122** published literature results returned from the search process which had a priority year of at least **2000**.

PUBLICATION VELOCITY

The assembled collection has been plotted against publication year to analyse the publication rate. Literature publication data in 2013 (highlighted in green) may be partial due to publication lag.

Tier 1 Entities by Technical Category



The chart above shows the filing activity of literature publications within the collection. It can be seen that there is a strong continual upward trend occurring in literature since 2000. In 2007 a dip in literature activity occurred followed by a subsequent increase in activity from 2009 – 2011. Most recently, the literature trend in this technology field appears to be decreasing once again.

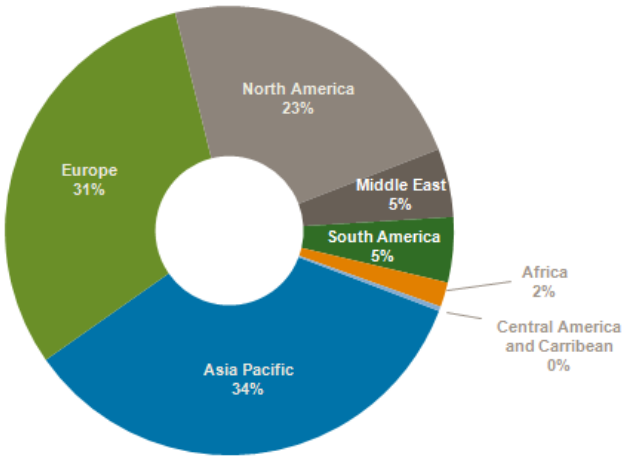
Literature appears to be a lot more sporadic in activity than patents. Patents activity in general seems to be increasing or at least constant. Literature has distinct periods of increasing and decreasing activity. This can be potentially explained by the academic / government sectors increasing their patent activity in this technology recently. Since academic / government makes up the majority of literature publication activity, an increase in their patent output could potentially lead to a decrease in literature output from this entity sector regarding this technology.

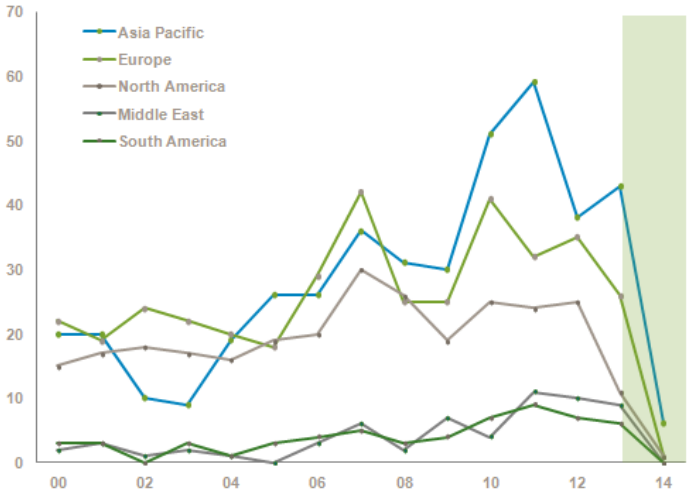
GEOGRAPHIC ANALYSIS

The region or specific country where an entity is based is a good indicator of the site where the research is undertaken. The regional analysis is based on the entity country. Each entity country has been grouped into its respective region and plotted in the chart below.

The chart reveals that the Asia Pacific has the largest volume of literature publications produced. A little over a third (34%) of literature publications in the data set have originated from the Asia Pacific. Europe (31%) and North America (23%) are the next top regions for literature associated with this technology.

Literature Activity by Region





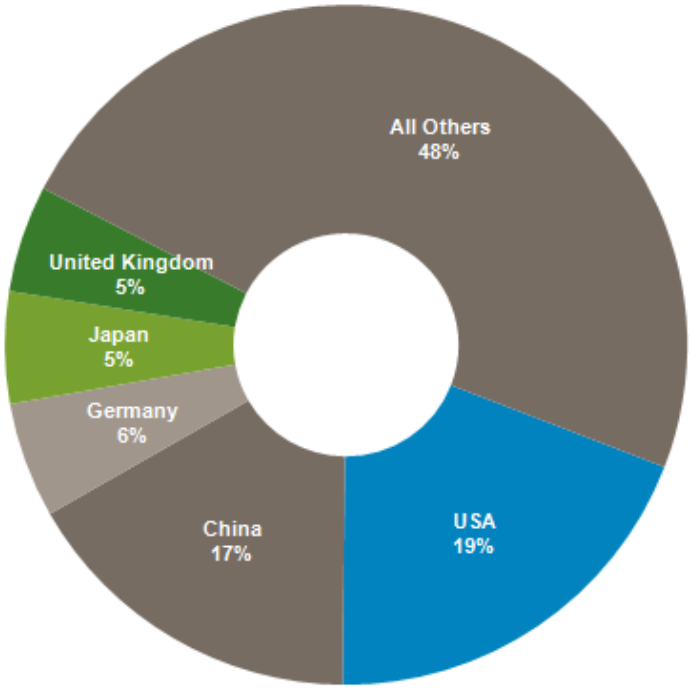
Region	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Total Publications
Asia Pacific	20	20	10	9	19	26	26	36	31	30	51	59	38	43	6	424
Europe	22	19	24	22	20	18	29	42	25	25	41	32	35	26	1	381
North America	15	17	18	17	16	19	20	30	26	19	25	24	25	11	1	283
Middle East	2	3	1	2	1		3	6	2	7	4	11	10	9		61
South America	3	3		3	1	3	4	5	3	4	7	9	7	6		58
Africa	1				1		3	2	1	3	2	4	2	3		22
Central America and Carribean							1	2	1							4

TIMELINE OF ACTIVITY BY ENTITY COUNTRY

The heat map below shows the number of literature publications by country within this technology field. This shows where entites are publishing literature related to this technology. The United States (19%) is the largest source of published literature followed by the China (17%), Germany (6%), Japan (5%) and the United Kingdom (5%).

Literature Activity by Country

Entity Countries	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Total Publications
USA	12	13	15	15	16	15	16	24	21	19	19	23	20	11	1	240
China	2	7	3	1	8	11	13	20	18	15	30	24	22	29	3	206
Germany	8	1	4	3	2	3	4	7	7	5	6	4	10	4		68
Japan	7	3	4	4	2	4	9	6	7	2	5	4	4	5		66
United Kingdom	3	5	4	4	3	2	3	6	7	4	6	5	5	6		63
India	4	1	1	1	1	4	2	4	2	3	4	14	4	4		49
South Korea	3	7		2	3	4	1	1	4	6	3	9	2	3		48
Brazil	3	2		2	1	2	3	5	3	3	5	7	6	5		47
Spain	2	3	1		3		3	8	4	3	4	8	3	2	1	45
Canada	2	4	4	2	1	4	2	4	1	1	4	2	4		1	36
All Other	18	19	18	21	20	19	33	39	18	34	44	45	42	31	3	404



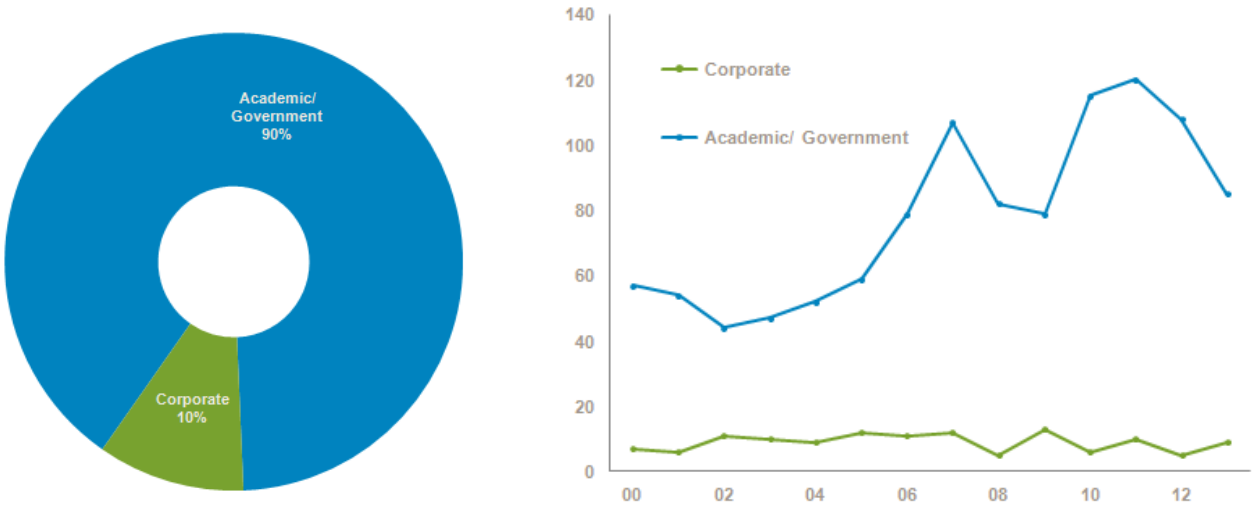
LITERATURE ENTITY ANALYSIS

SECTOR ANALYSIS

The entities within the collection were categorized into corporate or academic & government sectors in order to assess the level of research output from each sector. The chart below shows that 90% of literature publications were produced by academic & government entities.

