The first symposium on the applied techniques and industry economics in chinese beef cattle production

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Compte-rendu du 1er symposium sur la production de viande bovine en Chine

Le 1er symposium sur la production de viande bovine en Chine s'est tenu à Pékin du 26 au 28 juin 2015 sous l'égide du centre de recherche sur la production de viande bovine de l'Université d'Agriculture de Chine

Mots-clés : Viande bovine

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Cet article est une compilation des abstracts des conférences plénières présentées au 1er symposium sur la production de viande bovine en Chine par les conférenciers invités de différents pays ou organisations internationales (USA, Canada, Australie, France, Danemark, FAO).

Résumé :

Le centre de recherche sur la production de viande bovine de l'Université d'Agriculture de Chine a organisé le premier Symposium sur la production de viande bovine en Chine qui a eu lieu les 26-28 Juin 2015 à Pékin (http://www.bovine-online.org) avec pour thèmes la nutrition animale, l'alimentation des bovins et l'économie de la filière. Différents chercheurs des États-Unis, du Canada, d'Australie, de France, du Danemark, et de la FAO ont été invités comme conférenciers principaux. L'objectif de ce colloque était de présenter les concepts et les pratiques de pointe en matière de production de viande bovine afin de promouvoir la modernisation de l'industrie de la filière viande bovine en Chine. Il y eu environ 500 participants à ce colloque, parmi lesquels 60% étaient des professionnels de la filière, 20% des étudiants, 10% des fonctionnaires du gouvernement local, et 10% des professeurs d'université. Une interprétation simultanée anglais / chinois a été assurée lors de la conférence. Ce symposium a été sponsorisé par le centre de recherche sur la production de viande bovine de l'Université d'Agriculture de Chine et le Centre Sino-Français de recherche et de développement de la production de viande bovine. Cet article est une compilation des résumés des conférences plénières par les conférenciers invités, qui ont été préalablement publiés dans le Journal Chinois des Sciences Animales (Juin 2015, Volume 51).

Abstract: The First Symposium on the Applied Techniques and Industry Economics in Chinese Beef Cattle Production

The Beef Cattle Research Center of China Agricultural University has organized the First Symposium on the Chinese National Beef Cattle Nutrition, Feeding and Industry Economics in June, 2015 in Beijing (http://www.bovine-online.org). Experts from the United States, Canada, Australia, France, Denmark, and FAO of the United Nations have been invited to give plenary lectures at the Symposium. The goal of this Symposium was to introduce advanced concepts and practices in beef cattle to China and promote the modernization of China's beef cattle industry. There was approximately 500 participants to the Symposium, among which 60% are from industry, 20% are graduate students, 10% are local government officials, and 10% are university professors. Chinese/English simultaneous interpretation has been provided during the conference. This symposium has been sponsored by the Beef Cattle Research Center of China Agricultural University and the China-France Center for Beef Cattle Research and Development. This article are abstracts of the plenary lectures by experts from the United States, Canada, Australia, France, Denmark, and FAO of the United Nations, which have been previously published in Chinese Journal of Animal Science (June 2015, volume 51).

INTRODUCTION

Beef production and consumption in China has increased a lot since the economic reform and open economy policy in the late 1970s. However, the Chinese beef industry is still not yet completely organized. Furthermore, the Chinese beef industry is facing low productivity, which can be explained by some difficulties due to traditional practices (for example, cattle were used in the past as traction for agricultural work and not for milk and meat productions). These difficulties are associated with dispersion of small farms, reduced needs in animal traction, low digestible energy content of forage resources, lack of technical knowledge of small farmers, and delay in the genetic improvement of cattle breeds (Huang et *al*., 2013). Therefore, research and innovation are important for the beef industry in China to develop high quality beef. Meat quality includes quality traits related to the product itself (such each eating quality which is the subject of the last session of this symposium) and extrinsic qualities (for example sustainability and profitability which are the subject of the first and second sessions of this symposium). We also observe a general trend towards an increasing importance of environmental issues (reviewed by Hocquette et *al*., 2014) which can be addressed at least in part through animal nutrition and the best practice animal husbandry (sessions 4 and 5). Prevention of common diseases (addressed in session 5) is also a key factor to promote profitability. Due to the importance of all these topics, the Beef Cattle Research Center of China Agricultural University has organized the First Symposium on the Chinese National Beef Cattle Nutrition, Feeding and Industry Economics in June, 2015 in Beijing (http://www.bovine-online.org/) to disseminate knowledge regarding cattle husbandry to industry people. This article gathers abstracts of the plenary lectures by experts from the United States, Canada, Australia, France, Denmark, and FAO of the United Nations, which have been invited to present the latest research achievements regarding beef production in their respective countries or organizations.

SESSION 1: SUSTAINABLE BEEF CATTLE INDUSTRY

Mr. Zhongli Wang, the Deputy Directory-General from China's Ministry of Agriculture, gave a presentation in the first session after the opening conference. The presentation title was "the beef industry's production situation, development strategy and policy in China". He said that the beef industry in China is developing slowly. There are some limiting factors including the low degree of improved cattle genetics, the backward production techniques and the high risks of diseases. This year, the Ministry of Agriculture released a new policy about how to improve the development of the grass-fed animal husbandry. The policy focuses on the beef cattle, dairy and meat sheep with the major drives to change the production style, improvement of the profits and industry quality. Besides, the policy included three ideas about how to develop the beef cattle industry: the first is to improve the combination mode of farming and grazing, and to build a high-efficiency forage grass production system. The second is to promote the change of the development mode and to focus on building a new large scale operation, such as professional investors, family farms, farmer cooperatives and so on. The third is to improve support ability, and to use credit guarantee and interest subsidies to channel capital for improving the financial insurance support. The China Insurance Regulatory Commission and China Banking Regulatory Commission should strengthen cooperation to solve the huge capital investment and the difficulty of loaning in beef industry. Now, a new policy frame about strongly support of the beef industry has been came out by the China government. The policy frame includes supporting the project of building the standardization of livestock and poultry; the project of building standardized farms of beef cattle and mutton sheep; the project of increasing numbers of heifers and cow-calves; the project of giving the improved varieties subsidy and the project of making a demonstration of feeding crop residues and so on.

Prof Harinder Makkar from FAO presented the second conference. Prof Harinder Makkar argued that the generation of sound quantitative data at national levels is a prerequisite for sustainable livestock development as discussed by other authors for instance for better animal phenotyping (Hocquette et *al*., 2012b).

