

Impact of animal feed on food quality and health of elderly consumers



14117

2nd International
FEED *for* **HEALTH**
Conference

Book of Abstracts 2nd Feed for Health Conference, 14-15th June, Tromsø, Norway

Published by Nofima

Edited by Joop Luten, Marie Cooper, Heidi Katrine Trige and Oddvar Dahl

ISBN 978-82-7251-774-7 (print)

ISBN 978-82-7251-775-4 (pdf)

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Welcome address

The 2nd International Feed for Health (FfH) conference will be held in Tromsø, Norway, June 14-15th, 2010. As in previous FfH meetings, the programme of the FfH 2010 covers a wide range of topics, such as: the impact of new feedstuffs and additives on animal health and product quality; feed components improving animal health; feeding animals to produce functional foods for humans; the control and reduction of feed contaminants and carryover from feed to food; methods for identification and monitoring of contaminants; consumers perception of live stock production, animal health and welfare and quality and safety of the resulting food products.

The ultimate goal of the congress is to provide a comprehensive view of current knowledge and to draw perspectives on the role of food of animal origin in elderly nutrition. The possible roles of these foods in preventing cognitive decline and osteoporosis, as well as in improving the vitamin D status and body mass, will be also addressed.

The scientific and organizing committees of the FfH 2010 would like to express their warm thanks to the many contributors in the process, especially to the local organizer Dr. Joop Luten, to all scientists and technicians, especially Heidi Katrine Trige, of the Nofima Tromsø, who made the organization of the conference a pleasant task. Finally, this conference would not have taken place without the special support from the COST action FA0802 "Feed for Health".

I hope this conference will be not only an opportunity to implement the cross talk between different research fields of the food (of animal origin) chain, but also an important scientific event.

On behalf of the scientific committee of FfH 2010,

Luciano Pinotti

Chair COST Action FA0802

Welcome to the 2nd Feed for Health Conference 2010!

It is a great honour and pleasure to welcome all of you to the 2nd feed for Health Conference 2010 in Tromsø, Norway. This meeting entitled 'Impact of animal feed on food quality and health elderly consumers' will bring together scientists from more than 20 countries. The conference will address international challenges and perspectives:

- Impact of new feedstuffs and additives on animal health and product quality
- Feed components improving animal health
- Feeding animals to produce functional foods for humans
- The control and reduction of feed contaminants and carryover from feed to food
- Better methods for the identification and monitoring of contaminants
- The impact of changes in feed formulations and diversification of the sources for feeds
- Consumer perception of live stock production, animal health and welfare and of the quality and safety of the resulting food products

Special emphasis will be placed during the Conference on foods that improve the health of elderly consumers and on foods of marine origin. The role of nutrition and lifestyle in staying active, healthy and fit will be covered in one of the keynote presentations. The role of milk, meat, seafood and its constituents for an ageing population will be presented.

How to ensure the continued growth of the aquaculture industry with sustainable feed ingredients is another important topic covered by a keynote speaker followed by contribution on enrichment of food products by feed in animal production.

The role of old habits and new needs for meals for the elderly will be discussed in a key presentation. Several presentations will go into more depth on consumer perception of functional food, feed and food additives as well how consumers think about the origin of fish and aquaculture production.

The importance of safety and quality of fish feed will be a key issue in the last session during the conference.

The Scientific Committee has invited a number of keynote speakers from industry, science and regulatory authorities and assisted in the selection of long or short scientific presentations from partners in the COST Action Feed for Health and others.

Finally, I shall use this opportunity to thank our sponsors for their support for the Conference.

I wish you a warm welcome to the scientific sessions and to the social arrangements. I hope that you will enjoy it all.

Joop Luten
Chair Scientific and Organising Committee 2nd Feed for Health Conference

Programme for the 2nd Feed for Health

Sunday 13th June

18:00 19:00 Registration and welcome reception at Polaria Museum

Monday 14th June: Conference Center 'Arktika', Polar Environmental Centre

8:00 Continuation registration

Opening and welcome

8:30 *Bjørn Eirik Olsen*, Director Nofima Marked
Opening address

Luciano Pinotti, Chair COST Action Feed for Health
Welcome address

Joop Luten, Chair Organising and Scientific Committee Conference
Welcome address and introduction program

Session 1. Role of food for health of the elderly

Chairs: Ian Givens and Chris Knight

8:45 1.1 *Judy Buttris*
Holding back the years: is there a role for nutrition and lifestyle?

9:15 1.2 *Ian Givens*
Milk and meat in the diet: implications for an ageing population

9:35 1.3 *Doreen Gille*
Why milk is beneficial for the elderly and how they consume it

9:55 1.4 *Georgios Theodorou*
Effect of bioactive milk peptides from bovine milk on activation of T cells at different stages of immune system maturation

10:15 Coffee break

10:35 1.5 *Giovanni Savoini*
Modulatory effects of ω -3 polyunsaturated fatty acids on milk fatty acids composition and dairy goats immune response

10:55 1.6 *Ricard Bou*
Enrichment of meats and eggs in ω -3 PUFA by adding fish oils and vegetal fats into the feed. Strategies for quality and safety optimization

11:15 1.7 *Wieslaw Wiczowski*
Onion dry skin is a good source of bioavailable quercetin

11:35 1.8 *Hanne K Maehre*
Taurine enrichment of farmed fish

11:55 1.9 *Britt Fuglestad*
Effects of cod protein on cardiac metabolism and glucose tolerance in rats.

12:15 1.10 *Colm Moran*
Selenium enrichment of animal protein through diet and implications for human health

12:35 1.11 *Joop Luten*
Tailor making of selenium enriched farmed African Catfish by dietary modulation

12:40 1.12 *David Arney*
Integrating research and market needs in feed for health – a case study

12:45 1.13 *Dusica Ivanov*
Alfalfa protein carotenoid concentrate as the source of protein and egg yolk pigments

12:45 Lunch

Session 2. Feed supply

Chairs: Dolores Perez Marin

13:30	2.1	<i>Wolfgang Koppe</i> Aquaculture feeds: Ensuring growth of the aquaculture industry with sustainable feed ingredients
14:00	2.2	<i>Mindaugas Malakauskas</i> The effect of natural feed additives probiotics on numbers of <i>Campylobacter</i> spp. in caeca and further contamination of broiler carcasses during processing
14:20	2.3	<i>Nicole Frost Nyquist</i> Chicken feed enriched in selenium, omega 3 fatty acids and histidine
14:40	2.4	<i>David Kenny</i> Fatty acid concentrations of muscle, adipose, liver and mammary tissue following dietary supplementation of beef heifers with a partially rumen protected n 3 polyunsaturated fatty acid supplement
15:00	2.5	<i>Luciano Pinotti</i> Choline supplementation in dairy ruminants: production and metabolic effects

15:20 Coffee break

15:40	2.6	Jürgen Gropp Influence of additives used in animal nutrition on the quality of food
16:10	2.7	<i>Begoña de la Roza-Delgado</i> Real time analysis of fatty acids of dairy cow productions based on grazing strategies by Near Infrared Spectroscopy
16:30	2.8	<i>John O'Doherty</i> Effect of dietary fish oil and seaweed extract supplementation in lactating sow diets on sow colostum and milk composition and on intestinal microflora, intestinal morphology and pig performance post weaning
16:50	2.9	<i>Lenka Stockova</i> Development of technologies for sustainable feed production
17:10	2.10	<i>Adrian Vescan</i> Underestimated potential of using seabuckthorn (<i>Hippophae rhamnoides</i> L.) as feed and feed additive for livestock and poultry
17:15	2.11	<i>Djuro Vukamirovic</i> Determination of homogeneity and working accuracy in feed production
17:20	2.12	<i>Jovanka Levic</i> Development of technologies for sustainable feed production
17:25	2.13	<i>Jaroslava Ovesna</i> Extracted DNA as an analyte of feed analysis

19:30 Conference dinner at Rica Ishavshotel



Tuesday 15th June: Conference Center 'Arktika', Polar Environmental Centre, Tromsø

Session 3. Food, health perception of consumers

Chair: Pirjo Honkanen

09:00	3.1	<i>Øydis Ueland</i> Meals for the elderly; the role of old habits and new needs
09:30	3.2	<i>Aldona Miezele</i> Consumer attitudes of feed/food additives and foods of animal origin
09:50	3.3	<i>Themis Altintzoglou</i> How Europeans think of fish from aquaculture after exposure to balanced information
10:10	3.4	<i>Filiep Vanhonacker</i> Do European consumers care about fish origin?
10:30	3.5	<i>Wim Verbeke</i> Consumer reactions to functional foods and foods with nutrition and health claims