Plotting the publication volume of each segment over time shows that activity from academic & government has been steadily increasing from 2000 to 2007 before a dip in activity was observed in the 2008 – 2009 periods. Recently, after a brief increase, activity has started to decrease once again. There have been relatively low levels of literature output from the corporate sector with sporadic growth being observed over time.

Literature Activity by Sector



Interestingly, academic & government entities well outweigh corporate entities in literature publications with 90%. In stark contrast, academic & government entities only had 35% of the patent landscape. A potential explanation for this could be the cost associated with the patent process Vs publishing literature. Since government and particularly academic entities are reliant on funding and generally have tighter smaller budgets than those in the corporate space, publishing literature may be the more attractive and cheaper option available. This means that academic & government entities are required to be savvier with their innovation due to their

budgetary constrictions in this technology field. Additionally, academic & government entities are generally not as commercially focused as the corporate sector. A need to commercialize has traditionally not been as high a priority as it has been for the corporate sector.

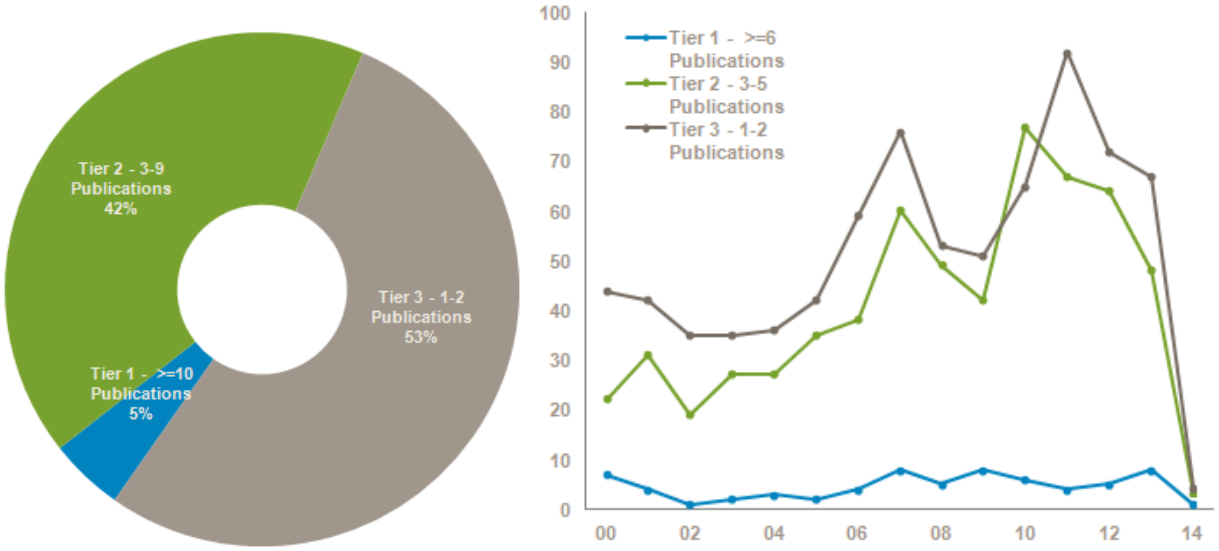
LITERATURE LANDSCAPE DISTRIBUTION BY ENTITY TIERS

An entity clean-up process was performed to standardize entity names and aggregate literature records held by the same entity where possible. The entities were then separated into tiers based on the volume of their holdings.

Tier 1 entities (5 entities in total) hold just 5% of the literature landscape each with 10 or more literature publications. This is followed by tier 2 entities (177 entities in total) which comprise 42% of literature activity with 3 – 9 publications. Tier 3 entities (1036 entities in total) each with 1 - 2 publications, comprise 40% of the literature data set.

Plotting publication activity over time reveals tier 2 and tier 3 entities driving growth. Tier 1 entities see sporadic growth occurring over the 2000 – 2013 periods.

Literature Activity by Entity Tier



Tier	Total Publications	Number of Entities
Tier 1 - >=10 Publications	68	5
Tier 2 - 3-9 Publications	609	177
Tier 3 - 1-2 Publications	773	1036

TIER 1 ENTITIES AND TIMELINES

The table shows the tier 1 entities within the field. The **Chinese Academy of Science** (China) is the leading source of published literature within this field. This is followed by the **Wuhan University** (China) and the **University of Girona** (Spain).

Tier 1 Entities – Literature

Tier 1 Entities	Total Publications
Chinese Acad Sci	21
Wuhan Univ	17
Univ Girona	11
Cent S Univ	10
Univ Illinois	10

Tier 1 Entities – Timeline and Total Activity

Tier 1 Entities	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Total
Chinese Acad Sci	2	2		1	2	1	2	3	1	2	1			4		21
Wuhan Univ						2	2		3	2	4	3		1		17
Univ Girona	1	2	1		1			2	1	1		1			1	11
Cent S Univ								2		1	1		4	2		10
Univ Illinois	4			1				1		2			1	1		10
Tier 2 - 3-9 Publications	22	31	19	27	27	35	38	60	49	42	77	67	64	48	3	609
Tier 3 - 1-2 Publications	44	42	35	35	36	42	59	76	53	51	65	92	72	67	4	773

The chart above shows the timeline of activity for all tier 1 entities in the literature collection. **The Chinese Academy of science** (China) recently reached a peak of literature publication activity in 2013.

Central South University (China) has seen increased levels of activity over the 2012 – 2013 periods. Prior to this, this entity had much lower numbers of published literature in this technology field. This shows that this entity has only recently become a significant 'player' in this technology field. Further investigation into potential reasons for this growth may be warranted.

TIER 2 ENTITIES AND TIMELINES

This table shows the publication activity of top tier 2 entities. This is only a partial table of tier 2 entities and the full table can be found in the accompanying excel work sheet.

Tier 2 Entities – Literature

Tier 2 Entities	Total Publications
Seoul Natl Univ	9
Texas A&M Univ	9
Univ Calif Los Angeles	9
Univ Vet Med Hannover	9
Iowa State Univ	8
Univ Belgrade	8
China Agr Univ	7
INRA	7
Univ Estadual Paulista Unesp	7
Univ Fed Minas Gerais	7
Univ Penn	7
Univ Washington	7

Seoul National University (South Korea), **Texas A & M University** (United States), the **University California - Los Angeles** (United States) and the **University of Veterinary Medicine Hanover** (Germany) lead all tier 2 entities with the highest activity rate of literature publications.

Tier 2 Entities – Timeline and Total Activity

Tier 2 Entities	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Total
Seoul Natl Univ		3			1	1			1	1	1	1				9
Texas A&M Univ								2	1	2	1	1	2			9
Univ Calif Los Angeles			2	1		2			1	1		1	1			9
Univ Vet Med Hannover	1						1	2	1	2	2					9
Iowa State Univ	1			1	1		1	2	2							8
Univ Belgrade		1	2	2		1				1			1			8
China Agr Univ		1				1			2	1				2		7
INRA		1						2			2	1		1		7
Univ Estadual Paulista Unesp								2			1	1	1	2		7
Univ Fed Minas Gerais				1		1					1	1	1	2		7
Univ Penn					1	1			1	1	2	1				7
Univ Washington						1		1	2		1	2				7

Interestingly, a large portion of tier 2 entities appear to be relatively new to this technology field. This is highlighted by many tier 2 entities, for example the **University Estadual Paulista - UNESP** (Brazil) and **Federal University of Minas Gerais** (Brazil), having increased literature activity in the 2009 – 2013 periods compared to the 2000 – 2008 periods.