Increasing future demand for animal products will ensue a huge demand on feed resources. Sustainability of feed production systems is being challenged due to scarcity of soil and water, food–fuel–feed competition, ongoing global climate change and increasing competition for arable land and non-renewable resources. Increase in resource use efficiency is a key to efficient animal production and food security. Information on availability of resources including feeds is critical to effectively manage them. While feed inventories or feed assessments provide critical information on feed productive capacities and feed availability at a regional or country level, the sufficiency of the feed supply can only be assessed relative to demands for feeds. Essentially, this comparison between livestock requirements and feed supplies constitutes the feed balance. In many countries feed balances at region, country or season levels are not usually available or accurate despite their strategic role for livestock development opportunities, for providing input data into country level food input-output analyses and for emergency prevention. Estimation of feed balance at a national level requires information on the amounts of feed resources available and their energy content, herd structure and livestock population (FAO, 2012). Reliable and harmonized herd structure data are also lacking. Information on what proportions of cereals being produced in a country is used for feeding livestock are also not reliably known which is critical for assessing food security situations in countries.

Equally important is the information on the Feeding systems i.e. how different feed resources are being fed to livestock. Assessment of environmental impacts of livestock and development of optimal feeding strategies rely on information about feeding systems and data on feed balance. Feeding balanced rations is pivotal for enhancing feed-use efficiency and decreasing release of environmental pollutants from livestock production systems. For preparation of balanced rations, availability of reliable data on chemical composition and nutritional value of feed resources is a must. Also for reducing wastages, ensuring food safety through enhancing feed safety and promoting international trade, data on the presence of microbial and chemical contaminants including mycotoxins, heavy metals, antibiotic and pesticide residues, etc. must also be strengthened. Development of a

National Feed Resource Information Systems linked to a Global Feed Resource Information Systems should be considered (Makkar and Ankers, 2014). Both policy makers and animal feed and crop scientists have a role to play in making this possible. The paper pressed upon the need to generate data on feed inventories, feed balances and feeding systems at the national level, and reliable data on chemical composition and microbial and chemical contaminants (Gizzi and Givens, 2004).

Dr. John McKinnon representing Dr. Greg Penner from Saskatoon, University of Saskatchewan, Canada presented structure of the North American beef industry.

The structure of the North American beef Industry involves a segmented production system which includes cow-calf, stocker, feedlot, and meat processor. A typical production scenario includes late winter or spring calving, summer grazing, weaning in the fall and then backgrounding over the winter, followed by stocker (pasture grazing) and feedlot finishing phases. As we all know, cow-calf production is very important and the cornerstone of the beef industry. Currently in North America, there are several major challenges facing the cow-calf sector. First, beef cow numbers have been decreasing in both Canada and the United States reaching 29 million head in the United States and 3.8 million head in Canada in 2015 (Statistics Canada 2015). While overall cattle numbers have decreased, herd size has increased averaging 79 head in the United States and 145 head in Canada (Statistics Canada 2015). Dominant breeds include Angus, Simmental, Hereford and Charolais. There is a move in cow-calf production systems towards adoption of low cost production methods, particularly extensive management systems (Kelln et *al*., 2012). Such systems require large parcels of land with diets based on forages, crop residues, and byproduct feeds. Backgrounding or stocker operations include grassing and confined feeding. There are several keys to profitable stocker and finishing operations. First, cow-calf and feedlot operations must be more closely linked to remove inefficiencies and losses at each stage of production. Secondly, forage, crop residues, and byproduct feeds need to be more fully utilized in cow-calf and backgrounding operations to achieve moderate, low cost growth rates. Thirdly, feedlots require an even distribution of feeder cattle throughout the year. According to the USDA (2015) as of January 1, 2015, there were 13 million cattle on feed, primarily in Texas (19.2%), Nebraska (19.5%), Kansas (16.6%), Iowa (9.3%), Colorado (7.3%) and others (28%). North American feedlot finishing relies on cereal grains and byproduct feeds to a great extent. The diet often contains greater than 85% cereal grain. There is a great deal of integration with the ethanol industry. The feedlot sector is focused on rapid and efficient gains producing highly marbled carcasses with high lean yield. As to the beef cattle slaughter, in 2014 US commercial cattle slaughter was 30.2 million head (USDA 2015) with 51.8% steers, 28.2 % heifers, and the remainder cull mature animals. Average slaughter weight was 603 kg. There are several external pressures facing the North American beef industry. Environmental sustainability is a major issue and involves development of environmental regulations and best management practices that govern operations including manure and mortality disposal. A second major challenge involves food safety and public health. The industry is focused on minimizing its role in the development of antimicrobial resistance and pathogen contamination of meat products. The industry is also heavily focused on minimizing potential animal welfare issues including mitigating pain, providing optimal pen feeding conditions and reducing issues with high-grain feeding. Adapting to and solving these challenges is a major focus of the industry and a challenge for the research community.

In the part of round table entitled “the beef cattle industry and national strategy”, Ms. Song Yinghui, the director for state - owned China Central Television, was the chair. As a consumer, producer, researcher and administer, 6 invited guests from different organizations including China Agricultural University, China Association of Animal Agriculture, Ministry of Public Security, Ministry of Foreign Affairs, China National Farming Co. Ltd. and National Athlete Training Center, put forward their own understandings and expectations on the beef cattle industry respectively. Many viewpoints concerned with beef safety, but beef knowledge, Chinese beef consumption level, diversified and future development in the industry were also presented in the meeting. “I hope we can not only get delicious and healthy beef, but also can eat at ease. So I want to make a contribution for our beef cattle industry. Raising beef cattle is one of my plans and I hope all athletes do not need to worry about the quality of beef they eat any more.” Wang Heng who is Men's gymnastics all-around runner-up in 25th world university games in 2009 said like this. Mr. Liu Qiangde, the Secretary General of National Cattle Industry Association China Association of Animal Agriculture (CAAS), proposed three suggestions: firstly, we should devote to finishing dairy bulls effectively; secondly, we should try our best to improve cows breeding rate and calving rate; and thirdly, we should use some technological means to increase the carcass weight of beef as far as possible. He also thought that the supervision on beef products through informal channels must be strengthened by our government. Dr. Xiong Yiqiang, the professor of China Agricultural University, introduced the development process of dairy bulls used in USA. He proposed researchers should put their attention on establishing the perfect technology and management system. Mr. Wang Jian, an counselor of Ministry of Foreign Affairs of the People’s Republic of China hold a point that our beef cattle enterprises should go abroad by means of diplomatic channel. As to the international cooperation, technical cooperation is much more important, compared with industry cooperation. There is a successful example for international cooperation that is the Beef Cattle Research Center program undertaken by the experts of China Agricultural University (CAU) and French National Institute of Agricultural Research (INRA) and under the leadership by Agricultural Ministries of China and France. In the end, Chen Dong, the deputy director general of the Bureau of International Cooperation of Ministry of Public Security made a proposal that everyone here can change the idea from beef cattle industry to beef cattle career, and work together towards the same goals to intensity, large scale, standardization and scientific industry for beef cattle industry.