10:50 Coffee break

Session 4. Safety and quality fish feed

Chairs: Vincent Baeten and Leo van Raamsdonk

11:10	4.1	<i>Janneche Utne Skåre</i> Feed for fish and fish for food
11:40	4.2	<i>Åshild Krogdahl</i> Effects on performance and product quality in Atlantic salmon fed diets reduced in organic pollutants
12:00	4.3	<i>Leo van Raamsdonk</i> A fish called ambiguity: risks and regulations of the use of fish in the food production chain
12:20	4.4	<i>Marc Berntssen</i> Reducing POPs in farmed Atlantic salmon; Strategies of feed composition and Norwegian national surveillance programme 2003-2008

12:40 Lunch

13:30	4.5	<i>Marie Cooper</i> Beware of unintended consequences: A cautionary tale
13:50	4.6	<i>Hilde Herland</i> Effects of dietary mineral supplementation on quality of fresh and salt cured fillets from farmed Atlantic cod
14:10	4.7	<i>Hanne K Maehre</i> Intensive artificial feed lacking nutrients significant for growth and development?
14:30	4.8	<i>Alba Tres</i> Verification of the identity of organic feeds for laying hens by fatty acid fingerprinting
14:50	4.9	<i>Francesca Fasano</i> Carryover of melamine in rainbow trout (<i>Oncorhynchus mykiss</i>) in muscle
14:55	4.10	<i>Aneliya Haritova</i> An <i>in silico</i> model for the prediction of muscle: plasma partition coefficients of feed contaminants
15:00	4.11	<i>Jelena Petrovic</i> Examination of antimicrobial resistance in Salmonella SPP, isolated from feed mills, chicken and pig abattoirs

15:05	<i>Åshild Krogdahl, Vice-chair COST Action</i> Wrap up Conference
	<i>Luciano Pinotti, Chair COST Action Feed for Health</i> Closing Conference
15:25	End
15:45	Management Meeting COST Action Feed for Health
17:00	End
	30 minutes presentation (including 5 minutes discussion), invited speaker
	20 minutes presentation (including 5 minutes discussion)
	5 minutes 'speed' presentation



1.1 Holding back the years: is there a role for nutrition and lifestyle?

Keynote speaker: Judith Buttriss

British Nutrition Foundation, London, UK

Abstract:

Declining birth rates and improvements in life expectancy in many parts of the world have led to the increased 'ageing' of the global population. In the UK, for example, life expectancy has doubled over the last 200 years and the World Health Organization has estimated that by 2025, there will be a total of around 1.2 billion people aged over 60. The fastest growing segment of the older population in western society is the 'oldest old' – those aged 80 years or more. While global ageing represents a triumph of medical, social, and economic advances over disease, it also presents tremendous challenges, particularly for health and social services. Unfortunately, 'healthy' life expectancy (*i.e.* the number of years spent in good health) has not increased at the same rate as actual life expectancy. As people age their health generally deteriorates and the prevalence of chronic diseases, such as cardiovascular disease, diabetes, osteoporosis and dementia, as well as disabilities, rise steeply with age. It is, therefore, a matter of increasing urgency to look for ways to maintain and ideally improve the physical and mental health of people as average lifespan extends, to help them cope independently, raise the quality of their lives and enable them to continue to participate within and contribute to the communities in which they live. It has long been known that healthy eating, regular physical activity and attention to energy balance are key components of a healthy lifestyle. But there is increasing interest in the potential for nutrition and other lifestyle interventions to have a role to play in 'holding back the years' and allowing us to enjoy our extended lifespan, particularly when best practice is adopted as part of a life course strategy. This presentation will summarise some of the findings of a Task Force that reviewed the evidence for a role of nutrition and physical activity, in particular, in healthy ageing.

1.2 Milk and meat in the diet: implications for an ageing population

Presenting author: Ian Givens

University of Reading, Reading, UK

Abstract:

An ageing population increases the risk of chronic disease and its associated financial cost substantially. Diet is a modifier of risk and since milk, meat and their products are staple components of most Western diets it is very important to understand whether these foods increase or decrease the risk of chronic disease. Foods derived from animals are an important source of nutrients, but there is considerable uncertainty about whether or not these foods contribute to increased risk of various chronic diseases. For milk in particular there appears to be an enormous mismatch between both the advice given on milk/dairy foods items by various authorities and public perceptions of harm from the consumption of milk and dairy products and the evidence from long term prospective cohort studies. Such studies provide convincing evidence that increased consumption of milk can lead to reductions in the risk of vascular disease and possibly some cancers and of an overall survival advantage from the consumption of milk although the relative effect of milk products is unclear. One of the key benefits of milk consumption appears to be an associated reduction in blood pressure and the effect seems to persist in older age. Simply reducing milk consumption in order to reduce saturated fatty acid intake is not likely to produce benefits overall though the production of dairy products with reduced saturated fatty acid contents is likely to be helpful. For red meat there is still conflicting and inconsistent evidence on the relationship between consumption and the development of colo rectal cancer, but this topic should not be ignored. Likewise the role of poultry meat and its products as sources of dietary fat and fatty acids is not fully clear. There is concern about the likely increase in the prevalence of dementia and data on the possible benefits or risks from milk and meat consumption need urgent attention. The future role of animal nutrition in creating foods closer to the optimum composition for long term human health will be increasingly important. Whilst some animal derived foods may have negative effects on long term health and research is required, these effects do need to be put into the context of other lifestyle risk factors to long term health such as obesity, smoking and alcohol consumption.

1.3 Why milk is beneficial for the elderly and how they consume it

Presenting author: Doreen Gille

Agroscope Liebefeld-Posieux, ALP, Berne, Switzerland

Abstract:

Milk is a very interesting commodity because of two main reasons: on the one hand it delivers various essential micro and macronutrients such as conjugated linoleic acids, vitamins (D, B₁₂...), minerals (Ca, Mg, I ...), proteins or short chain fatty acids to all groups of population from the young to the old. On the other hand, milk provides a basis for a large variety of processed dairy products like yoghurt, cheese or kefir. This range makes a continuous consumption of milk and dairy products possible since at least one type of these products suits everybody's taste.

Especially for the elderly, milk and dairy products should be important components of the daily menu as older persons strongly benefit from the properties of this food group. Ageing is accompanied by many different physiological alterations and following declines of the health status. Osteoporosis (the loss of bone mass), sarcopenia (the age related loss of skeletal muscles), overweight and diabetes type 2 are just a few of occurring restrictions that may complicate the life of older men and women. Milk consumption does not guarantee the prevention of all these diseases and restrictions. However, it is beyond all questions that the ingredients of milk support the health of the elderly by, for example, reducing the risk of osteoporosis, helping to sustain skeletal muscles or supporting the cardiovascular system. According to the up to date scientific literature, the first part of this presentation will provide information about the beneficial effects of milk and dairy product compounds on the most important physiological changes in older adults including comprehensible examples.

The extension of the lifetime of populations in industrial countries all over the world is a positive development and enrichment for the society as long as the elderly stay healthy. In contrast, ageing associated diseases are and always will be a burden on health care systems and politics. For this reason, food industry is in charge to help preventing these occurrences by developing special food which is tailored to the particular needs of elderly persons. Unfortunately, there are insufficient information about elderly consumer habits and taste preferences relating to milk and dairy products. Hence, Agroscope Liebefeld Posieux (ALP) accomplished a consumer survey in order to obtain knowledge about the preferences of the Swiss elderly. Finally, the second part of the presentation will represent the results of this survey.

1.4 Effect of bioactive milk peptides from bovine milk on activation of T cells at different stages of immune system maturation

Presenting author: Georgios Theodorou

Department of Animal Science and Aquaculture, Agricultural University of Athens, Athens, Greece

Co author: Ioannis Politis

Department of Animal Science and Aquaculture, Agricultural University of Athens, Athens, Greece

Abstract:

Apart from their basic nutritional role, bovine milk proteins contain encrypted within their primary structures peptide sequences capable of modulating specific physiological functions. Bioactive peptides are released from their native proteins by enzymatic proteolysis, milk processing/fermentation or gastrointestinal digestion. These peptides possess a wide variety of properties including immunoregulatory properties. We have used the weaning piglet as a model system to study the effect of various bovine milk peptides on T cell activation in vitro or in vivo. In this model system, T cells are obtained prior to or at weaning, a time period which coincides with immaturity of the immune system and four to eight weeks later, a time period that the immune system has developed its full functionality. Our in vitro data indicate that several bovine milk peptides down regulated production and/or release of Interleukin 2 (IL 2), IL 4 and Interferon gamma (IFN γ) by cultured T cells isolated from blood samples obtained prior to or at weaning.. In contrast, there was a slight elevation in production and/or release of all three cytokines (IL 2, IL 4 and IFN γ) by cultured T cells isolated from blood samples obtained four to eight weeks later. It is apparent that the in vitro effect of the bovine milk protein peptides depends upon the state of maturation of the immune system and/or the state of differentiation of T cells. Experiments performed using various PKA and PKC inhibitors indicate that milk peptides act by inhibiting the PKC system. Our in vivo data indicated that supplementation of the diet of weaning piglets with 500mg of low molecular weight bovine milk peptides /daily for a period of four weeks after weaning resulted in a 35% increase of CD4(+) T cells in Peyer's patches. In conclusion bovine milk protein peptides modulate T cell function at or after weaning.