TIER 3 ENTITIES

Due to the small number of literature publications associated with tier 3 entities in the data set, constructing meaningful metrics around such small entity publication numbers is difficult and has not been undertaken. The literature records associated with these entities can be viewed in the accompanying ‘raw’ data with this report.

LITERATURE TECHNICAL ANALYSIS

This chapter of the report focuses on the technical attributes of the literature in the collection. The documents in the collection were aggregated into the following technical categories. The following table shows the number of publications relating to these categories and it should be noted that one publication can appear in multiple categories.

Taxonomy - Literature

Technical Categories			Inventions
01 Animals		01.01 Cat / Feline	20
		01.02 Dogs / Canine	104
		01.03 Duck	6
		01.04 Turkey	8
		01.05 Chicken	30
		01.06 Pig / Porcine / Swine	247
		01.07 Sheep	89
		01.08 Goat	51
		01.09 Buffalo / Ox / Cow / Bovine	692
		01.10 Camel	11
		01.11 Deer / Cervidae	7
		01.12 Horse	19
		01.13 Rabbit	30
		01.14 Other Animals	51
02 Blood Components		02.01 Erythrocyte	73
		02.02 Leukocytes	118
		02.03 Platelets	53
		02.04 Plasma	338
		02.05 Whole Blood	53
		02.06 Serum	674
03 Process		03.01 Collection / Extraction	77
		03.02 Transportation	44
		03.03 Anticoagulation	9
		03.04 Homogenization	6
		03.05 Inspection	9
		03.06 Separation	5
		03.07 Centrifugation	29
		03.08 Cooling	3
		03.09 Freezing	33
		03.10 Heating - Temperature Regulation	24
	03.11 Filtration	03.11.01 Ultra-filtration Membrane Processing	35
		03.11.02 Nanofiltration Membrane Processing	3
		03.11.03 Microfilteration Membrane Processing	1
	03.12 Drying	03.12.01 Spray Drying	18
		03.12.02 Other Drying Methods	8
		03.13 Decoloration Process	6
		03.14 Preservation / Storage	57
		03.15 Sterilization	29

04 Bioactives	04.01 Proteins	04.01.01 Plasma Proteins	145
		04.01.02 Serum	674
		04.01.03 Immunoglobulin	149
		04.01.04 Fibrinogen	30
		04.01.05 Albumin	412
		04.01.06 Lipoproteins	16
		04.01.07 C-reactive Protein	3
		04.01.08 Transferrin	12
		04.01.09 Globulin	21
		04.01.10 Hemoglobin	96
		04.01.11 Haptoglobin	9
		04.01.12 Glycoprotein	13
		04.01.13 Prothrombin	5
		04.01.14 Plasminogen	6
		04.01.15 Interferon	12
		04.01.16 Proteins in General	42
	04.02 Enzymes	04.02.01 Transglutaminase	4
		04.02.02 Superoxide Dismutase	4
		04.02.03 Thrombin	11
		04.02.04 Enzymes in General	103
		04.03 Opioid	1
		04.04 Fatty Acids	43
		04.05 Lipids	40
		04.06 Oligosaccharides / Polysaccharides	13
		04.07 Antioxidants	36
		04.08 Antimicrobials	43
		04.09 Growth Stimulating	10
		04.10 Other Bioactives	4
05 Applications	05.01 Food / Beverages	05.01.01 Color Enhancement	2
		05.01.02 Emulsifier	7
		05.01.03 Fat Replacer	1
		05.01.04 Binder	14
		05.01.05 Food In General	203
		05.02 Animal Feed	7
		05.03 Aquaculture	2
		05.04 Nutraceuticals	37
		05.05 Fertilizers	6
		05.06 Cosmetics	11
		05.07 Laboratory Research / Testing	269
		05.08 General Health Care	1
		05.09 Pharmaceutical	266
		05.10 Biopolymers	1

Literature associated with 'buffalo / ox / cow / bovine' was highly represented in the dataset in terms of the animal involved. Literature directed toward 'pig / porcine / swine' was the next most populated category. In terms of blood component, literature associated with 'serum[1]' or 'plasma' was found abundantly in the data.

'Process' related literature did not have any exceptional stand out categories that were observed however processes directed toward 'collection / extraction', 'preservation / storage' and 'transportation' had the highest instances of literature for this category. Literature directed to 'bioactives' revealed high amounts of literature associated with 'serum' and 'albumin' technology. Literature associated with 'enzymes in general' was well populated.

[1] 'Serum' associated technology is represented in both the 'blood components' and 'bioactives' technology categories as it was found to be prominent when referred to in each category's context.

Applications of this technology directed to ‘food in general’, ‘laboratory research / testing’ and ‘pharmaceutical’ uses were the most active. Interestingly, the literature results mirror the patent results in this application area of this technology.

TIMELINE OF TECHNICAL CATEGORY

The table below shows the filing activity timelines for all literature publications in the dataset sorted by technology. Darker shades of blue in the following table help show where increased literature activity has occurred. Lighter shades of blue / gray highlight where less activity has occurred.

With this in mind, it can be clearly seen that some of the technology areas highlighted are increasing in activity over time. Technology associated with ‘buffalo / ox / cow / bovine’, blood components which include ‘plasma’ or ‘serum’ and bioactive related technology associated with ‘albumin’ can all be seen to be strongly increasing in activity over time.

In contrast, there are technology areas that are stagnant or have very little literature activity occurring. These technologies are located by their low levels of activity or complete lack of activity (shown by blank or white cells). Examples of this include ‘microfiltration membrane processing’, ‘opioid’ related enzyme technology and applications related to food / beverage ‘fat replacers’, ‘general health care’ and ‘biopolymers’.

Timeline of Technology

Technical Categories			00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
01 Animals		01.01 Cat / Feline	3	2	1			2		2		1	3	2	2	2	
		01.02 Dogs / Canine	2	6	6	2	3	8	12	12	9	7	9	12	11	5	
		01.03 Duck					2			1				2		1	
		01.04 Turkey					1		1			1	3	1		1	
		01.05 Chicken		2	1	2	1	4	1	1	1		4	4	5	4	
		01.06 Pig / Porcine / Swine	17	17	13	16	15	9	17	22	15	21	12	22	30	19	2
		01.07 Sheep	3	2	2	8	8	5	3	13	6	7	8	13	6	4	1
		01.08 Goat	4			5	3	3	5	5	4	5	1	9	3	4	
		01.09 Buffalo / Ox / Cow / Bovine	31	32	29	28	34	39	49	67	49	51	79	78	65	57	4
		01.10 Camel	1	1	1		1			1		1	1			4	
		01.11 Deer / Cervidae								2		2	2		1		
		01.12 Horse	1	1	4	1	2	1			1	1	2	1	1	3	
		01.13 Rabbit	2	3	1	2	2		3	5		1	2	3	4	2	
		01.14 Other Animals	3	6	1		1	1	3	8	6	3	8	6	3	1	1
02 Blood Components		02.01 Erythrocyte	3	3	5	2	5	5	5	9	6	6	8	8	4	4	
		02.02 Leukocytes	5	5	7	4	3	10	12	11	10	6	12	13	15	5	
		02.03 Platelets	1	2	4	4	2	5	2	6	3	4	6	3	8	3	
		02.04 Plasma	21	25	16	16	20	20	25	35	18	29	22	34	32	20	5
		02.05 Whole Blood	3	4	3	2	2	1	2	4	2	2	6	7	8	7	
		02.06 Serum	30	34	29	24	29	36	47	66	55	43	77	78	62	60	4
03 Process		03.01 Collection / Extraction	3	5	1	3	3	4	5	4	8	7	8	14	6	6	
		03.02 Transportation	3	2	3	1	1		1	3	3	4	4	7	6	6	
		03.03 Anticoagulation		2		3		1	1				1		1		
		03.04 Homogenization			1			1	1				1	1		1	
		03.05 Inspection		1				1		1	1		2	2		1	
		03.06 Separation	1	2						1		1					
		03.07 Centrifugation	1	3		1		1		2	1	2	4	6	6	2	
		03.08 Cooling								1		1			1		
		03.09 Freezing	3		1	3	2	2	2	2		2	5	6	1	4	
		03.10 Heating - Temperature Regulation	1	5				1	2	2	2	3	2	4	1	1	
	03.11 Filtration	03.11.01 Ultra-filtration Membrane Processing	4	2	2	3		3		2	4		2	8	2	3	
		03.11.02 Nanofiltration Membrane Processing											1	1		1	
		03.11.03 Microfilteration Membrane Processing											1				
	03.12 Drying	03.12.01 Spray Drying	1	1	2	1	3	1	1	1			1	1	1	3	1
		03.12.02 Other Drying Methods								1		1	3	2		1	
		03.13 Decoloration Process	1	1						1		1	1	1			
		03.14 Preservation / Storage		2	3	2	3	1	5	7	7	4	7	6	2	7	1
		03.15 Sterilization	3		1	1	1	3		3	2	3	5	4	3		