SESSION 2: BEEF PRODUCTION CHAIN AND ITS PROFITABLE KEYS

Profitability is the key driver for the beef industry to ensure incomes to farmers and co-workers. Prof John McKinnon from Canada discussed this topic from experience in North-America in a conference entitled "North American Cow-Calf Production-Keys to Profitability".

The cow-calf industry is the foundation of the North American cattle industry. There are approximately 29.6 million beef cows in the United States, 6.7 million in Mexico and 3.9 million in Canada (USDA, 2015 and Statistics Canada, 2015). Beef cattle are raised under a wide range of environmental and management conditions. Historically, the industry developed as a family-based business; however there has been some movement to corporate ownership. The industry is traditionally a low input, low margin business that utilizes native and introduced grasslands and marginal land not suited for grain production.

In order to assess the success of a cow-calf operation it is necessary to evaluate three key pillars of sustainability and profitability. These include personal (family), production and economic aspects of operating a cow-calf enterprise. From a personal perspective, the majority of producers have family based goals that include security, lifestyle, environmental sustainability and passing the operation to future generations. Achieving these goals is a critical measure of success for many producers.

There are a number of indicators that one can use to measure the productive capability of a cow-calf operation. Perhaps the most important is the number of calves weaned per cow exposed to the bull. This measure encompasses all aspects of management including genetics (i.e. growth), reproductive performance, health, milk production potential and nutritional management. Ideally, your goal is strive to wean a calf per cow exposed to the bull, annually! Other performance parameters that reflect on productivity of the operation include the GOLD performance indicators. These include Growth, Open cows, Length of the calving season and Death loss (Alberta Agriculture 1985). Nutritional management, particularly in the last trimester of pregnancy and from calving through breeding is critical to obtaining production targets.

While it is important to strive for optimum herd productivity; it is equally important to balance the cost of improving performance against the cost of those improvements. Maximizing weaning weights at the expense of reproductive performance has been a classic mistake of many producers. Another example relates to winter management. While it is possible to intensively house beef cows over the winter, this practice increases feeding and management costs. In western Canada, there has been a movement to manage cows over the winter on pasture. This practice is based on the concept of stockpiling feed on pasture for late fall and winter grazing (Kelln et *al*., 2015; McCartney et *al*., 2004). Approaches include seeding annual cereals such as barley or oat, harvesting prior to maturity and leaving the forage in the field (as swaths) for winter grazing. Grazing whole plant standing corn or leaving hay bales strategically located in the field for grazing are also relatively new low-cost approaches to winter feeding of the cow herd. These approaches help to reduce the costs of machinery, harvesting, feeding and manure management.

In order to make profitable management decisions, it is critical to understand the costs involved with production. Understanding the contribution of variable and fixed costs to the total cost of production helps to highlight areas for improvement and allows for detailed enterprise analysis. This knowledge leads to economic sustainability and a sense of security and well- being for the owner and family.

Dr. Paul Beck from the University of Arkansas (USA) gave the second conference entitled "Stocker or backgrounding cattle production system and its keys to the profitability"

The stocker and backgrounding industry in the USA is characterized in the simplest sense as growing light bodyweight weaned calves to heavier bodyweights in preparation for subsequent finishing (Peel, 3003). Most calves in US production go through a post weaning growing program prior to entry into finishing programs. These calves typically weight between 150 to 350 kg and they represent an essential segment in the beef production and marketing supply chain. The enterprise services that the stocker-cattle segment supplies to the beef industry are well characterized (Beck et *al*., 2013). These services include providing the market with immunocompetent weaned feeder cattle that have been acclimatized to feed bunks and water sources and have been grouped in semi-truck load lots; other services include providing placement area for calf numbers that are in excess of feedyard capacity at times of the year when large numbers of calves are marketed. Quite often stocker producers strive to purchase mismanaged light bodyweight calves, increase value by castration, dehorning, and vaccination, adding bodyweight, and marketing at a profit to feedlots. Even though these services (grouping of calves and adding perceived quality) add profitability to the stocker enterprise, net returns are dependent on performance and costs of production.

In practice, it is hard to characterize a singular "Stocker" or "Backgrounding" system, because these systems can take place across all regions and climates, the production practices can range from drylot feeding of high roughage growing diets or limit feeding high concentrate diets to grazing permanent pastures or annual pastures. In general "stocker" refers to a weaned calf grown by grazing standing forage on pasture and "backgrounding" refers to growing weaned calves in drylot. Pastures utilized by the stocker industry range from native grass prairies to introduced perennial pastures to planted annual pastures in crop fields. Diets used by backgrounding producers range from feeding predominantly hay or silage to high roughage growing diets to limit fed high concentrate diets.

Research conducted at the University of Arkansas over the 10-year period from 1999 to 2009 was compiled to characterize the effects that grazing season and forage species have on animal performance and net returns to stocker cattle enterprises (Beck et *al*., 2013). Weight gains of unsupplemented calves grazing warm-season perennial pasture during the summer (0.53 kg/day) were increased by providing a 25% crude protein supplement to steers grazing warm-season grass increased weight gains (0.79 kg/day) and net return per calf by 83% even though costs of gain were increased by 50%. Calves grazing toxic endophyte tall fescue during the spring were limited to 0.52 kg/day, even though forage nutritive quality was adequate for gains in excess of 0.9 kg/day. Gains were increased in calves grazing non-toxic endophyte infected tall fescue (0.9 kg/day) or small grain pasture (1.0 kg/day) and even though costs of gain were increased by over 20%, net returns were increased by 200 to 300%. The production systems with the greatest total cost of production (supplemented warm-season pastures, non-toxic tall fescue, and small grain pastures) also had greater animal performance which lead to numerically lower cost per kg bodyweight gain compared with less productive forage systems. It is apparent from this analysis that minimizing total cost of production does not necessarily lead to increased net returns, especially if the increased total cost of production creates a situation in which animal production is improved economically.