1.5 Modulatory effects of $n-3$ polyunsaturated fatty acids on milk fatty acids composition and dairy goats immune response

Presenting author: Giovanni Savoini

Università degli Studi di Milano, Milano, Italy

Co authors: Alessandro Agazzi, Donata Cattaneo, Valerio Bronzo and Fabrizio Cecilian

Università degli Studi di Milano, Milano, Italy

Abstract:

There is a general view that $n-3$ PUFAs are beneficial in human diseases. Due to these positive effects and to the fact that milk fat of ruminants contains a low level of PUFAs and a relatively high proportion of saturated fatty acids, feeds rich in $n-3$ PUFAs are used in dairy ruminant nutrition to enhance the EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) contents in milk. Moreover $n-3$ fatty acids could modulate immune response in dairy ruminants since $n-3$ PUFAs reduce tissue levels of the immunosuppressive agents arachidonic acid and prostaglandin E2.

We found that in colostrum, fish oil supplementation of dairy goats diet lowered the proportions of C18:0, C18:2, C18:3 and elevated those of C16:1 and very long chain $n-3$ PUFAs, mainly EPA and DHA. In mature milk, fish oil supplementation lowered the proportion of C18:0 and raised C16:1 and $n-3$ PUFAs (C18:3, EPA and DHA). Estimated transfer efficiencies for EPA and DHA into mature milk were 14 and 7%, respectively. Supplementation of dairy goats diets with fish oil enhanced also the content of cis 9,trans 11 CLA in milk fat from 0.6% to 1.93%.

In vitro the phagocytic activity in goat polymorphonuclear leukocytes was significantly increased by EPA and DHA, while DHA significantly downregulated the production of Reactive Oxygen Species (ROS). Moreover, other in vitro studies on EPA and DHA showed their important and specific roles in modulating monocyte immune functions.

The administration of fish oil to dairy goats in transition appeared to affect the variation in blood leukocytes with a constant increase in CD4 and CD8 positive cells in comparison with an isocaloric and isoproteic fat enriched palm oil supplemented diet.

In conclusion goat's colostrum and milk can be enriched in $n-3$ PUFAs and CLA by maternal dietary fish oil supplementation during late gestation and early lactation, moreover EPA and DHA have important and specific roles in modulating immune functions. These results support use of fat sources rich in $n-3$ PUFAs in goat diets not only to increase the nutritional value of milk for human consumption, but also because they can improve animal health.

1.6 Enrichment of meats and eggs in n 3 PUFA by adding fish oils and vegetal fats into the feed. Strategies for quality and safety optimization

Presenting author: Ricard Bou

University of Barcelona, Faculty of Pharmacy, Barcelona, Spain

Co authors: Francesc Guardiola, Rafael Codony and Alba Tres

University of Barcelona, Faculty of Pharmacy, Barcelona, Spain

Abstract:

A summary of the research carried out in our center on the enrichment in n 3 PUFA of meat and poultry products by means of the addition of fish oils and vegetal fats into the animals feed is presented.

Fatty acid composition of eggs and pork, chicken and rabbit meats can be easily modified by dietary factors thus increasing the nutritional value of these meats and eggs. However, this enrichment entails several drawbacks such as an increased susceptibility to oxidation and the overall decrease in sensory properties. As the efficacy of an enriched product on humans' health also depends on consumers' compliance, it is crucial to reduce these detrimental effects. In this frame, different dietary strategies involving the addition of antioxidants into the feeds, the amount of n 3 PUFA to be added, the quality of the fat sources and the combinations of these factors are reviewed. Moreover, before the addition of a certain n 3 source into the animals feed it should be taken into account that among the available sources there is a wide range in the fatty acid composition, oxidative status and contamination with harmful compounds. For this reason some of these aspects will be also discussed.

From our point of view, chicken meat is a valid model for meat enrichment in n 3 PUFA allowing a significant increase in n 3 PUFA content in meat by adding moderate amounts of fish oils into the feeds. However, a minimum tocopherol supplementation is required to prevent lipid oxidation and off flavors, which would result in a longer shelf life. Despite that, the oxidation level of the fat source, the presence of pollutants, origin and processing of fish oil and vegetal fat sources rich in n 3 PUFA are important since the variability observed in their composition may cause some adverse effects on meat quality and safety.

1.7 Onion dry skin is a good source of bioavailable quercetin

Presenting author: Wieslaw Wiczowski

Institute of Animal Reproduction and Food Research of the Polish Academy of Sciences in Olsztyn, Olsztyn, Poland

Co author: Mariusz Piskula

Institute of Animal Reproduction and Food Research of the Polish Academy of Sciences in Olsztyn, Olsztyn, Poland

Abstract:

Onion, a vegetable consumed worldwide, is known to be a rich source of quercetin, which is known as a strong bioactive compound. Many studies have presented biological activities of quercetin that may be beneficial to health. It can act as an antioxidant, inhibit platelet aggregation and/or a broad spectrum of enzymes and has been demonstrated to have anti-inflammatory properties. Taking the above into consideration, onion may be an excellent source for production of functional food. The objective of this research was a comparative analysis of quercetin bioavailability from flesh scales and dry skin of onion.

In onion flesh, quercetin was present as glucosides: quercetin 3,4' glucosides, quercetin 4' glucoside, quercetin 3 glucoside and in trace amount as aglycone. In onion dry skin the predominant form of quercetin was aglycone. The experiment was performed on Wistar male rats and 9 volunteers after formal approval by the local Ethical Committee. After 3 days of a phenolics low diet and overnight fast, rats and subjects consumed the onion preparations (onion flesh and dry skin) in water supplying doses of 1.4 mg and 7.0 mg of quercetin per kg of body weight of volunteers and rats, respectively. Following the challenge blood was collected at certain time intervals. Plasma was prepared and stored at 70 °C until analyzed. Plasma quercetin was measured on HPLC with electrochemical detection (+850 mV) after enzymatic release from the conjugates (glucuronides and sulphates). The identity of the released quercetin peak in plasma after enzymatic hydrolysis was confirmed with HPLC MS. Pharmacokinetic parameters of quercetin: the area under the plasma concentration time curve (AUC), the quercetin peak plasma level (C_{max}), the time to reach the peak plasma level (T_{max}) and the constants of elimination (k_{el}) were calculated with Kinetica v. 4.3 software (InnaPhase). In the case of the rat study, the maximum plasma concentration was reached 10 min after administration of both onion flesh or onion dry skin and there were no significant differences in its concentration between the two samples. The area under the curve of absorption, a bioavailability marker of quercetin from dry skin was two times higher than after onion dry skin administration. In the case of the volunteers, the C_{max} was reached at 2.80 h after onion dry skin consumption and at 2.30 h after dry skin consumption. The AUC after onion dry skin consumption was also significantly higher than after shallot flesh intake. Both experiments demonstrated that onion dry skin is a good source of bioavailable quercetin.

1.8 Taurine enrichment of farmed fish

Presenting author: Hanne K. Maehre

Norwegian college of fishery science, University of Tromsø, Tromsø, Norway

Co authors: Edward Schram (1), Joop Luten (1,2) and Edel O. Elvevoll (3)

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(2) Nofima Marin AS, Nofima Marked, Tromsø, Norway

(3) Norwegian college of fishery science, University of Tromsø, Tromsø, Norway

Abstract:

Objective: Aquaculture enables dietary modulation of fish because farmers and feed manufacturers may control components in the feed. In order to produce fish muscle with additional beneficial effects for human consumers, the development of tailor made farmed fish has become a field of interest. Our goal was to modify the feed composition in order to raise the contents of the health beneficial components in the fish muscle. A successful enhancement of a nutrient depends on many factors. Challenges to be met may include to which extent the component is retained in the flesh, or actively excreted.

Taurine is one of the components that may contribute to the health benefits of seafood consumption. A high intake of seafood and thus this amino acid has been associated with a low incidence of cardiovascular disease. The objective of this study was to examine whether taurine levels in fish muscle could be increased through enrichment of the feed.