04 Bioactives	04.01 Proteins	04.01.01 Plasma Proteins	10	9	10	10	9	7	8	15	11	10	9	17	9	10	1
		04.01.02 Serum	30	34	29	24	29	36	47	66	55	43	77	78	62	60	4
		04.01.03 Immunoglobulin	10	6	4	7	10	6	10	21	11	13	14	12	13	12	
		04.01.04 Fibrinogen	1	3	1	2	1	1	3	5	1	2	4	2	4		
		04.01.05 Albumin	18	20	17	15	11	19	28	39	36	28	52	50	38	38	3
		04.01.06 Lipoproteins	1	1	2	2			1	1	2		2	2	1		1
		04.01.07 C-reactive Protein							1				1			1	
		04.01.08 Transferrin		1		1		2	1	1	1		2			3	
		04.01.09 Globulin	2	5			1	1	2	2	2		1	1	3	1	
		04.01.10 Hemoglobin	4	6	5	5	6	3	8	7	7	8	9	15	5	7	1
		04.01.11 Haptoglobin		1		1			1				1	2	1	2	
		04.01.12 Glycoprotein			3	1			3	1		2		2	1		
		04.01.13 Prothrombin			1	1			1						2		
		04.01.14 Plasminogen		1			1	1	1	2							
		04.01.15 Interferon					2	2	1	1		1	1	2	2		
		04.01.16 Proteins in General	4	2		3	2	5	3	4	3	3	5	3	1	4	
	04.02 Enzymes	04.02.01 Transglutaminase		1						1		2					
		04.02.02 Superoxide Dismutase						1							1	1	1
		04.02.03 Thrombin		1	2	1			1	2		3			1		
		04.02.04 Enzymes in General	7	6	2	6	5	5	9	10	9	9	11	11	6	7	
		04.03 Opioid													1		
		04.04 Fatty Acids	3	2	2	1	1	4	2	5	4	2	3	7	5	2	
		04.05 Lipids	2	3	1	2	2	1	2	7	2		4	5	5	3	1
		04.06 Oligosaccharides / Polysaccharides	2			2	1				3		2	1		2	
		04.07 Antioxidants			1	2		1	3	3		1	3	6	7	8	1
		04.08 Antimicrobials	1	2	3	3	3	2	4	4		3	4	7	4	3	
		04.09 Growth Stimulating				1		1	1	1	1		2	1	1	1	
		04.10 Other Bioactives								1	1				1	1	
05 Applications	05.01 Food / Beverages	05.01.01 Color Enhancement								1					1		
		05.01.02 Emulsifier		1		2				1		1	1			1	
		05.01.03 Fat Replacer				1											
		05.01.04 Binder			2	2		1	3	2				3		1	
		05.01.05 Food In General	5	6	6	7	10	9	17	16	13	11	23	31	27	20	2
		05.02 Animal Feed			2					2	1				1	1	
		05.03 Aquaculture										1		1			
		05.04 Nutraceuticals	3	1	2	1	2	2		3	4		2	8	5	3	1
		05.05 Fertilizers								1	1		2	1		1	
		05.06 Cosmetics					1		2	1	2		2	1	1	1	
		05.07 Laboratory Research / Testing	8	12	10	12	12	11	22	27	24	21	23	35	30	20	2
		05.08 General Health Care											1				
		05.09 Pharmaceutical	4	10	6	11	10	8	18	25	20	24	32	40	30	27	1
		05.10 Biopolymers												1			

TIER 1 TECHNICAL CATEGORY

The following table shows all tier 1 entities split by technical category.

Tier 1 Entities by Technical Category

Technical Categories			Chinese Acad Sci	Wuhan Univ	Univ Girona	Cent S Univ	Univ Illinois
01 Animals		01.01 Cat / Feline	0	0	0	0	1
		01.02 Dogs / Canine	0	0	0	0	2
		01.03 Duck	1	0	0	0	0
		01.04 Turkey	0	0	0	0	1
		01.05 Chicken	0	0	0	0	2
		01.06 Pig / Porcine / Swine	3	0	11	0	3
		01.07 Sheep	0	0	0	0	0
		01.08 Goat	0	0	0	0	0
		01.09 Buffalo / Ox / Cow / Bovine	16	17	7	10	6
		01.10 Camel	2	0	0	0	0
		01.11 Deer / Cervidae	1	0	0	0	0
		01.12 Horse	0	0	0	0	0
		01.13 Rabbit	1	0	0	0	0
		01.14 Other Animals	0	0	0	0	0
02 Blood Components		02.01 Erythrocyte	0	0	4	0	0
		02.02 Leukocytes	0	0	0	0	1
		02.03 Platelets	0	0	0	0	0
		02.04 Plasma	4	0	10	0	3
		02.05 Whole Blood	0	0	1	0	0
		02.06 Serum	14	17	4	10	6
03 Process		03.01 Collection / Extraction	0	0	0	0	2
		03.02 Transportation	0	1	0	0	1
		03.03 Anticoagulation	0	0	0	0	0
		03.04 Homogenization	0	0	0	0	0
		03.05 Inspection	0	0	2	0	0
		03.06 Separation	0	0	0	0	0
		03.07 Centrifugation	1	0	0	1	0
		03.08 Cooling	0	0	0	0	0
		03.09 Freezing	0	0	0	0	0
		03.10 Heating - Temperature Regulation	0	0	2	0	0
	03.11 Filtration	03.11.01 Ultra-filtration Membrane Processing	0	0	0	1	1
		03.11.02 Nanofiltration Membrane Processing	0	0	0	0	0
		03.11.03 Microfilteration Membrane Processing	0	0	0	0	0
	03.12 Drying	03.12.01 Spray Drying	0	0	2	0	3
		03.12.02 Other Drying Methods	0	0	0	0	0
		03.13 Decoloration Process	0	0	1	0	0
		03.14 Preservation / Storage	0	0	3	0	0
		03.15 Sterilization	0	0	0	0	0

04 Bioactives	04.01 Proteins	04.01.01 Plasma Proteins	1	0	7	0	5
		04.01.02 Serum	14	17	4	10	6
		04.01.03 Immunoglobulin	3	0	0	0	2
		04.01.04 Fibrinogen	0	0	1	0	0
		04.01.05 Albumin	14	17	4	10	2
		04.01.06 Lipoproteins	0	0	0	0	1
		04.01.07 C-reactive Protein	0	0	0	0	0
		04.01.08 Transferrin	0	0	0	0	0
		04.01.09 Globulin	0	0	2	0	0
		04.01.10 Hemoglobin	4	0	6	1	1
		04.01.11 Haptoglobin	0	0	0	0	0
		04.01.12 Glycoprotein	0	0	0	0	0
		04.01.13 Prothrombin	0	0	0	0	0
		04.01.14 Plasminogen	0	0	0	0	0
		04.01.15 Interferon	0	0	0	0	0
		04.01.16 Proteins in General	3	0	1	0	0
	04.02 Enzymes	04.02.01 Transglutaminase	0	0	2	0	0
		04.02.02 Superoxide Dismutase	0	0	0	0	0
		04.02.03 Thrombin	0	0	0	0	0
		04.02.04 Enzymes in General	4	0	0	0	0
		04.03 Opioid	0	0	0	0	0
		04.04 Fatty Acids	0	0	0	1	3
		04.05 Lipids	0	0	0	0	2
		04.06 Oligosaccharides / Polysaccharides	1	0	0	0	0
		04.07 Antioxidants	0	0	0	2	0
		04.08 Antimicrobials	0	0	0	0	0
		04.09 Growth Stimulating	0	0	0	0	0
		04.10 Other Bioactives	0	0	0	0	0
05 Applications	05.01 Food / Beverages	05.01.01 Color Enhancement	0	0	0	0	0
		05.01.02 Emulsifier	0	0	1	0	0
		05.01.03 Fat Replacer	0	0	0	0	0
		05.01.04 Binder	0	1	0	1	0
		05.01.05 Food In General	4	1	4	2	3
		05.02 Animal Feed	0	0	0	0	0
		05.03 Aquaculture	0	0	0	0	0
		05.04 Nutraceuticals	0	0	4	1	0
		05.05 Fertilizers	1	0	0	0	0
		05.06 Cosmetics	0	0	0	0	0
		05.07 Laboratory Research / Testing	6	0	0	0	0
		05.08 General Health Care	0	0	0	0	0
		05.09 Pharmaceutical	6	5	0	5	2
		05.10 Biopolymers	0	0	0	0	0