In a third conference, Dr Darryl Gibb (Gowans Feed Consulting, Canada) discussed the topic of profitability for finishing cattle.

High energy finishing diets can improve animal performance, carcass quality, and in many markets, economic returns. When properly processed, grains provide highly digestible starch and are often the cheapest source of energy. As dietary energy is the primary nutritional driver of animal performance (NRC, 1996), high grain diets are typically used most efficiently, thereby resulting in the lowest cost per unit of gain. Fats are energy dense ingredients that are not fermented in the rumen, so can increase dietary energy density without contributing to some of the digestive challenges associated with feeding additional starch. Other high energy (bi-)products should be considered when available. When comparing ingredient values, simple comparisons of energy content (*i.e.* ratios, percentage difference) often underestimate differences in economic value. Value of ingredients are best determined based on their predicted impacts on performance and cost of gain.

Despite the incentive to provide energy dense finishing diets, adequate forage must be provided to maintain intakes, gains, and digestive health of finishing cattle (Galyean and DeFoor, 2003). In barley-based diets, 4.5% point change in physically effective neutral detergent fibre (peNDF) and degradable starch with each ration provides a safe transition onto finishing diets. 6% peNDF is a safe level in barley-based finishing diets. Non-conventional "roughage" sources such as whole oat can also be a simple, cost effective replacement of forage in finishing diets (Gibb et *al.*, 2009).

There are often economic incentives to feed high grain diets, but there are also health risks resulting indirectly from ruminal acid production including bloat, overload, laminitis, and liver abscesses (Galyean and Rivera, 2003). As well, excess starch and/or lack of fibre can reduce dry matter and energy intakes resulting in reduced energy intakes and even gains. Feed delivery strategies (bunk management) may help minimize negative effects of acidosis.

Finishing diets result in increased fat deposition. Although intramuscular fat (marbling) has value, it is primarily subcutaneous fat (back fat; reduces carcass value) that accumulates late in the feeding period. Although live animal gains my decline as fat deposition displaces lean growth at this time, a higher percentage of the gain is retained on the carcass. As a result, dressing percent (carcass weight/live weight) increases with increasing days on feed, thus providing incentive to feed cattle to heavier weights for cattle feeders selling carcasses. Growth patterns of cattle can be managed to enhance performance and profitability of finishing cattle by shifting mature weight. Back grounding (growing) cattle at reduced gains prior to finishing and use of growth promoting technologies (*i.e.* implants, beta agonists) are examples of how performance can be improved by increasing mature weight.

SESSION 3: FEED PROCESSING AND USE IN BEEF CATTLE FEEDING

Prof Harinder Makkar from FAO presented a second conference entitled "Sustainable livestock production through animal nutrition: A 360 degree perspective and a framework for future R & D".

Achieving high production is not sufficient. High animal productivity, animal product safety and quality, animal welfare and health and protection of environment and biodiversity are also being increasingly demanded by society. Increasing awareness and emphasis on animal welfare, environment, product safety and quality have become a priority in food production systems involving animals. Transition towards more sustainable path must consider sustainability in its full complexity encompassing all of its pillars - economic, ecological, and social - while recognizing interactions between agriculture, human and natural systems. Partial solutions will not produce the desired results. For example, any effort towards conservation that ignores the need for economic development, food security and livelihoods are unlikely to succeed. Conversely, socio-economic development will not be sustainable if it does not maintain the ability of the ecosystem and society to adapt to short and long-term changes. This complexity necessitates consideration of sustainability as a societal issue and requires integrated efforts by a wide range of stakeholders to capitalize on the strength of livestock production systems and to minimize the potential negative impact of rapid growth in demand and supply of animal products. It is also imperative that such efforts be realistic, equitable, and conscious of ecological, socio-economic and cultural dimensions. This paper presented a 360 degree view of animal nutrition and a framework for future research and development. According to which animal nutrition is at the cross-roads where almost all sectors and services of the livestock industry meet. Animal nutrition impacts productivity, animal product safety and quality, animal welfare and health and protection of environment and biodiversity. In addition, it also affects food and fuel competition, land use and land use change and global-nitrogen cycle among other parameters. Animal nutritionists are in the driver's seat for taking the livestock sector towards sustained development following the principles of sustainable animal diets and using the proposed framework based on the 360 degree perspective as a guiding tool for future research and development. To make a denting impact, a multi-disciplinary approach in which animal nutritionists work with experts from the fields of environment, economics, social sciences, public health, among others is required. The proposed framework could exploit the complimentary expertise and knowledge of these specialists to deliver a livestock industry that is more sustainable. Equally important is the role of appropriate policies and institutional support and therefore scientists also need to work with policy makers, private sector, civil societies and farmers to help identifying the options that are environmentally, socially and economically sustainable. Also a paradigm shift from maximization of animal production to optimization of animal production by thinking efficiency in multi-dimensions is required.

Dr. Wenzhu Yang from Canada presented a conference entitled "Feed additives used in beef cattle feeding".

Feed additives are used in beef cattle production systems to improve animal health and the efficiency of nutrient use. Some of these compounds alter digestive processes to improve the profile of nutrients available from the feed whereas others have their effects on post-absorptive metabolism. This presentation will briefly outline several major feed additives used in beef cattle feeding: additives that alter rumen fermentation including ionophore antibiotics, poloxalene, buffers and plant secondary metabolites; additives that alter rumen fermentation and gastrointestinal functions such as direct-fed microbials (DFM), feed enzymes (FE); and additives that affect post-absorptive metabolism, β-adrenergic agonists and melengesterol acetate.

The growth promoting technologies used in beef cattle production are mainly antibiotics, ionophores and β-adrenergic agonists as well as anabolic implants (Stackhouse-Lawson et *al*., 2013). These technologies are widely used in North America and other countries. Ionophores are carboxylic polyether compounds and four products (lasalocid, laidlomycin propionate, monensin and salinomycin) are currently licensed in North America. Feeding ionophores change ruminal bacterial populations and shift in more propionate production in the rumen. They also decrease deamination of amino acids (AA) and ammonia concentration in the rumen, resulting in increased flow of dietary AA to the abomasum. The main effects of feeding ionophores are the decrease in feed intake, increase averaged daily gain (ADG) and improve feed efficiency in stocker and finishing beef cattle (Duffield et *al*., 2012). However, the effect depends on dietary energy level and it decreases with increasing concentrate inclusion in the diet. Ionophores have beneficial effects on health by decreasing the risk of subclinical acidosis. The class of β-adrenergic agonists is fed in growing cattle to increase lean tissue and decrease fat in muscle tissue. General responses included increased ADG and improved feed efficiency with no effect on DM intake in cattle fed β-adrenergic agonists.