Materials and methods: African Catfish (*Clarias gariepinus*) were randomly divided into 15 tanks (n = 26 in each tank). The mean initial weight of the fish was 97.4 ± 3.6 g. Four fish meal based feeds enriched with 4, 9, 13 and 26 mg synthetic taurine/kg feed respectively were given to the fish for 43 days. One additional group received feed with no added taurine (control). Taurine content was examined in the feeds on day 1 of the experiment and in the fish muscle on days 1 and 43 of the experiment.

Results and discussion: There were no significant differences in growth between the groups. The taurine concentration in fish muscle increased in all groups compared to baseline and was doubled in the group receiving the highest dose of taurine. All of the fish fed diets with additional taurine had significantly higher taurine concentrations than the group fed the control feed. The correlation between added taurine in the feeds and accumulated levels in the fish muscle was however not linear over the analysed range of concentrations, but levelled off at concentrations above 9mg added taurine/kg feed or 1.8mg/gram fish muscle. This may be due to the fact that an increased concentration of taurine in the muscle will lead to an increased excretion of taurine and that this excretion is activated when the accumulation of taurine reaches a certain level.

Conclusion: These results show that taurine levels in fish muscle can be increased through enrichment of the feed. However there seems to be a limit for when additional taurine in the feed will not further increase the concentration in the fish muscle.

1.9 Effects of cod protein on cardiac metabolism and glucose tolerance in rats

Presenting author: Britt Fuglestad

Nofima Marin AS, Nofima Marin, Tromsø, Norway

Co authors: Marie Cooper (1), Terje Larsen and Ellen Aasum (2)

(1) Nofima Marin AS, Nofima Marin, Tromsø, Norway

(2) University of Tromsø, Tromsø, Norway

Abstract:

The effects of dietary fat and carbohydrate on metabolic control in humans have been widely studied, whereas interest in the effects of various dietary proteins has recently emerged. A lower incidence of type 2 diabetes has been reported in populations consuming large amounts of fish. Epidemiological studies have suggested that constituents in fish other than omega 3 fatty acids could protect against development of glucose intolerance in lean fish eaters.

Aim: To examine the effect of cod protein administration in diet induced insulin resistance and to examine the effect on myocardial substrate utilization.

Methods: Male Wistar rats were placed on a high fat/high sucrose (HF/HS) diet containing 15% cod protein for 3 months. As controls we included rats fed HF/HS with 15% casein, as well as rats fed standard chow. A glucose tolerance test was performed following 8 weeks on the diets, 1.5 g/Kg glucose was administered by an intraperitoneal injection and blood samples were taken from the saphenous vein. At the end of treatment glucose and fatty acid oxidation were measured in isolated perfused working hearts using ¹⁴C glucose and ³H palmitate. Ventricular function was measured in the isolated perfused hearts

Results: The animals in the cod protein group gained most weight and had the largest amount of perirenal fat. Furthermore, the cod protein group had the highest increase in blood glucose during the glucose tolerance test and did not return to the starting value at the end of the 2 hr test. Although glucose oxidation in the cod protein group was not significantly reduced compared to the chow group, there was a trend of increased fatty acid oxidation, suggesting a diabetic phenotype. There was no difference in ventricular function between the groups.

Conclusion: Administration of cod protein did not prevent development of diet induced insulin resistance, nor did it improve myocardial substrate metabolism.

1.10 Selenium enrichment of animal protein through diet and implications for human health

Presenting author: Colm Moran

Alltech Inc., Levallois-Perret, France

Abstract:

There has been an increasing interest in the selenium status of humans due a greater understanding of its health protective effects, especially due its role in key antioxidant systems. Its principle role as an essential part of the glutathione peroxidases (GSH Px) which provide a defence against oxidative stress by catalyzing the reduction of organic hydroperoxidases that react with the selenol group of selenocysteine. Therefore, an adequate intake of Se is needed to decrease the risk of myopathy, immunodeficiency, cardiovascular disease, cancer, Alzheimers syndrome and other selenium deficiency syndromes. In the field of animal and human nutrition it is widely accepted that the range between nutritionally adequate and toxic levels of selenium is relatively narrow. Traditionally, selenium supplementation of animal diets has become commonplace particularly with the inorganic selenium salts, sodium selenite and sodium selenate. However, substantial evidence in the scientific literature has demonstrated that organic forms of selenium, such as L selenomethionine (SeMet), are superior to inorganic forms in improving selenium status of animals and humans. For human populations on a Western style diet the largest contributor of selenium has come in the form of animal protein. In recent years there has been a greater focus on the selenium enrichment of animal protein (milk, meat, eggs) as a means of delivering biologically available selenium to humans.

Feeding the animal a source of natural organic selenium, such as Sel Plex a selenium enriched yeast allows for greater tissue deposition. In a wide range of studies, we have demonstrated that the replacement of an inorganic form of selenium with Sel Plex results in significant increases in selenium content of eggs from laying hens; meat from fowl (broiler, turkey, pheasant); meat from ruminants (beef, lamb, kid); meat from fish and milk from dairy cows, gairy goats and lactating sheep. Sel Plex increased the level of total Se, selenomethionine, selenocysteine and SelV in the animal products. The enrichment of animal products with selenium can play an important role in the prevention of common diseases.

1.11 Tailor making of selenium enriched farmed African Catfish by dietary modulation

Presenting author: Joop Luten

Nofima Marked, Nofima Marin AS, Tromsø, Norway

Co author: Edward Schram

IMARES Wageningen, The Netherlands

Abstract:

Several review papers have appeared addressing the health beneficial effects of selenium in relation to e.g. coronary heart disease, oxidative stress conditions, the immune system and cancer. Excluding cereals, seafood is one of the food commodities relatively rich in Se (0.2-0.5 mg Se/kg fillet). The Se content in farmed fish is lower (approx 0.2 mg Se/kg fillet) but data are scarce. Selenium is an essential element and its forms a part of a number selenoproteins.

The concept of enrichment of farmed fish with bioactive forms of selenium was studied in several trials using African Catfish as model species. Fish feed enriched with several bioactive compounds of selenium was used in short term feeding trials. The dose response was studied as well the effect of depuration time on the final content of selenium in the edible part. Speciation analysis of the various selenium compounds was carried out in various tissues of the African Catfish. The results show the potential of tailor making selenium enriched farmed fish for the consumer.

1.12 Integrating research and market needs in feed for health – a case study

Presenting author: David Arney
Estonian University of Life Sciences, Estonia

Co author: Katri Ling
Estonian University of Life Sciences, Estonia

Abstract:

Research quality is increasingly being assessed by funding agencies in terms of market impact. For example, in the UK this will become the basis of government research quality assessment and consequently research funding (and prestige). We should ensure that our research can demonstrate clear advantages to the marketplace or we will not be funded. From the business perspective, innovation and testing of new ideas through collaboration with researchers is the most promising way of enhancing the competitiveness of enterprises in agribusinesses.

One solution to this is the integration of research bodies and private enterprises into a formal structure. Such a structure is in place in Estonia in the field of feed for health. To enhance the dairy industry's competitiveness and profitability through innovative solutions, and in compliance with the national Competence Centre Programme of Estonia, the Bio Competence Centre of Healthy Dairy Products (CC) has been formed. The shareholders of the company are two universities (the University of Tartu and the Estonian University of Life Sciences) and three enterprises (a feed company Starter Ltd., a Dairy Co operative E Milk and the Animal Breeders' Association of Estonia).

The research activities of the consortium currently include: legumes ensiled with novel EU registered starter cultures, by products of the biofuel industry as alternative feeds with rumen inert fat and protein, a year round feeding strategy to optimize production of milk with increased PUFA (particularly n3) content, principles of manufacturing fermented dairy products from milk with increased PUFA, with healthy pro or/and prebiotics, higher antioxidant activity and prolonged shelf life and biomarkers for assessing coagulation properties of milk and welfare of dairy cows.

Each of these research areas has been informed by our research expertise and capabilities and by constant suggestion and control by the industry partners.

Demonstrable impacts on the marketplace to date include: the provision of novel products, such as "Südamejuust" cheese for health (decreasing blood pressure) and a range of other products at the planning stage.

In addition to this, the consortium has produced 15 articles in international journals. As a consortium, we are more effective in attracting funding, publicising our achievements and expertise, and carry a more powerful voice in governmental decision processes.