Interestingly, the five tier 1 entities shown above seem to be prominent in many of the same technology categories. All appear to have technology focused in utilizing ‘buffalo / ox / cow / bovine’ in their blood product applications. Additionally, technology associated with blood ‘serum’ and ‘albumin’ technology is also prominent. Most literature from these tier 1 entities also appears to be directed toward ‘food in general’ and ‘pharmaceutical’ applications.

There are some differences however. The **Chinese Academy of Science** (China) has literature directed to utilizing the blood of other animals such as ‘ducks’, ‘camels’, ‘deer’ and ‘rabbits’, whereas the **University of Illinois** (United States) has technology utilizing ‘dog / canine’, ‘turkey’ and ‘chicken’ associated blood technology. In terms of bioactives, the **Chinese Academy of Science** (China) and **University of Illinois** (United States) both have interest in ‘immunoglobin’ and ‘hemoglobin’ related technology.

Literature discussing the 'process' related to animal blood technology, appears not to be prominently discussed within the literature for all tier 1 entities. This is highlighted by the low levels of activity shown in this technology category. Interestingly, the **Chinese Academy of Science** (China), **Wuhan University** (China) and **Central South University** (China) have very little mention of any process related literature within the dataset. The **University of Girona** (Spain) does however have small pockets of literature in this category directed to 'inspection', 'heating – temperature regulation', 'spray drying', 'decoloration process' and 'preservation / storage'.

In terms of the application of the blood product, The **University of Girona** (Spain) has a high interest in 'nutraceutical' applications. The **Chinese Academy of Science** (China) has significant numbers of literature directed to 'laboratory research / testing' and **University of Illinois** (United States) has literature associated with 'emulsifiers' for food / beverage technology.

PROFILE OF TECHNICAL CATEGORIES

The table below shows a summary profile for each of the technical categories. The analysis includes the following measurements and indicators for each technical category:

- The total number of publications in each technical area.
- The most prolific entity within the field based on all entities in the literature dataset
- Total citations
- The average citation impact of the publications associated with the topic
- Recency of the inventive effort (% filed since 2009)

Technical Categories			Total Publications	Most Prolific Entity	Total Citations	Citation Impact*	% of Collection Published from 2009 to present
01 Animals		01.01 Cat / Feline	20	MULTIPLE	188	9.4	50%
		01.02 Dogs / Canine	104	Univ Washington	1059	10.2	42%
		01.03 Duck	6	MULTIPLE	41	6.8	50%
		01.04 Turkey	8	MULTIPLE	60	7.5	75%
		01.05 Chicken	30	MULTIPLE	153	5.1	57%
		01.06 Pig / Porcine / Swine	247	Univ Girona	1509	6.1	43%
		01.07 Sheep	89	INRA	545	6.1	44%
		01.08 Goat	51	MULTIPLE	126	2.5	43%
		01.09 Buffalo / Ox / Cow / Bovine	692	Wuhan Univ	7663	11.1	48%
		01.10 Camel	11	Chinese Acad Sci	26	2.4	55%
		01.11 Deer / Cervidae	7	MULTIPLE	37	5.3	71%
		01.12 Horse	19	Univ Caldas	243	12.8	42%
		01.13 Rabbit	30	MULTIPLE	175	5.8	40%
		01.14 Other Animals	51	F Hoffmann La Roche & Co Ltd	581	11.4	43%
02 Blood Components		02.01 Erythrocyte	73	Univ Girona	384	5.3	41%
		02.02 Leukocytes	118	MULTIPLE	734	6.2	43%
		02.03 Platelets	53	MULTIPLE	699	13.2	45%
		02.04 Plasma	338	Univ Girona	3307	9.8	42%
		02.05 Whole Blood	53	Univ Caldas	305	5.8	57%
		02.06 Serum	674	Wuhan Univ	7272	10.8	48%
03 Process		03.01 Collection / Extraction	77	MULTIPLE	572	7.4	53%
		03.02 Transportation	44	MULTIPLE	384	8.7	61%
		03.03 Anticoagulation	9	MULTIPLE	114	12.7	22%
		03.04 Homogenization	6	MULTIPLE	20	3.3	50%
		03.05 Inspection	9	MULTIPLE	44	4.9	56%
		03.06 Separation	5	MULTIPLE	2	0.4	20%
		03.07 Centrifugation	29	MULTIPLE	260	9.0	69%
		03.08 Cooling	3	MULTIPLE	10	3.3	67%
		03.09 Freezing	33	MULTIPLE	437	13.2	55%
		03.10 Heating - Temperature Regulation	24	MULTIPLE	226	9.4	46%
	03.11 Filtration	03.11.01 Ultra-filtration Membrane Processing	35	Indian Inst Technol	411	11.7	43%
		03.11.02 Nanofiltration Membrane Processing	3	MULTIPLE	6	2.0	100%
		03.11.03 Microfilteration Membrane Processing	1	Indian Inst Technol	5	5.0	100%
	03.12 Drying	03.12.01 Spray Drying	18	Univ Illinois	253	14.1	39%
		03.12.02 Other Drying Methods	8	MULTIPLE	23	2.9	88%
		03.13 Decoloration Process	6	MULTIPLE	33	5.5	50%
		03.14 Preservation / Storage	57	MULTIPLE	501	8.8	47%
		03.15 Sterilization	29	MULTIPLE	179	6.2	52%

04 Bioactives	04.01 Proteins	04.01.01 Plasma Proteins	145	Univ Girona	1600	11.0	39%
		04.01.02 Serum	674	Wuhan Univ	7272	10.8	48%
		04.01.03 Immunoglobulin	149	Florida State Univ	1456	9.8	43%
		04.01.04 Fibrinogen	30	MULTIPLE	376	12.5	40%
		04.01.05 Albumin	412	Wuhan Univ	5019	12.2	51%
		04.01.06 Lipoproteins	16	MULTIPLE	125	7.8	38%
		04.01.07 C-reactive Protein	3	MULTIPLE	17	5.7	67%
		04.01.08 Transferrin	12	Yangzhou Univ	165	13.8	42%
		04.01.09 Globulin	21	Univ Girona	296	14.1	29%
		04.01.10 Hemoglobin	96	Univ Girona	707	7.4	47%
		04.01.11 Haptoglobin	9	MULTIPLE	77	8.6	67%
		04.01.12 Glycoprotein	13	MULTIPLE	219	16.8	38%
		04.01.13 Prothrombin	5	MULTIPLE	42	8.4	40%
		04.01.14 Plasminogen	6	MULTIPLE	89	14.8	0%
		04.01.15 Interferon	12	MULTIPLE	152	12.7	50%
		04.01.16 Proteins in General	42	MULTIPLE	232	5.5	38%
	04.02 Enzymes	04.02.01 Transglutaminase	4	Univ Girona	39	9.8	50%
		04.02.02 Superoxide Dismutase	4	MULTIPLE	12	3.0	75%
		04.02.03 Thrombin	11	McMaster Univ	148	13.5	36%
		04.02.04 Enzymes in General	103	MULTIPLE	1174	11.4	43%
		04.03 Opioid	1	MULTIPLE	0	0.0	100%
		04.04 Fatty Acids	43	Univ Illinois	539	12.5	44%
		04.05 Lipids	40	MULTIPLE	405	10.1	45%
		04.06 Oligosaccharides / Polysaccharides	13	Univ Fed Sao Carlos	202	15.5	38%
		04.07 Antioxidants	36	MULTIPLE	277	7.7	72%
		04.08 Antimicrobials	43	Dankook Univ	414	9.6	49%
		04.09 Growth Stimulating	10	MULTIPLE	157	15.7	50%
		04.10 Other Bioactives	4	MULTIPLE	5	1.3	50%
05 Applications	05.01 Food / Beverages	05.01.01 Color Enhancement	2	MULTIPLE	4	2.0	50%
		05.01.02 Emulsifier	7	Univ Fed Minas Gerais	104	14.9	43%
		05.01.03 Fat Replacer	1	Univ Fed Minas Gerais	13	13.0	0%
		05.01.04 Binder	14	MULTIPLE	209	14.9	29%
		05.01.05 Food In General	203	Dankook Univ	1649	8.1	56%
		05.02 Animal Feed	7	Florida State Univ	41	5.9	29%
		05.03 Aquaculture	2	MULTIPLE	16	8.0	100%
		05.04 Nutraceuticals	37	MULTIPLE	324	8.8	51%
		05.05 Fertilizers	6	MULTIPLE	49	8.2	67%
		05.06 Cosmetics	11	MULTIPLE	124	11.3	45%
		05.07 Laboratory Research / Testing	269	Chinese Acad Sci	2350	8.7	49%
		05.08 General Health Care	1	Univ Estadual Paulista Unesp	6	6.0	100%
		05.09 Pharmaceutical	266	Chinese Acad Sci	3019	11.3	58%
		05.10 Biopolymers	1	MULTIPLE	4	4.0	100%