The goal of using DFM and FE in diets of ruminants is to improve feed efficiency. Both DFM and FE have the potential to reduce the use of antibiotics in production systems (Birkelo, 2003). However, these technologies are still in the developmental stage and have limited current use in beef cattle production systems. The DFM contain live microorganisms: bacteria or fungi, and produce selective changes in microbial populations in the gastrointestinal tract. Feeding DFM can improve health and performance of stressed stocker calves, and increase in ADG, improve feed efficiency, and prevent ruminal acidosis of growing cattle. The DFM can also inhibit pathogen from adhering to the intestinal epithelium and reduce E.coli O157:H7. Inclusion of FE in the diet of beef cattle is to increase fiber digestion, thus increase forage utilization and improve production efficiency. Although positive responses to FE in ADG in cattle fed high forage or in feed efficiency in cattle fed high grain diets were observed, responses were never consistent because many factors (diet, animal, FE, etc.) can affect the responses. Better characterization of the factors responsible for variation in animal response may result in more effective products.

Plant essential oils (EO) are the volatile fraction of plant compounds derived from any portion of the plant. The studies have been mainly focussing on the effect of EO on modifying ruminal fermentation because of the antimicrobial activity (Calsamiglia et *al*., 2007). A primary finding in ruminants is that EO can inhibit ruminal proteolytic activity and shift the molar proportions of volatile fatty acid (VFA) to more propionate production, which is similar to that of monensin. The use of plant EO in cattle diets is still an emerging technology.

In conclusion, the use of growth promoting technologies effectively increases productivity and production efficiency of beef cattle. However, public concerns on developing antibiotic resistant bacteria by using antibiotics in animal production are driving to seeking alternatives. The feeding DFM, FE and plant EO show promise in production and health of beef cattle.

This session ended with a conference entitled "Feed processing and utilizations in beef cattle feeding" and presented by S. J. Bartle, J. C. Simroth, and E. F. Schwandt from the Beef Cattle Institute of Kansas State University.

Grains are processed for several reasons, but the primary reason is to increase digestibility. The function of the outer layers of grain kernels is to protect the reproductive parts of kernel (germ) and the stored energy source (endosperm or starch) from environmental or biological harm. To make efficient use of the grain kernel these outer layers must be broken. Grain processing also increases the surface area available to fermentation by the ruminal bacteria and further small intestinal digestion. The most common methods of grain processing include: whole grains, grinding (hammer mill), dry rolling, steam-flaking, and high moisture ensiling. Each of these methods are used in the U.S. feedlot industry. In general, dry rolling is used in smaller feedlots and steam-flaking is used in larger feedlots. High moisture ensiling is used by both small and large feedlots in areas where corn is grown. High moisture corn involves harvest the grain kernels when they are between 25 and 35% moisture, grinding or rolling, storing the corn under anaerobic conditions and allowing the corn to ensile. High moisture corn is usually fed at up to 50% of the grains in the diet. The dry rolling process involves passing the kernels between two metal rolls. The rolls may vary from 18 to 45 cm in diameter and 45 to 137 cm in length. The distance between the rolls and tension on the rolls are used to control the fineness of the particles produced. Steam flaking adds steam conditioning before the rolls to the process. Adding moisture and heating of the kernels along with the pressure of the rolls results in a change to the starch structure (gelatinization) in addition breaking the outside layer of the kernel, and increasing surface area. The changes to the starch structure increase both the rate and extent of starch digestion in the gastro-intestinal tract, and increase the energy derived from the kernel (Corona, et *al*., 2005; Zinn et *al*., 2002). The energy derived from the kernel with steam flaking is greater than would be predicted from the increase in digestibility. Steam flaking appears to reduce methane production, which increases the energy available to the animal. On average, steam flaking of corn increases average daily gain about 6% and decreases dry matter intake about 5% compared to dry rolling in high grain finishing diets used in the U.S (Zinn et *al*., 2011). Steam flaking is also considerably more expensive than dry rolling both in terms of the equipment needed, and the cost of operating the equipment (Macken et *al*., 2006). Also, a higher level of management is needed to successfully steam flake grain than is necessary for dry rolling. The major factors to consider before investing in a steam flaking process include: number of cattle to be fed, cost of grains, cost of energy, and the availability of high quality employees. Fecal starch can be used as an indicator of the efficiency of digestion and therefore efficiency of grain processing. Processing parameters can be optimized by evaluating fecal starch levels before and after a processing change. In conclusion, efficient use of grain often requires that the grain be processed. The method used is dependent upon several factors including the number of cattle to be fed, the economics of each method and several management factors such as labor and supporting equipment availability. An excellent source for feed processing details is the proceedings of the Cattle Grain Processing Symposium held at Oklahoma State University in 2006 (Richards et *al*., 2006).

SESSION 4: BEEF CATTLE FEEDING TECHNIQUES AND SUCCESSFUL EXPERIENCE

This session started by a conference entitled "Production of quality beef based on the local cattle and feed resources in developing countries: experiences from Tanzania and Uganda", by Prof. Jørgen Madsen from Denmark.

A research and education project aiming at human resources development through PhD education was sponsored by Denmark and carried through by universities in Tanzania, Uganda and Denmark. The topic for the research was chosen to be improvement of livestock production and increased revenue from livestock. It should be achieved through more efficient utilization of the feed resources and by producing meat from goats and cattle with a higher market value. In both countries there is an expanding middleclass and tourist industry that demands meat of a higher quality than the domestic market produce. Currently, the most lucrative segment of the market is entirely dependent on imported meat, with no local income generation and loss of foreign currency as a result. The local meat produced at present derives mainly from old worn out animals or from young animals that are not finished for production of good quality carcasses and high quality meat. Moreover, the meat is marketed "warm" without sufficient ripening and can as a consequence only be sold for local consumption at relatively low prices.

The ownership of the land partly determines the cattle production system. In Tanzania all land is own by the state and most grazing land is communally used by the people. This has the effect that too many cattle are grazing the land and the average daily weight gain of the cattle is only 100 gram. The fattening experiment was therefore carried out at a state farm. In Uganda there are several larger farms and the experiments was carried out at two private farms.