1.13 Alfalfa protein carotenoid concentrate (APCC) as the source of protein and egg yolk pigments

Presenting author: Ivanov Dusica

University of Novi Sad, Institute for Food Technology, Novi Sad, Serbia

Co authors: Slavica Sredanovic and Jovanka Levic

University of Novi Sad, Institute for Food Technology, Novi Sad, Serbia

Abstract:

Alfalfa is a widely grown forage legume with more than 32 millions hectares of planted area globally. It is one of the biggest sources of protein per hectare of planted area and rich with other useful components for poultry feeding. Alfalfa's total usability value may be upgraded by selective fractionation of highly valued components according to sustainable feed production principles. Fractionation of alfalfa juice by coagulation and production of alfalfa protein carotenoid concentrate (APCC) were investigated. Nine kg APCC dry matter containing 56.00% protein, 10.34% fat, 2.21% fiber, 1252 mg/kg total xanthophylls, 554 mg/kg carotene, 832 ppm lutein and 53 ppm zeaxanthin was produced out of each 100 kg alfalfa dry matter, by using investigated production procedure. Concentration of xanthophylls in APCC was about six times higher in comparison with concentration of xanthophylls in alfalfa flour. Usage of APCC in laying hen diet formulation ensures the required amount of carotenoids. This facilitates production of naturally well pigmented egg yolks which consumers prefer, unlike with usage of conventional feed components (corn, dehydrated alfalfa, corn gluten meal etc.) and without coloring agents. Since these pigments could provide a range of health benefits not only to a variety of animals, but also to human, it is of great interest to investigate the way of increasing its concentration in egg yolk. Physiological concentrations of xanthophylls protect cultured human lens epithelial cells against UVB radiation. Lutein and Zeaxanthin have been identified as carotenoids that may play a critical role in the prevention of age related macular degeneration, the leading cause of blindness.

By feed formulation, it is possible to influence yolk weight, yolk proportion and yolk composition and thus to enhance the yield of those substances which have a positive influence on human health. In this study, APCC is used as the concentrated source of natural pigments and proteins in feeding of laying hens. Adding 3% of APCC in compound, instead of 3% of soybean meal and 0.15% Oro Glo[®] pigmenter, egg production was increased by 3.21%, and feed intake per 1 kg of egg mass was decreased by 4.7%. Color intensity on "La Roche" scale was significantly ($P < 0,01$) more intensive with APCC (10.2), in comparison with Oro Glo (7.9) usage. The amounts of carotene, xanthophylls, lutein and zeaxanthin were increased by 39.6 %, 41.10 %, 33.18 % and 40.12 % respectively.



2.1 Aquaculture feeds: Ensuring growth of the Aquaculture industry with sustainable feed ingredients

Keynote speaker: Wolfgang Koppe

Skretting Aquaculture Research Centre, Stavanger, Norway

Abstract:

Aquaculture is one of the livestock industries which is growing at high rates. While most agree that fish from aquaculture operations is beneficial for human nutrition, concerns are raised about the sustainability of the raw materials used for producing fish feed.

Already today, a clear development is seen, that both fish meal and fish oil, which have been the traditional sources of protein and fat in fish diets, especially for salmonids, are limited in supply, and can actually limit further growth of aquaculture production.

Alternative raw materials have been researched and clear recommendations exist regarding which qualities of commodity plant based raw materials can be safely used for fish feed. The presence of anti nutritional factors and the digestibility of individual nutrients are areas which are of major interest.

Although both fish meal and fish oil have been delivered an easy and unique combination of nutrients, increasing knowledge on the specific physiological needs of fish will allow us to formulate high performance, low marine feeds which match all requirements for growth and health of fish. Research can also clearly document, that the eating quality of the final product is not influenced. The fatty acid combination can be steered towards any wanted target, which needs to be defined from the consumers' end.

In summary, the tools for producing fish with feeds which have a minimized content of fish meal and an optimized content of fish oil exist today.

2.2 The effect of natural feed additives probiotics on numbers of *Campylobacter* spp. in ceaca and further contamination of broiler carcasses during processing

Presenting author: Mindaugas Malakauskas
Lithuanian veterinary academy, Kaunas, Lithuania

Co authors: Egle Kudirkiene and Jurgita Buneviciene
Lithuanian veterinary academy, Kaunas, Lithuania

Abstract:

Campylobacteriosis continues to be the most commonly reported gastrointestinal illness in humans caused by a bacterial pathogen in the European Union, with 190,566 confirmed cases in 2008. The highest rate of *Campylobacter* spp. positive foodstuffs are found in samples of fresh poultry meat with an average of 30.1% of samples contaminated. It is concluded that the most important source of human campylobacteriosis is contaminated animal products and especially poultry meat. *Campylobacters* can access broiler flocks in various way. Through farm personnel, rodents, birds, insects, etc. The birds of infected flocks are asymptomatic carriers and infections cannot be detected by clinical symptoms of infected birds. The prevalence of campylobacter positive broiler flocks differs between 3 to 91 % in various EU countries. The proportion of broiler carcasses contaminated with *Campylobacters* spp. and the concentration of campylobacter in carcasses are significantly dependent on the amount of faecal material released during processing and the numbers of campylobacter in the faeces of slaughtered broilers. Therefore feeding strategies aimed to reduce numbers of campylobacter in the intestines of living broilers before slaughter can be used as an intervention for reduction of *Campylobacter* spp. concentration on broiler carcasse. This will reduce consumer risk of acquiring campylobacteriosis in relation to poultry meat consumption.

Preliminary results of our study showed that application of probiotics via drinking water for broilers can reduce concentrations of campylobacter in the faeces of live broilers and ceacal content of slaughtered broilers. Such reduced numbers of campylobacter due to applications of probiotics results in reduced contamination of broiler carcasses with these bacteria. Therefore application of probiotics together with other biosecurity measures could be used to reduce campylobacter concentrations on broiler carcasses.

2.3 Chicken feed enriched in selenium, omega 3 fatty acids and histidine

Presenting author: Nicole Frost Nyquist

The Norwegian University of Life Sciences, Ås, Norway

Co authors: Liv Marit Biltvedt, Rune Rødbotten, Liv Torunn Mydland, Espen Govasmark, Birger Svihus, Magny Thomassen and Anna Haug

The Norwegian University of Life Sciences, Ås, Norway

Abstract:

The composition of chicken feed is essential to chicken health, meat composition and meat quality. Further, chicken meat composition is important in human nutrition since optimal intake of nutrients may prevent non communicable diseases. In Norway, consumption of chicken meat is high and increasing. The concentration of selenium, omega 3 fatty acids and histidine dipeptides in broiler muscle is a reflection of the feed concentrations of selenium, omega 3 fatty acids and histidine.

The objective of the study was

- i) To alter the fatty acid composition towards more omega 3 fatty acids and oleic acid and less omega 6 fatty acids
- ii) To produce selenium rich chicken meat that may enhance human selenium intake, by supplementation of selenium enriched yeast to the chicken feed
- iii) To increase the concentration of the biologically important dipeptides carnosine and anserine in the meat by histidine supplementation to the chicken feed.

Two hundred male newly hatched broiler chickens (Ros 308) were randomly divided into 12 dietary treatment groups. The chickens were individually fed diets enriched either in rapeseed oil, linseed oil, soybean oil, selenium enriched yeast, histidine or different combinations of these ingredients. The breast muscle and liver fatty acid composition, selenium concentration and concentration of histidine dipeptides were determined, as well the glutathione peroxidase concentration in whole blood and plasma. The effect of the different diets on fatty acid composition, selenium concentrations, amino acid and dipeptide composition in breast muscle and liver from chickens as well as growth parameters will be discussed.

2.4 Fatty Acid Concentrations of Muscle, Adipose, Liver and Mammary Tissue following Dietary Supplementation of beef heifers with a partially rumen protected n 3 Polyunsaturated Fatty Acid Supplement

Presenting author: David Kenny
University College Dublin, Dublin, Ireland

Co authors: Alan Hennessy, Catherine Stanton and Stuart Childs
Teagasc, Moorepark Food Research Centre, Teagasc, Moorepark, Fermoy, Co. Cork, Ireland

Abstract:

The main aim of this study was to examine the potential to improve the nutraceutical composition of beef through inclusion of a partially ruminally protected n 3 PUFA supplement in the finishing diet of beef cattle. Specific objectives were to evaluate (i) the effect of a partially rumen protected n 3 polyunsaturated fatty acid (n 3 PUFA) enriched dietary supplement on the fatty acid composition of muscle, adipose, liver and mammary tissues (ii) effect of duration of supplementation on the fatty acid composition of plasma and adipose tissues and (iii) the usefulness of blood plasma as a predictor of tissue concentrations of specific fatty acids in beef heifers. Twenty Charolais crossbred heifers were blocked by live weight and body condition score and randomly assigned within block to one of two isolipid dietary treatments (n = 10 per diet) supplemented with either palmitic acid as a control or a n 3 PUFA supplement for a 91 day period. Animal feed intake and live weights were recorded on a weekly basis, while body condition score was recorded fortnightly. Plasma sampling and adipose tissue biopsies were undertaken on days 0, 10, 35 and 91 of the supplementation period, while samples of muscle, liver and mammary tissue were taken following slaughter on day 91. The fatty acid composition of the feed, plasma and tissue samples were determined by gas liquid chromatography. Data were analysed using mixed models ANOVA incorporating repeated measures where appropriate. Regression of fatty acid concentrations between different tissues was also conducted. Dietary lipid source did not affect average daily gain or body condition score. Diet x day of sampling interactions were observed in the ratio of n 6 to n 3 PUFA ($P < 0.001$) and increases in the ratio of PUFA to saturated fatty acids (SFA) ($P < 0.01$) in plasma with increases observed for both ratios in heifers offered the n 3 PUFA enriched diet. A diet x day of sampling interaction was also observed for the ratio of PUFA to SFA for adipose tissue ($P < 0.01$) and was manifested similarly to plasma. Additionally, the n 3 PUFA enriched diet also resulted in reductions in the ratio of n 6 to n 3 PUFA in the liver ($P < 0.001$), muscle ($P < 0.001$) and mammary tissue ($P < 0.001$) and increases in the ratio of PUFA to SFA in the liver ($P < 0.001$), muscle ($P < 0.05$) and mammary tissue ($P < 0.001$). There were positive relationships for n 6 to n 3 PUFA ratio between plasma and liver ($\beta_1 = 0.15 \pm 0.054$, $R^2 = 0.52$, $P < 0.01$) and also between plasma and muscle ($\beta_1 = 0.53 \pm 0.089$, $R^2 = 0.83$, $P < 0.001$).

2.5 Choline supplementation in dairy ruminants: production and metabolic effects

Presenting author: Luciano Pinotti

Department of Veterinary Sciences and Technology for Food Safety-Università degli Studi di Milano, Italy

Co authors: Anna Campagnoli (1), Carlo Polidori (1), Vittorio Dell'Orto (2) and Antonella Baldi (2)

(1) UNITEL - Università Telematica Internazionale-Milano, Italy

(2) Università degli Studi di Milano, Italy

Abstract:

Choline has been classified as a vitamin like compound. Two types of choline functions are known: as choline *per se*, for which the choline moiety is required and functions as a methyl donor. Choline *per se* plays a major role in lipid metabolism, particularly in lipid transport, as a lipotropic agent. Choline is also an important source of labile methyl groups for the biosynthesis of other methylated compounds. Based on this second function choline and methionine are interchangeable, as sources of methyl groups. Ruminants differ from most other mammals in regard to their choline and methyl group metabolism. In adult ruminants, choline is extensively degraded in the rumen, as a consequence choline supplementation in these animals in order to be effective, required the development of rumen protected choline (RPC). Accordingly the aim of the present work was to provide an overview of the effects of RPC administration on milk production and lipid and methyl group metabolism in transition dairy ruminants. Findings in transition and early lactating dairy cows and goats suggest that greater choline availability can improve not only milk production, but also lipid and methyl group metabolism. Furthermore use of RPC administration resulted in higher post ruminal choline release, absorption and milk choline secretion in both cows and goats. However, the underlying mechanisms are not known with certainty and more intensive feeding experiments are required to investigate the effect of choline on lipid and methyl group metabolism. It is also evident that our knowledge of the interaction of choline with vitamins and other essential nutrients is incomplete in dairy ruminants.

2.6 Influence of additives used in animal nutrition on the quality of food

Keynote speaker: Jürgen M. Gropp

FEEDAP Panel of the European Food Safety Authority, Parma, Italy

Abstract:

Feed additives contribute in general to health and welfare of the animals and provide by this a certain standard of quality of food of animal origin. Some of the nutritional additives and the colourants (sensory additives) have an influence on the characteristics and composition of food. The effect of some additives is described as an illustration.

The vitamin A content of liver of all food producing animals depends more or less linearly on the dietary vitamin A supply and to a lower degree its content in milk and eggs. All commercial compound feedingstuffs contain supplemental vitamin A. Liver contributes to about 60-80 % of the retinol intake of the population in some European countries, milk and dairy products to 45-60 in some others. On the other hand, excess vitamin A in animal nutrition may lead to excess retinol intake in some subpopulations, particularly if vitamin A containing supplements are taken. This leads in turn to a limitation of the maximum content of feedingstuffs set by the European feed legislation and prevents a higher retinol supply of subpopulations with a marginal retinol supply. Vitamin E supplementation of feedingstuffs at doses exceeding the requirement improves the oxidative stability of food. Consequently the colour of beef is maintained and rancidity of pork products is prevented for a longer period. Vitamin B₁₂ in food (mainly liver), the only source of vitamin B₁₂ in human nutrition, originates completely from the supply of this vitamin to animals or of cobalt to ruminants, which synthesise the vitamin by the rumen microbes.

Certain compounds of trace elements may increase the trace element content of food of animal origin. A particular role is played by selenomethionine that occurs in selenium enriched yeasts. The selenium containing amino acid provides Se to the Se pool of the body for its specific functions and enters the amino acid pool for protein synthesis. This part of the Se deposition may serve as a slow release compound. Feeding selenomethionine results in higher Se contents of tissues (meat) and products (milk and eggs) compared to inorganic sources. A benefit from such a food for the consumer seems only to arise if the food is correspondingly labelled.

The desired color of egg yolks and fish flesh is under current conditions of animal husbandry, only obtained by feed supplementation with carotenoid pigments. Whereas salmon requires red carotenoids (e.g. astaxanthin), the laying hen needs in general a mixture of yellow and red pigments.

2.7 Real time analysis of fatty acids of dairy cow productions based on grazing strategies by Near Infrared Spectroscopy

Presenting author: Begoña de la Roza Delgado

Regional Institute for Agro-Food Research and Development (SERIDA), Villavicoso, Spain

Co authors: Ernesto Morales Almaráz, Ana Soldado, Amelia Martínez Fernández and Fernando Vicente

Regional Institute for Agro-Food Research and Development (SERIDA), Villavicoso, Spain

Abstract:

Different studies have examined the role of nutrition in lactating cows in altering the fatty acids (FA) composition of milk, reducing the proportion of saturated fatty acids and increasing polyunsaturated fatty acids. Diet plays an important role in determining the degree of unsaturation of cow milk fat. The production of this enriched milk makes it necessary to establish quality controls over its fatty acid profile. However, reference analyses for FA are expensive and time consuming. An alternative could be Near Infrared Spectroscopy (NIR) technology as a method for real time analysis of milk FA. NIR has great potential for application to milk and its products, owing to its quick, concise and non-destructive characteristics. The objective of this work was to study possible applications of FT NIR spectroscopy in the determination of fatty acids in milk production.

Calibration models were constructed based on NIR spectra of 226 milk samples obtained from cows randomly assigned to three nutrition treatments based on feeding with TMR ad libitum and combined with access to grazing from zero to twelve hours after morning milking. Reference FA data were obtained by Gas Chromatography Mass Spectrometry (Varian 4000 GC/MS, Inc. Palo Alto, CA, USA). NIR spectra were collected in an FT NIR Spectrum One (Perkin Elmer) in the range 1100-2500nm at 4nm interval. The milk raw spectra were measured two times, first in transmittance mode using a quartz sample vessel with 1mm light pass, and after that in trans reflectance mode by analysis of cream milk isolated by centrifugation. Prior to NIR measurement, every sample was dipped into a water bath at 40°C. All spectra data were transferred into Foss WinISI1.5 software for data analysis.

The calibration equations were developed using Modified Partial Least Square (MPLS) regression, and applying first and second derivatives and scatter correction (SNVD or MSC) as pre treatments. Results showed great differences among calibrations developed with transmittance (milk) and trans reflectance (cream milk) spectra. The chemometric models on cream milk for oleic and palmitic acids were found to be acceptable ($r^2=0.81$ and 0.66 respectively) and would be helpful to determine if a feed strategy could improve the FA profile of milk fat.