This analysis makes for insightful reading. Many of the technologies do not have standout entities that are prominent. Instead, there are many entities that are prominent or have shown interest in many of the categories. Process related technology (in general) is a good example of this. Only the **Indian Institute of Technology** (India) and the **University of Illinois** (United States) lead technology related to 'filtration' and 'drying' process technology, other related technology is populated by multiple entities.

There are technology fields represented that have had 100% of their literature published since 2009. Some categories that fit these criteria have low total publication numbers; however they are still shown to be recent. Technology that match this criteria includes 'nanofiltration membrane processing', 'microfilteration membrane processing', 'opioid' related bioactive technology and applications of the technology directed toward 'aquaculture', 'general health care' and 'biopolymers'.

Citation impact shows the extent that a publication within a technology has been cited by other publications therefore providing insight into the perceived interest and importance of literature published within that technology field. Understanding this, we can see there are a number of technologies which have high citation impact values. The highest recorded value (16.8) was given to 'glycoprotein' associated bioactives. This technology may have low levels of activity (13 publications) however due to the high citation impact, it can be said that the technology involved is of a high and innovative quality.

CROSS TECHNOLOGY CHARTS

The matrix on the next page shows a cross-correlation of all technical categories in the data set, with the heat-map showing highly correlated categories. The matrix suggests there could be a “literature gap” (areas in a lighter shade of blue or white) in technology areas where there is little or no activity, but where **Meat & Livestock Australia** experts may consider having potential. Please note that due to the number of technology categories and large size of the cross technology chart, a table has not been provided in this report. The full cross technology table can be viewed in the corresponding excel work file under the tab labeled ‘**cross charts’**.

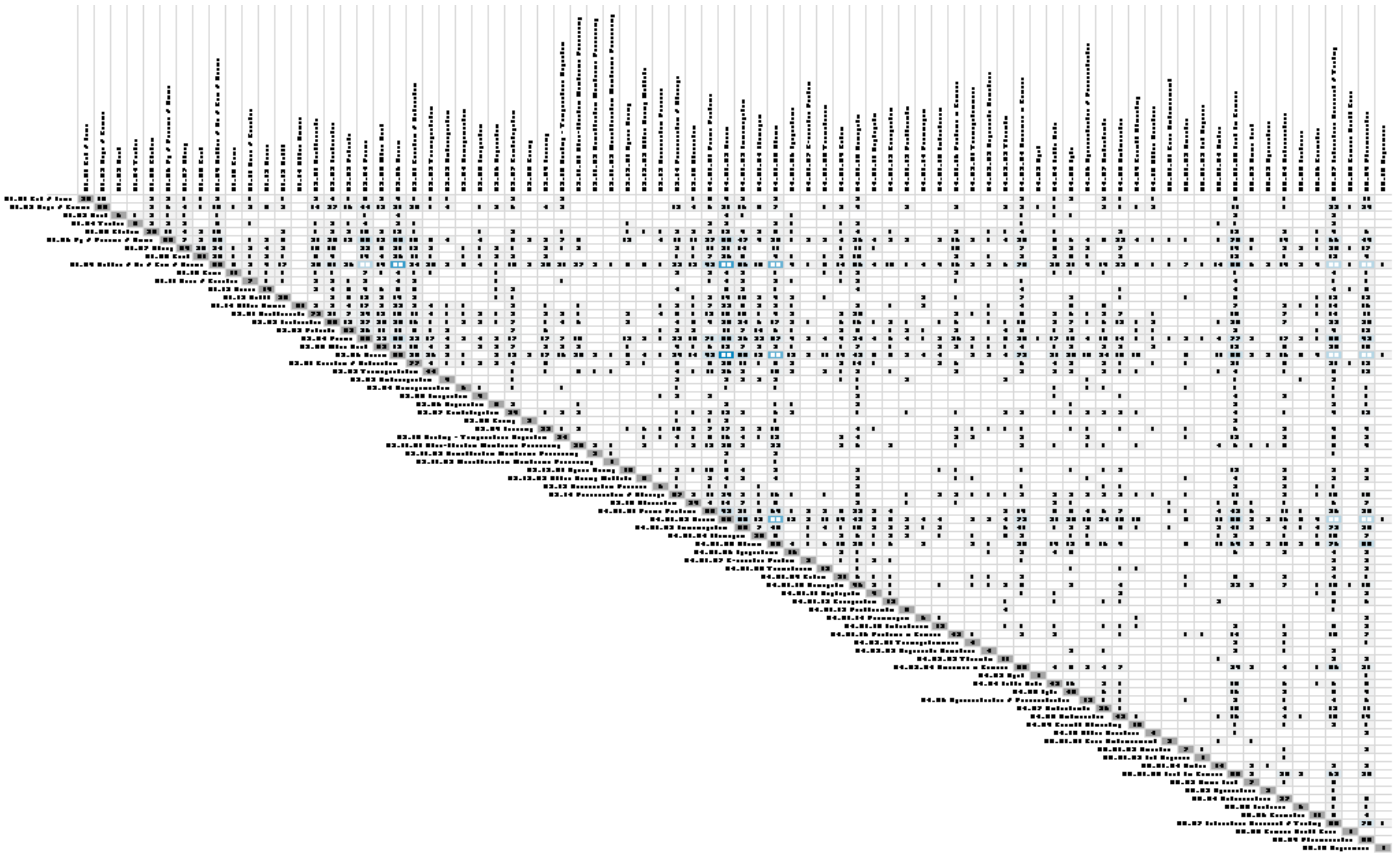
There appear to be multiple areas of low activity relating to this category including many technology areas relating to the ‘process’ associated with animal blood technology. These include ‘anticoagulation’, ‘homogenization’, ‘inspection’, ‘separation’, ‘cooling’, filtration related processes including ‘nanofiltration’ and ‘microfilitration’ membrane processing. A number of bioactive proteins and enzymes are also represented in low numbers in the literature dataset and therefore in low numbers when compared with other technology categories. Examples of these include ‘c-reactive proteins’, ‘transglutaminase’ and ‘superdioxide dismutase’. Examples of animal blood products ‘applications’ in which low activity across all technology category areas was observed included ‘biopolymers’ and ‘color enhancement’ in food / beverages applications.

In general, areas of high literature publication usually represent a low interest of perceived commercialization opportunity. A low indication of activity in literature publications could equate to more interest in patent strategy and commercialization in that technology area or a lack of interest in the technology in general potentially due to low expertise, lack of need or budgetary requirements for research and development.