To change the production system to an extended value chain requires cooperation between several actors. The flow of cattle and meat goes from buying cattle from the pastoralists to ranches and feedlots where they are fattened and then bringing them to the abattoir where they are slaughtered and kept in a cool room for some days and ending up selling the meat at the domestic market where it competes with imported meat. To study all these factors it requires several scientific disciplines as social science, animal science, meat science and marketing. The project has tried but cooperation between several countries and disciplines requires a large project. The project has concentrated on the feeds that are currently available and what could be done at the ranches and feedlots and at the abattoir.

The following results have been communicated to both the local advisors and the international audience by scientific papers (Kamatara et *al*., 2014), posters in congress (Madsen et *al*., 2008), meetings, articles pamphlets and film and the documentation can be found at the IGMAFU-meat homepage: http://iph.ku.dk/english/research/livepro/igmafu/

- four PhDs and about 15 MSc degrees have been obtained or are close to be finished and interest and capacity to research in and develop tender quality for the local and neighboring country markets have been established among scientists in Tanzania and Uganda.
- it is possible to produce quality beef on the local zebu cattle by feeding them appropriate for a few month before slaughter and eventually keeping the carcasses in a cold room for a few days
- keeping the carcasses in a cold room for a few weeks before marketing make most cattle meet tender
- that local feeds are available for fattening cattle
- that the pastoralists are willing to sell cattle at all times if offered an appealing price
- supplementation of goats has proved to be less profitable if browse feeds are available as they reduce natural search for feeds if they are fed supplements
- the quality of goat carcasses is not improved by supplementation to the same extent as for cattle
- that establishing a value chain in tender quality beef requires involvement of several stakeholders and is beyond what a project with focus on education and training in research can obtain
- that local farmers and pastoralists in cooperation with slaughterhouses have started to use the results of the project and initiated a value chain by producing quality beef.

It is recommended that the government or donors in both Uganda and Tanzania call all relevant actors in the production and marketing of tender quality beef to identify and organize the actors and to give precise recommendations for actions that can minimize the import of tender quality beef and continuously produce and market the local tender quality beef. That donors support the establishment of the value chain of tender quality beef.

The second conference of this session was delivered by Dr. Jeff Lehmkuhler (University of Kentucky, USA) and was entitled "Production of Quality Beef for Market Needs from Holstein Dairy Production".

In the United States, there are approximately 29.7 million beef cows and 9.3 million dairy cows (USDA, 2015). Beef and dairy cattle are utilized for the production of beef for consumption. Male dairy calves are primarily utilized for beef production in the United States. It is estimated that 8% of the of the fed cattle supply in the US are dairy steers (Schaeffer, 2005). This population represents a consistent genetic base leading to a uniform and a high marbled end product which is desirable in today's market place.

The key to successful dairy beef production begins at birth. The highest incidence of calf mortality occurs pre-weaning (NAHMS, 2002). When considering dairy operations, it was reported that 6.5% of calves were stillborn and of the heifers retained an additional 1.8% died post-weaning (NAHMS, 2010). Ensuring newborn calves receive colostrum within 12 hours of birth is critical for successful passive immunity. In addition, it was noted that approximately 19% of dairy heifers had serum protein levels low enough to categorize them as having a failed passive immunity transfer (NAHMS, 2010). Generally, failure to receive sufficient colostrum results in greater morbidity.

Within the last decade, a considerable amount of research has been conducted on the level of nutrients offered through milk replacers. For years, calves received approximately 10% of their body weight in milk replacer in an effort to encourage the consumption of grain-based calf starter feeds and forages to stimulate rumen development and reduce input costs (Khan, et *al*., 2011). In many instances, the same rate of milk nutrients are offered from day one through weaning resulting in low body weight gain. Intensified milk feeding programs rely on higher protein and lower fat milk replacers offered at twice the conventional levels. Greater milk consumption leads to greater gains, improved feed efficiency and reduced morbidity in young dairy calves (Cowles et *al*., 2006; Diaz et *al*., 2001; Davis Rincker et *al*., 2011).

Post-weaning feeding programs for dairy steers vary depending upon the region of the country, feed resources and processor demands. Due to increased maintenance energy requirements, dairy beef often have lower gain efficiency values. In addition, dairy steers have a greater DM intake. The rate of growth can influence the frame size of dairy beef at harvest with slower gains early in life yielding larger framed animals while high energy feeding from 150-175 kg until harvest yields a slightly smaller stature animal. The use of growth promoting implants and beta-adrenergic agonists in dairy beef provide similar benefits as in beef breeds and aid in improving efficiency.

Dairy beef steers and heifers are a viable alternative to beef breeds for the production of high quality beef. They are less efficient and have a greater cost of production than beef breeds but can be managed the same as beef past 175 kg.

SESSION 5: THE PREVENTION AND TREATMENT OF COMMON DISEASES OCCURRING IN BEEF CATTLE FEEDLOT

This session was composed of two conferences, the first being entitled "Effective prevention of common diseases occurring in feedlot cattle" and given by Dr Dave Rethorst from Kansas State University (USA).

The 2011 Feedyard Study published by the National Animal Health Monitoring System (NAHMS) reports that bovine respiratory disease (BRD) occurs in 16.2% of all cattle in feedyards in the United States. This represents more cattle affected than the other five categories combined, digestive disorders (4.3%), atypical interstitial pneumonia (2.8%), bullers (2.8%), lameness (1.8%) and central nervous system diseases (1.1%). This would indicate that the majority of preventive measures should be dedicated to respiratory disease.

Respiratory disease occurs in cattle from birth to harvest. Between birth and weaning the incidence is relatively low, 3.8%. The high incidence of BRD is associated with weaning. The NAHMS data indicates that 19% of cattle develop respiratory disease between weaning and 700 pounds. From 700 ponds to harvest 7.4% of cattle are affected by BRD.

The high incidence of BRD associated with weaning appears to be related to the stacking of stressors that occurs during this time. Weaning is major stressor in a calf's life that can be compounded by the addition of other stressors such as castration, transportation, co-mingling and handling. Each additional stressor causes more immunosuppression. When combined with the pathogen exposure that occurs with co-mingling of calves, an excellent opportunity for calves to become sick is created.

Several strategies exist to prevent the BRD at weaning including preconditioning programs, pre-weaning vaccination, and the use of anti-microbial metaphylaxis. These strategies are not consistently effective.