2.8 Effect of dietary fish oil and seaweed extract supplementation in lactating sow diets on sow colostrum and milk composition and on intestinal microflora, intestinal morphology and pig performance post weaning

Presenting author: John O'Doherty

School of Agriculture, Food Science and Veterinary Medicine, University College Dublin, Dublin, Ireland

Co authors: Stephen Leonard and Torres Sweeney

School of Agriculture, Food Science and Veterinary Medicine, University College Dublin, Dublin, Ireland

Abstract:

Abstract: A 2 x 2 factorial experiment (n = 10 sows/treatment) was conducted to investigate the effect of maternal dietary supplementation with seaweed extract (SWE) and fish oil (FO) from d 109 of gestation until weaning (26 d) on sow colostrum and milk composition and suckling piglet humoral immune response, as well as post weaning pig performance, gastrointestinal morphology and selected microflora of the 9 d old weaned pig. The *Laminaria spp.* derived seaweed extract contained laminarin (1 g) and fucoidan (0.8 g) and the fish oil contained approximately 40% eicosapentaenoic acid (EPA) and 25% docosahexaenoic acid (DHA). The SWE supplemented sows had greater colostrum IgG ($P < 0.01$) and milk protein ($P < 0.05$) concentrations on day 12 of lactation compared to non SWE supplemented sows. Piglets suckling SWE supplemented sows had greater serum IgG ($P < 0.01$) and IgA ($P < 0.05$) concentrations on day 5 and IgG concentrations on day 12 ($P < 0.05$) of lactation compared to non SWE supplemented sows. In contrast, FO supplementation exerted a suppressive effect on piglet serum IgA concentrations on day 5 of lactation ($P < 0.05$) compared to non FO supplemented diets. Dietary FO supplementation enhanced the n 3 PUFA proportion of sow milk ($P < 0.001$) and piglet serum at weaning ($P < 0.001$). Pigs weaned from SWE supplemented sows had higher ADG ($P < 0.05$) between d 0–21 post weaning and pigs weaned from FO supplemented sows had higher ADG ($P < 0.05$) and gain to feed ratio ($P < 0.05$) between d 7–14 post weaning. There was an interaction between maternal SWE and FO supplementation on caecal *E. coli* numbers ($P < 0.05$) and the villous height to crypt depth ratio in the ileum ($P < 0.01$) and jejunum ($P < 0.05$) in the 9 d old weaned pig. Pigs weaned from SWE supplemented sows had lower caecal *E. coli* numbers and a higher villous height to crypt depth ratio in the ileum and jejunum compared to non SWE supplemented sows ($P < 0.05$). However, there was no further effect of SWE on *E. coli* numbers and villous height to crypt depth ratio with FO inclusion. In conclusion, the current study demonstrates that SWE supplementation from d 109 of gestation until weaning (26 d) enhanced colostrum IgG concentrations and circulatory IgG concentrations in suckled piglets on d 5 and 12 of lactation. The inclusion of SWE and FO supplementation to the maternal diet influenced the gastrointestinal environment and performance of the weaned pig.



2.9 Evaluation of resistance to FHB and DON accumulation in winter wheat varieties suitable for feed production

Presenting author: Lenka Štoková

Crop Research Institute in Prague, Prague, Czech Republic

Co author: Jana Chrpová

Crop Research Institute in Prague, Prague, Czech Republic

Abstract:

In central Europe, Fusarium head blight (FHB) is caused by a complex of *Fusarium graminearum*, *F. culmorum* and some species of minor importance. The fungus reduces grain yield substantially and affects grain quality. Mycotoxin contamination of human food and animal feed became a more important feature than the direct yield losses that often occur irregularly. Many mycotoxins are produced in culture, but most important are trichothecenes (which include deoxynivalenol – DON). The response to artificial infection with *Fusarium culmorum* was studied in advanced breeding lines during registration process and in winter wheat varieties recommended in the Czech Republic in three years (2007, 2008, 2009) in field tests on hill plots conducted at the location Prague – Ruzyně in 3 replicates. Artificial inoculation of spikes with isolate B of *F. culmorum* was performed at mid flowering stage (GS 64). Head blight symptoms were evaluated in three terms after inoculation. Resistance of the same variety set was also evaluated under the conditions of natural infection (FHB N) in 4 locations that are used for these types of tests by the Central Institute for Supervising and Testing in Agriculture (CISTA). To support FHB infection, the trials in two replicates were established after the preceding crop maize and application of reduced tillage system. The prevalent pathogen species was found to be *F. graminearum*. The official CISTA method was used for evaluation of disease incidence. Grain samples obtained from 10 spikes inoculated with *F. culmorum* and from all spikes in a naturally infected hill plot were analysed for DON content by the ELISA method. The highest level of resistance to accumulation of DON was detected with the use of both methods in the varieties Bakfis, Baletka, Federer and Sakura. Sakura is a variety with the feed quality and is suitable for growing in regions promoting a higher FHB incidence, where this variety is able to give high grain yield in connection with low contamination of grain by DON (under the limit of 1,25 mg/kg). The moderate resistance to FHB was confirmed in the variety Sakura (on the level of German variety Petrus) also in the results with nine winter wheat cultivars evaluated in field experiments at two sites for three years. The results of these trials demonstrate a pronounced and relatively stable effect of cultivar resistance on reducing head blight, grain yield losses and contamination of grain by mycotoxin DON.

2.10 Underestimated potential of using seabuckthorn (*Hippophae rhamnoides* L.) as feed and feed additive for livestock and poultry

Presenting author: Adrian Vescan

University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania

Co authors: Cristian Radu Sisea and Cristian Ovidiu Coroian

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Abstract:

Seabuckthorn is a spinescent, deciduous and dioecious berry producing shrub, with a high economical and ecological potential. Seabuckthorn leaves and young branches were used in ancient Greece as horse fodder supply, hence the genus name *Hippophae*, meaning 'shining horse'. Native seabuckthorn constitutes an important food supply for a large number of wildlife species. Due to its hardiness and ability to fix atmospheric nitrogen, this species can easily be used in organic farming. While fruits are the main product, an important issue is represented by the potential uses of leaves and fruit and seed residues resulting from juice and oil extraction. Each hectare of artificial seabuckthorn forest can produce around five tons of leaves and young branches/year. Seabuckthorn leaves have similar content in crude protein and crude fiber as *T. pratensis* and *T. repens* and higher crude fat content. Compared to alfalfa hay, seabuckthorn leaves have similar content in crude protein, almost double in crude fat and calcium and less in crude fiber. A comparative study from China, including 16 types of fodder supplies, such as green forage grasses, dried grass and soybean, showed that seabuckthorn leaves, seed and fruit residues have the highest content in crude fat and very good values for crude protein, crude fiber, lysine, Ca and P. Russian studies recommend leaf cake (leaf residues after oil extraction) as a fodder additive with a high content of well digestive proteins (13.3%), essential amino acids (lysine 6.8% from protein), carotenoids (70 mg%), chlorophyll (115 mg%), micro and macro elements and high caloric value (7500 kcal/kg of leaf cake). Seabuckthorn berries, leaves, young sprouts and industrial residues showed a high content of nutritive and bioactive substances that encourage the use of this species as a livestock and poultry feed supply. Long term feeding with seabuckthorn products can promote growth and general immunity from diseases; furthermore, no toxic effects were detected. Our preliminary data regarding nutritive components of leaves and fruits from several Romanian seabuckthorn populations (*H. rhamnoides* subsp. *carpatica*), showing similar results, are also presented. Romania has important unexploited natural seabuckthorn resources that can secure the animal husbandry sector with an inexpensive and high quality complementary feed supply.

2.11 Determination of homogeneity and working accuracy in feed production

Presenting author: Djuro Vukmirovic
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Co authors: Olivera Djuragic, Radmilo Colovic, Bojana Kokic, Nedeljka Peno and Jovanka Levic
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Abstract:

Without systematic and continuous control at all stages of production, we cannot speak about quality and safety of food and sustainable production. Researchers should pay special attention to critical characteristics of raw materials, critical points in the production process and other risk factors. For example, carryover is a potential risk in the production of feed and it is a key for ensuring the safety of consumers. Production of mixed feed for animals without carryover, taking into account the technical aspects is absolutely impossible. Testing the homogeneity of feed and level of carryover of selected places in the production chain provides useful information for the introduction of corrective measures to reduce the risk of contamination.

Preliminary technological research included determining the mixture homogeneity and accuracy of working manufacturing process to choose the optimal solution for mixing homogeneous liquid and solid components and develop new products and improved methods of examination.

We have investigated three different methods with different types of indicators and their suitability for the measurement of mixing uniformity in a feed processing plant. Indicators were different according to number and size of particles. Mixing uniformity was evaluated statistically in two different ways. Datasets for a sampling point consisting of particle counts (Microtracers F, FS and FSS) were analyzed as Poisson distributions, characterized by their means. Probability values obtained from this group were 32.3%, 35.1% and 39.4% respectively. Datasets consisting of concentrations were analyzed as normal distributions, characterized by means and standard deviations or coefficients of variation (Cv in %). Both methods with Microtracer and Methylene blue were suitable for the test of homogeneity (Coef. of variation 4.14% and 3.62 % respectively) while the method with NaCl showed a relatively high coefficient of variation (8.88%). According to summary results, all investigated methods were suitable for determination of feed uniformity but determination with method of Microtracer was quick and cost effective. In further research, this method is used in determination of working accuracy in feed production line. The results showed that decomposition of feed leads to carryover into the next batch (1.6 % and 1.2 % in critical control points).