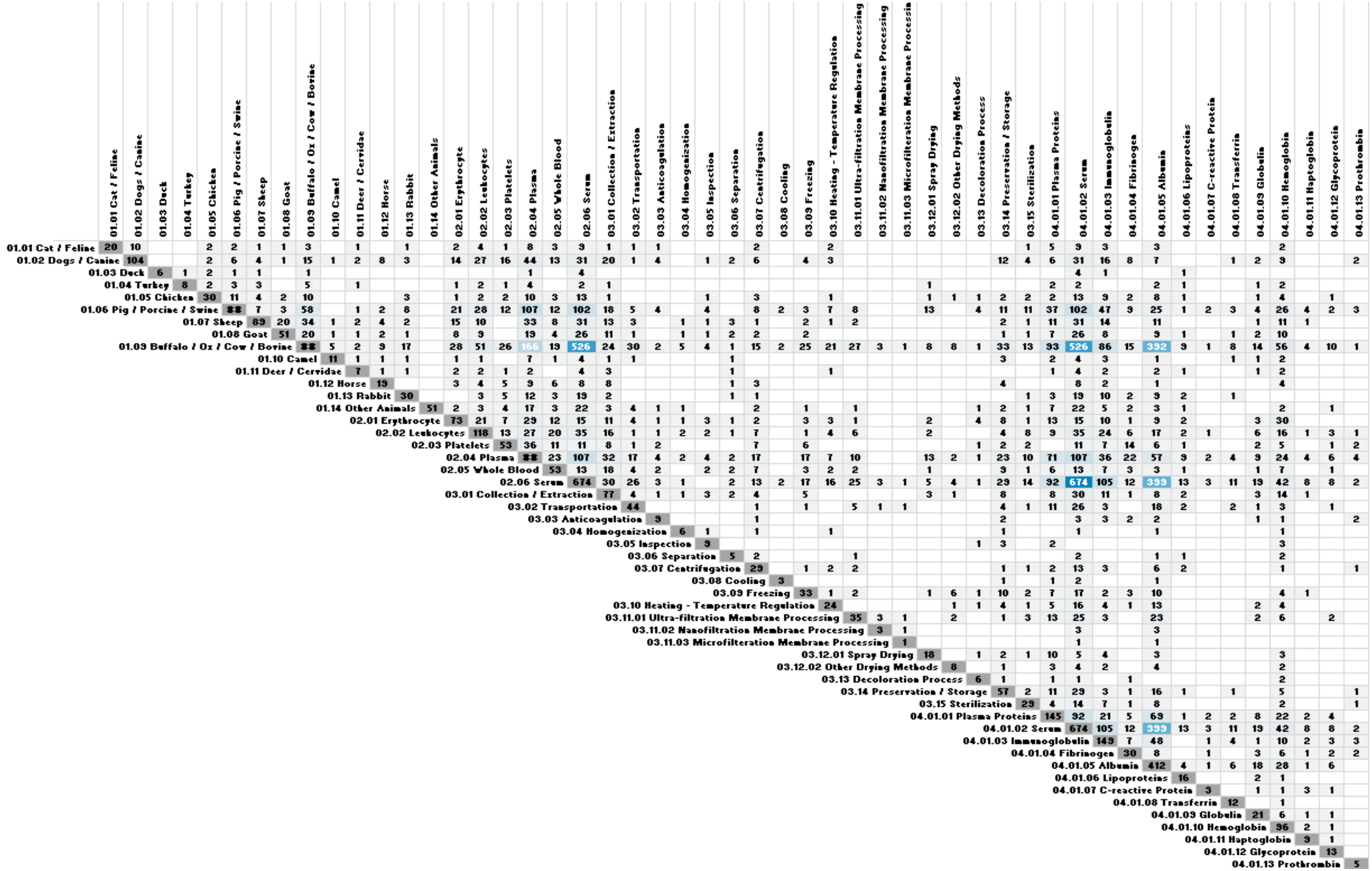
The full literature cross technology chart is represented below. Please note that this cross technology chart is very large due to the numerous technologies involved. This chart has can be viewed in sections over the next few pages of this report. The full chart can be viewed in its entirety (more easily) in the corresponding excel work file that is provided with this report.

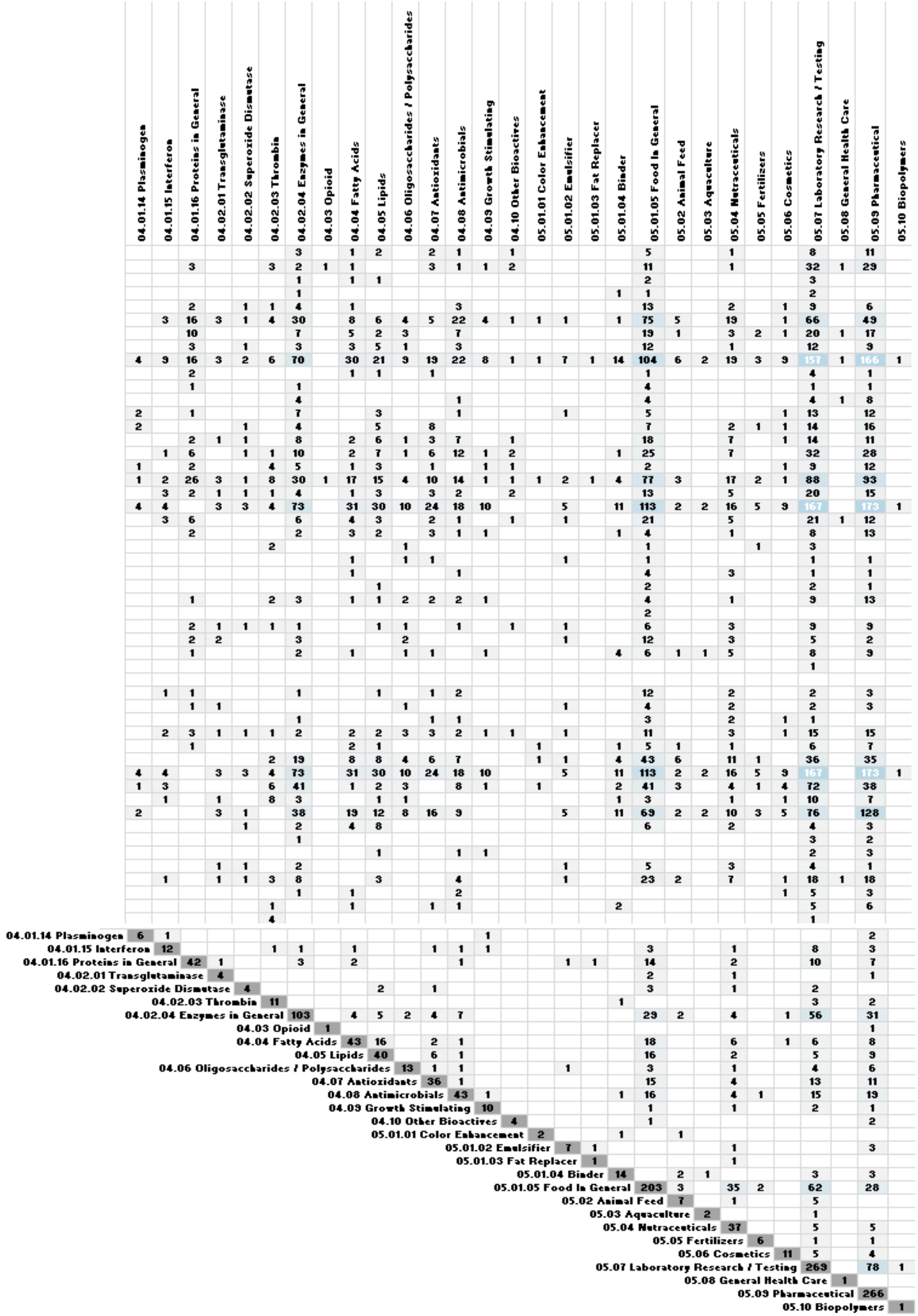
The full literature cross technology chart is represented below. Please note that this cross technology chart is very large due to the numerous technologies involved. This chart has can be viewed in sections over the next few pages of this report. The full chart can be viewed in its entirety in the corresponding excel work file that is provided with this report.