Weaning Quality Assurance is holistic program that was developed with a conception to consumption approach to enhance the lifetime health and performance of the calf. The program begins by addressing protein, energy and trace mineral nutrition through-out gestation. Once the calf is born, adequate vaccinations and parasite control are used to enhance immune system function. Early in life castration and low stress handling and weaning techniques are used to reduce stress and ensure the immune system is functioning properly. The program culminates with a 45 day post-weaning feeding program on the farm or ranch of origin.

The goal of this program is to reduce the morbidity and mortality associated with BRD which will in turn reduce antibiotic use. This reduction of antibiotic use will slow the development of antibiotic resistance.

The second conference was given by Dr. Roy Burris from University of Kentucky. It was entitled "Techniques for Reduction of Shipping Fever in Beef Cattle".

Shipping Fever, or Bovine Respiratory Disease, is the major health problem encountered by beef calves upon arrival at cattle feeding operations. There are many management practices, in addition to vaccinations, that can aid in reducing the occurrence of shipping fever. These efforts generally focus on (1) increasing disease resistance of calves and (2) lowering or spreading out the disease challenge. Resistance can be increased by providing good nutrition, immunity (including vaccinations), disposition and maintaining good overall health. The disease challenge can be several of the following factors: weaning, castration, dehorning, feed and water deprivation, inclement weather, infectious agents, transportation, dehydration and parasitism.

Management practices which can minimize sickness can be considered according to their timing in the production cycle of feedlot cattle – pre-shipment, during shipment and post-shipment (receiving).

Pre-shipment practices. Calves should get a good start in life. Intake of colostrum at birth can help get calves off to a good start and provide them with immunity. Preconditioning is a practice that gets feeder calves ready for shipment to feedlots. Preconditioned generally refers to calves that are preweaned (45 days), vaccinated and boostered, trained to eat feed and drink from a trough, treated for internal and external parasites, dehorned and castrated (healed).

During shipment. Calves that may have been recently weaned are commingled with other calves (and potential pathogens) and may undergo crowding along with feed and water deprivation. Transportation stress manifests itself in the form of shrink (weight loss) and sickness. Weight loss is in the form of "gut" fill and tissue fluid loss and must be regained before the cattle begin to make production gain (return to payweight). The time that cattle are in transit has the greatest effect on shrink and should be minimized. Rumen function is also reduced as much as 75% during feed and water deprivation.

Post-shipment (receiving). When cattle are "received" at the feedlot after hauling, they should consume feed and water as soon as possible – even before processing. Feed intake of stressed calves will not be normal upon arrival. Thus, they should receive an energy dense diet that contains about 16% crude protein. Potassium level in the receiving diet should also be increased to 1.2 to 1.4%. Calves have generally been receiving forage diets and can best be started on low-starch feeds and leafy, clean hay. Bunk space should be adequate and waterers should be kept clean.

In summary, shipping fever results in major losses to the beef feeding industry. Vaccinations and management practices can, if used properly, decrease those losses. Immunity is needed before disease challenges occur and disease challenges should be minimized and spread out.

SESSION 6: CARCASS GRADING SYSTEMS AND ASSESSMENT OF BEEF EATING QUALITY

The last session of this symposium was focused on beef eating quality which has been the subject of a great deal of research (reviewed by Hocquette et *al.*, 2012a). This paper was presented by DW Pethick (in collaboration with R Polkinghorne and JM Thompson) from Australia. It describes "the Australian MSA system for evaluation of beef quality by assessment of eating quality".

Meat Standards Australia (MSA) is a quality management system aimed at delivering an accurate description of beef eating quality to the consumer. MSA grading outcomes predict palatability based on sensory results from untrained consumer taste panels scoring samples of meat (0-100) for tenderness, juiciness, flavour and overall liking and then grading the sample on the following word associations; unsatisfactory (no grade), good everyday (3 star), better than everyday (4 star), or premium quality (5 star). The 4 sensory traits were then combined into a single score (MQ4), by weighting tenderness, juiciness, flavour and overall liking scores by 0.3, 0.1, 0.3 and 0.3, respectively. The MQ4 score was then used to calculate the optimum boundaries for the grades; namely 45.5 for ungraded versus 3 star, 63.5 for 3 versus 4 star and 76.5 for 4 versus 5 star using discriminate analysis. MSA has identified those critical control points from the production, pre-slaughter, processing and value adding sectors of the beef supply chain that impact on palatability using large-scale consumer testing. Since the inception of MSA in 1997 over 673,000 samples have been tested using more than 96,000 consumers (Polkinghorne et *al.*, 2008).

Key grading factors include:

Bos indicus %: The magnitude of the Bos indicus effect varies with muscle and depresses the MQ4 score by 2-10 points compared to British, European and Dairy breeds. More recent research has investigated the influence of gene variants within the calpain-system to show that in part the MSA Bos indicus effect is associated with the gene markers in this meat tenderisation system. In the future it will be possible to include gene markers within the calpain-system into the MSA model (Robinson et *al.*, 2012).

Sex: Preliminary work suggests that when corrected for carcase grading parameters (such as rib fat, marbling, ossification) bulls have a lower eating quality score, depending on animal age. There is little difference between heifers and steers when corrected for other carcase grading parameters (Pethick et *al.*, 2004).

USDA Ossification/carcase weight/weaning status: These parameters are used to assess the effect of maturity at different carcase weights and the effect varies by muscle. Unweaned pasture based cattle (about 10 months of age) are called "milk fed vealers" in Australia and these have more tender cuts by about 5 points across most muscles.

Marbling: As marbling score and rib fat are positively correlated, both parameters are used to assess the impact of marbling on palatability of individual muscles. An increase in USDA marble score from 250 to 550 results in an increase of 8 palatability units for the striploin, with the magnitude of the adjustment varying with muscle.

Hormonal growth promotants: Cuts/muscles from animals implanted with steroidal growth promotants have lower consumer scores with the effect ranging from 0-10 points depending on the muscle. The scientific literature points to β agonists having at least the same or greater magnitude of effect (Dunshea et *al.*, 2005).

Carcase hanging method: This effect is applied to individual muscles with tenderstretch delivering superior eating quality for loin and hind leg cuts. Tenderstretch also markedly reduces the eating quality variation in cuts between similar carcases.

Ultimate pH of the loin: This is a threshold measure and above pH 5.7 (AUSMEAT meat colour > 3) carcasses are not eligible for grading. High pH meat can be tougher, have reduced shelf life, a dark colour and different cooking properties with respect to the degree of doneness. Managing ultimate pH requires an understanding of muscle glycogen metabolism (Pethick et *al.*, 2000).

Aging: The rate of ageing is estimated differently for each muscle within hanging option. MSA graded beef cannot be sold to the consumer before 5 days aging. Ageing the striploin from 5 to 21 days increases the palatability score by 4 MQ4 units.

Muscle: The model predicts the palatability of 39 muscles with up to a 30 point range in eating quality score

Cooking method: Palatability for individual muscles is predicted for a specific cooking method such as grilling, roasting, casserole, stir fry and variations for thin slicing.

Packaging: New research is underway to quantify the eating quality impacts of high oxygen retail display systems with recent literature typically showing a negative effect due to oxidative damage to proteins and lipids within the meat (Kim et *al.*, 2010).

Cattle within the MSA system must come from registered producers and undergo best practise management and stress minimisation such as no mixing of different mobs of cattle. At slaughter all carcases are graded once ultimate pH is obtained and then the grading data is used by the MSA model at the abattoir to predict the cut x cook outcome.

The last conference paper entitled "French and European grading systems for bovine carcasses and beef: current situation and future perspective" was presented by JF Hocquette from France but was prepared by a group of scientists from Europe and Australia (Bonny SPF, Legrand I, Gardner G, Pethick DW, Wierzbicki J, Allen P, Farmer L, and Polkinghorne RJ).

Despite efforts by the European beef industry, variability in beef palatability is still an issue. Initially, a regulated beef carcass classification scheme was established in the 1980s under the authority of the European Commission: the EUROP system which describes conformation and external fat level of carcasses. Subsequently, quality labels have been developed in France to officially recognize local and typical products with the aim to fight against the usurpations of famous geographical names and to enhance the sustainable development of agriculture. This has evolved such that three EU schemes now exist, known as PDO (protected designation of origin), PGI (protected geographical indication) and TSG (traditional speciality guaranteed), all promoting and protecting the names of quality agricultural products and foodstuffs. France has also developed a quality label called "Label rouge", certifying that the product possesses a specific set of characteristics establishing a level of quality higher than that of a similar product of the standard type (INAO, 2009). Palatability and quality associated with the image of the products are important for this label. However, the relative importance of labels of origin or quality is very low in the French beef market. Therefore, there is still no beef grading scheme for the mass market. In the absence of such a scheme, select French retailers have chosen to simplify cut names, included a description of their potential eating quality (based on knowledge on the cut) and a recommendation of their culinary destination.

On the other hand, Australia has developed the Meat Standards Australia (MSA) system, which is a Total Quality Management System aimed at delivering an accurate description of beef eating quality to the consumer. The MSA system takes into account not only the cut, its culinary destination but also ageing time, carcass weight and fatness, animal maturity and other parameters, all included in a mathematical model to accurately predict beef eating quality for each cut x cooking method combination (Thompson, 2002). The MSA model can be used to underpin brands or existing labels associated to origin or tradition. The French scientific and industry sectors have recognized the strengths of this scientifically proven system, however it may not be seamlessly adaptable to the French beef industry. This is due to the complexity of the French beef industry and market (with a great number of animal types) and due to competition from pre-existing quality labels (Hocquette et *al*., 2011). The MSA system has been tested in various countries from Asia, America, and Africa, as well as a number of European countries including France (Legrand et *al*., 2013), the Irish Republic (Allen et *al*., 2014), Northern Ireland (Farmer et *al*., 2009, ICoMST meeting) and Poland (Guzek et *al*., 2015). After compiling the European data into one combined database, the suitability of the existing MSA model has been tested for its ability to represent European cattle and consumers. Despite some minor differences in the model adjustment, consumers provide similar responses in all countries for the assessment of beef quality with the MSA system. A series of additional experiments conducted in Ireland and Poland demonstrated the robustness of the model in accounting for the effects of electrical stimulation, hanging method, time of boning and ageing time (Allen et *al*., 2014), as well as thermal treatment (Guzek et *al*., 2015). However, analysis of the broader dataset has identified some animal factors that may need to be adjusted to suit the European beef industry. For example, young bulls had lower eating quality scores than steers or females (heifers and cows), thus the MSA model predicted the scores for bulls with less accuracy. Similarly, for 6 out of the 16 muscles tested, some differences were observed between breed types (Bonny et *al*., 2015, EAAP meeting). Whereas in Australia the usual maturity estimate is ossification score, it appears inadequate for carcasses with more advanced maturity such as cull cows commonly used for beef production in France (Bonny et *al*., 2015, ICoMST meeting). Finally, while the EUROP system may adequately describe carcass characteristics, it does not predict eating quality of cooked beef at the consumer level (Bonny et *al*., 2013, EAAP meeting). In conclusion, the MSA model could be used by the beef industry at least in some European counties to sort cuts into eating quality classes and reduce the amount of variation in eating quality.

CONCLUDING REMARKS

This symposium aimed to introduce advance concepts, technology and experience to Chinese beef cattle production through professional presentations and specific forums given by well-known experts from the United States, Canada, Australia, France, Denmark, and FAO of the United Nations and China. The topics covered six aspects in relation to the sustainable beef cattle industry: beef production chain and its profitable keys, feed processing and use in beef cattle feeding, beef cattle feeding techniques and successful experience, prevention and treatment of common diseases occurring in beef cattle feedlot, carcass grading systems and assessment of beef eating quality. Twenty-three excellent presentations brought participants up-to-date knowledge, techniques and experience in applied beef cattle production. All participants felt greatly fruitful. Dr. Qingxiang Meng, Chairman of the Beef Industry Economics Committee (BIEC), Chinese Society of Forestry, Animal Husbandry and Fishery Economics, and Professor of China Agricultural University, on behalf of the organizing committee, expressed his feeling that this meeting no doubt will promote the modernization of China's beef cattle industry.

In addition, there were three specific forums covering grain steam-flaking processing (hosted by Hebei Kaite Feed Co. Ltd, China), utilization of yeast products in beef cattle feeding (hosted by Phileo-Lesaffre, France), and beef cattle crossbreeding (hosted by Evolution International, France). Nine speakers from China, US and France gave their presentations in the forums.

In total, 512 participants from China's beef cattle operations, local governments and institutes, and international companies attended this meeting. Fourteen media organizations such as China Central TV Station, China News Network, and People's Daily, made the news reports.

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