Literature Cross Technology Chart (Total Chart View)



(Table expanded on pages 71 & 72)


01.01 Cat / Feline
01.02 Dogs / Canine
01.03 Duck
01.04 Turkey
01.05 Chicken
01.06 Pig / Porcine / Swine
01.07 Sheep
01.08 Goat
01.09 Buffalo / Ox / Cow / Bovine
01.10 Camel
01.11 Deer / Cervidae
01.12 Horse
01.13 Rabbit
01.14 Other Animals
02.01 Erythrocyte
02.02 Leukocytes
02.03 Platelets
02.04 Plasma
02.05 Whole Blood
02.06 Serum
03.01 Collection / Extraction
03.02 Transportation
03.03 Anticoagulation
03.04 Homogenization
03.05 Inspection
03.06 Separation
03.07 Centrifugation
03.08 Cooling
03.09 Freezing
03.10 Heating - Temperature Regulation
03.11.01 Ultra-filtration Membrane Processing
03.11.02 Nanofiltration Membrane Processing
03.11.03 Microfilteration Membrane Processing
03.12.01 Spray Drying
03.12.02 Other Drying Methods
03.13 Decoloration Process
03.14 Preservation / Storage
03.15 Sterilization
04.01.01 Plasma Proteins
04.01.02 Serum
04.01.03 Immunoglobulin
04.01.04 Fibrinogen
04.01.05 Albumin
04.01.06 Lipoproteins
04.01.07 C-reactive Protein
04.01.08 Transferrin
04.01.09 Globulin
04.01.10 Hemoglobin
04.01.11 Haptoglobin
04.01.12 Glycoprotein
04.01.13 Prothrombin


04.01.14 Plasminogen
04.01.15 Interferon
04.01.16 Proteins in General
04.02.01 Transglutaminase
04.02.02 Superoxide Dismutase
04.02.03 Thrombin
04.02.04 Enzymes in General
04.03 Opioid
04.04 Fatty Acids
04.05 Lipids
04.06 Oligosaccharides / Polysaccharides
04.07 Antioxidants
04.08 Antimicrobials
04.09 Growth Stimulating
04.10 Other Bioactives
05.01.01 Color Enhancement
05.01.02 Emulsifier
05.01.03 Fat Replacer
05.01.04 Binder
05.01.05 Food In General
05.02 Animal Feed
05.03 Aquaculture
05.04 Nutraceuticals
05.05 Fertilizers
05.06 Cosmetics
05.07 Laboratory Research / Testing
05.08 General Health Care
05.09 Pharmaceutical
05.10 Biopolymers

HIGH IMPACT PUBLICATIONS

Below is a list of top 'high impact' publications identified within the collection. Older documents however have had more opportunity to be cited. To compensate for this fact, age-weighted frequencies (average citations per year) have been calculated. Further investigation of these high impact literature publications may be warranted by **Meat & Livestock Australia.**

High Cited Publications	Age-Weighted Citation
Dissolving microneedles for transdermal drug delivery	**19.17**
Entity - Georgia Inst Technol; Kyungwon Univ	
Publication Year - 2008	
Times Cited - 115	
Studies of interaction between colchicine and bovine serum albumin by fluorescence quenching method	**19.00**
Entity - Wuhan Univ	
Publication Year - 2005	
Times Cited - 171	
Analysis of binding interaction between puerarin and bovine serum albumin by multi-spectroscopic method	**11.71**
Entity - Cent S Univ; Mem Sloan Kettering Canc Ctr; Nantong Univ; Okayama Prefectural Univ	
Publication Year - 2007	
Times Cited - 82	
Successful treatment of canine leukocyte adhesion deficiency by foamy virus vectors	**11.33**
Entity - NCI; NIH; Univ Washington	
Publication Year - 2008	
Times Cited - 68	
Comparison of six PCR methods using peripheral blood for detection of canine visceral leishmaniasis	**10.83**
Entity - Ctr Hosp Univ; Fac Med	
Publication Year - 2002	
Times Cited - 130	
Platelet-rich plasma and bovine porous bone mineral combined with guided tissue regeneration in the	**10.67**
Entity - Univ Belgrade; Univ Calif Los Angeles	
Publication Year - 2002	
Times Cited - 128	
Synthesis of a Novel Hydrazone Derivative and Biophysical Studies of Its Interactions with Bovine Serum Albumin by Spectroscopic, Electrochemical, and Molecular Docking Methods	**10.00**
Entity - Wuhan Univ	
Publication Year - 2010	
Times Cited - 40	
Conjugated linoleic acid suppresses triglyceride accumulation and induces apoptosis in 3T3-L1 preadipocytes	**9.21**
Entity - High Point Univ; Univ N Carolina	
Publication Year - 2000	
Times Cited - 129	
Effect of N(4)-Phenyl Substitution in 2-Oxo-1,2-dihydroquinoline-3-carbaldehyde Semicarbazones on the Structure, DNA/Protein Interaction, and Antioxidative and Cytotoxic Activity of Cu(II) Complexes	**9.00**
Bharathiar Univ; Texas A&M Univ	
Publication Year - 2011	
Times Cited - 27	

APPENDIX A – DATA COLLECTION

DATA COLLECTION STRATEGY

The patent collection was developed using the full patent content on Thomson Innovation®, which included the Derwent World Patent Index® (DWPI). The use of the patent content on Thomson Innovation ensures a comprehensive collection. The patent collections were normalised on the DWPI database structure to allow for accurate analysis. The Literature collection was also developed using the full content literature coverage on Thomson Innovation®, which includes Web of Science, Conference proceedings, Current Contents Connect and Inspec.

Data de-duplication was performed to remove literature references with identical accession numbers. Additionally, literature references with identical titles were subjected to preliminary screening to identify and eliminate redundant references. The net result of this step is unique literature references in the dataset.

Entity names were cleaned and unified to the extent possible so that known subsidiaries and merger and acquisition entities were grouped under a single company name for a more accurate view of the entities holdings.

Specifically, the search process returned a set of **1489** screened DWPI inventions. There were a total of **1122** literature results returned from the search process.

WHAT IS NOT INCLUDED?

The search strategies employed identified **1489** patented inventions and **1122** literature publications. There may have been other inventions developed which may not have been protected by patent or published as papers in journals. The inventors may have chosen to pursue the developments without patent protection or publishing literature. They may have chosen their ideas to be protected by trade secrets, which by their nature are not publically accessible.

DATA COUNTING DEFINITION

The DWPI database is structure around “patent families”[1].

Each related patent application and granted patent is added to the DWPI family record as it is [published. This being the case, all counts of records in the project refer to patent families or inventions, and not to individual patent documents. For example, United States granted, United States application and European application patent for a single invention family is counted in aggregate as “1” in all the analyses in this report unless otherwise noted.

This provided a more accurate measure of the level of inventive activity from an entity within the technical space, and a truer picture of the overall level of innovation across the field as a whole

COUNTS AND TOTALS, SCIENTIFIC PAPERS

The Web of Science database is formed around individual papers, articles, review studies and editorials published in its source journals.

Each record is therefore a unique article in the body of scientific literature. The date the journal containing the article was published is used throughout the report in all timelines and charts.

TIMELINES AND DATES

As each DWPI record contain potentially many individual application and publication events, this report utilises the earliest known priority filing date for each patent family. The tables and charts included in the report use these dates unless otherwise noted.

The patent and literature data in the collection had an earlier priority date of at least **2000**. Because of the way the data was collected, there is some data in the report that has an earliest priority date earlier that **2000**. To the extent possible, this data was removed from the analysis but it may remain in some of the aggregate findings.

[1] A single patent only provides a statutory monopoly for the patent technology within the legal jurisdiction of the authority that granted the patent. This means that inventors must file applications for a patent in each jurisdiction where they foresee a need for protection.

APPENDIX B – BACKGROUND ON CONSULTANT

Nick Solomon, based in Melbourne (Australia), delivers research and analysis projects and solutions using advanced statistical analysis of scientific and technical data sources and primary patent, trademark and literature information. The reports are designed to provide intelligence on technical or competitive trends to senior client executives and decision makers.

Nick's responsibilities also include providing expert insight and best practice knowledge on Thomson Reuters' products and services and assessing customer requirements.

In an earlier role, Nick managed Information Services of an Australian Intellectual Property Law firm for 10 years, where he became familiar with all aspects of the Intellectual Property field and analytics associated. Prior to this, Nick worked in research at the Commonwealth Scientific Industrial Research Organisation (CSIRO) and as an IP Administrator for a Co-operative research center.

Nick joined Thomson Reuters in 2013 and has a Bachelor of Applied Science (Biochemistry/Chemistry) from Swinburne University and a Diploma in Business / Management.