2.12 Development of technologies for sustainable feed production

Presenting author: Jovanka Levic

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Co authors: Slavica Sredanovic (1) and Rade Jovanovic (2)

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(2) Institute for Application of Science in Agriculture, Belgrade, Serbia

Abstract:

Sustainability is a serious challenge for the whole feed and food chain, including researches involved in various research areas within that chain. There is a direct impact of feed production on employment, emission into the environment (dust, noise, waste, gasses), energy consumption, use of finite resources, but also indirect impact on the sustainability of the feed materials supply chain (outlet for by products from food industry, soya production systems, fish meal production), and on the sustainability of the livestock production with regard to food safety (salmonella and other contaminants), livestock effluents (N and P digestibility, use of feed additives), feed conversion rates, balanced diets, etc.

Our national project “Development of technologies for sustainable feed production” includes investigation of possibilities for manufacturing of new and improved feed products, with increased digestibility and utility, by using contemporary technological processes and additives. Five scientific research organization, with complementary research area, and five enterprises, which are interested in research results, have been involved with this project. Research work is multidisciplinary and includes different areas: Feed manufacturing technology; Animal Nutrition; Food safety; Quality control and feed evaluation; Quality of products of animal origin.

Planned project activities are divided into several stages:

- Preparing of research which includes: review of literature, determining critical characteristics of materials, identifying critical points in the production process and other risks, determination of mixture homogeneity and working accuracy of feed manufacturing processes, selection of optimal raw materials and processing parameters, development and choice of testing methods, selection of best procedures, etc.
- Using of alternative additives (i.e. herb extracts) in feed.
- Different technological processes for sustainable feed production: micronization (corn, barley, oat, triticale, wheat), extrusion (soy bean), and separation (alfalfa, sunflower meal, silage.)
- Application of additives to increase digestibility and usability
- Evaluation of produced feeds and compounds.

Investigation results could be applied in:

- Processing of raw materials
- Feed production with improved technological processes
- Production and application of herb extracts
- Production of special feed for various types and categories of animals

Final goal of the project is sustainable feed production, which is safe for humans, animals, and environment.

2.13 Extracted DNA as an analyte in feed analysis

Presenting author: Jaroslava Ovesná

Crop Research Institute, Prague6, Ruzyne, Czech Republic

Co authors: Jan Hodek, Lucie Pavlátová, Ladislav Kuera, Leona Svobodová and, Vlad. Pouchová

Crop Research Institute, Prague, Ruzyne, Czech Republic

Abstract:

It is a matter of fact that feedstuff may affect the quality of meat products. Several parameters are of interest, among them the presence of mycotoxins and genetically modified organisms. Although they have dramatically different impact, both may be detected by methods using DNA as an analyte.

Several methods can be used to analyze DNA, currently PCR based methods are employed. Taq polymerase and its derivatives are used for target DNA sequence amplification. Taq polymerase as such needs optimal condition for its full activity. Quality of DNA that serves as the target for the enzyme depends highly on the matrix from which DNA is extracted. Green material contains high molecular weight DNA and several extraction methods can be used to obtain high quality DNA. A similar situation is reported for commodities containing single species grains. Often feedingstuff is processed and complex and contains PCR enhancers and inhibitors. Also DNA is degraded and fragmented. That makes analysis biased and less accurate.

We will present the impact of matrix (feedstuff) processing and DNA purification procedure of PCR efficiency in real time PCR assays for quantification of GMO and *Fusarium* sp. contents.

3.1 Meals for the elderly; the role of old habits and new needs

Keynote speaker: Øydis Ueland
Nofima Mat, Ås, Norway

Abstract:

The older age segments of the population constitute a growing and diverse group with different needs and requirements with regard to food and nutrition. Traditional products and meals are of great importance for many elderly, but general changes in society when it comes to food culture will also affect this group. The life situation of active elderly can also add restrictions on what kind of food they prepare and eat. Consequently, current food intake and habits in the ageing population are at a crucial stage of change which will need the attention of food providers and food industry to ensure that the needs and wants of this group are met.

As one grows older there is a diminished ability in sensory perception, particularly smell, but also for taste and textural perception, that can result in reduced food intake through less enjoyment in eating. In addition, physical problems with chewing and swallowing, declining appetite, illness, medicine intake, and lower energy requirements contribute to challenges for elderly in achieving an optimal diet.

Eating situations are also social situations and a change in daily life brought about through loss of partner, friends, job, or mobility can make it difficult to adjust in order to make dietary adjustments that uphold a satisfactory diet. Meals may take on new meanings; for instance, medicines needing to be taken with a meal, or eating just for passing time.

Studies show that old habits prevail, and upholding a traditional diet is therefore important in older age groups. However, new skills may have to be learned in order to manage daily meal preparation and consumption. Food acquisition poses problems for elderly for whom size of product units sold in stores and transportation back home can be challenging. Storage at home is another problem, both from a space and a food safety point of view. Handling of kitchen equipment and preparatory procedures can be difficult with some products that are parts of traditional dishes, such as cutting of cabbage or peeling potatoes. Furthermore, cooking skills may need to be learned or relearned taking into account a number of circumstances such as one person households eating small amounts, that the meal should be satisfactory, nutritionally acceptable, and familiar.

Personalised nutrition is a popular concept, particularly for young persons and adults with ambitions for a longer and better life, but for no other group is the concept more relevant than for elderly consumers.

3.2 Consumer attitudes to feed/food additives and foods of animal origin

Presenting author: Aldona Miezeliene

Food institute of Kaunas Technological University, Kaunas, Lithuania

Co author: Gitana Alencikiene

Food institute of Kaunas Technological University, Kaunas, Lithuania

Abstract:

Food is a major source of pleasure, worry and stress for the consumer. Today a wide range of competitively priced food products of consistently high quality are on the market. Understanding consumer behavior and attitudes contributes to a better understanding of food choices and usage. It is an important step in product creation and development and can define its success or failure in the market. Technological and environmental changes associated with modern food production, such as genetic engineering, the use of feed and food additives are also of vital importance for food science, producers and society and of increasing interest to consumers.

The objectives of this study were to identify the most important determinants of food choice in Lithuania and to determine consumer attitudes with respect to the usage of feed and food additives in industry. 204 respondents divided into 5 age groups from 5 different regions of Lithuania participated in the research. The consumer panel was aged from 19 to 76 year. The data were collected at participants homes and workplaces using a previously prepared questionnaire. The results indicated that most consumers (86.9%) preferred traditional, well known food products in their daily ration and only 2.3 % were interested in the use of new and unknown products. Most of the respondents noted that some of feed (82%) and food (68%) additives are necessary in nowadays technologies, but they would prefer additives of natural origin. The similar parts of the respondents (32 34 % in average) would like to choose and use food products with natural or/and harmless food additives, but 23 % preferred food without additives. The majority of consumer maintained that feed additives could be related to negative health impact for consumers of animal products.

Acknowledgements:

The research is fulfilled according to COST Action FA 0802. The authors thank Agency for International Science and Technology Development Programmes in Lithuania for financial support.

3.3 How Europeans think of fish from aquaculture after exposure to balanced information

Presenting author: Themistoklis Altintzoglou
Nofima Marin, Tromsø, Norway

Co authors: Wim Verbeke (1), Filiep Vanhonacker (1) and Joop Luten (2)
(1) Department of Agricultural Economics, Ghent University, Belgium
(2) Nofima Marked, Tromsø, Norway

Abstract:

The positive effects of the consumption of fish are well documented and known by consumers. However, safety risks due to environmental contaminants can also be present in fish and influence consumers' perception of fish. Existing sustainable methods of aquaculture can improve the environmental and welfare conditions for farmed fish. Furthermore, aquaculture practices are regulated and guaranteed by authorities within the European Union.

This presentation will describe the effect of balanced, non persuasive information related to safety, healthiness and sustainability concerning aquaculture on the image of farmed fish among European consumers.

Consumers from Belgium, Norway and Spain (n=1319) participated in this study. The participants were exposed to messages about food safety, human nutrition and health risks and benefits, sustainability of the production method and European origin and guarantee for fish from aquaculture. The message exposure and all evaluations were performed by means of an experimental, on line survey.

The image of fish from aquaculture was found to be predominantly positive. The information provided to the consumers led to neither positive nor negative influence on the image of farmed fish. Furthermore, consumers who were exposed to information related to the EU origin and aquaculture related guarantee reported a more positive image of farmed fish.

These results provide valuable input for transparent communication about fish farming practices which might increase consumer trust and will not harm the image of fish from aquaculture. Increasing consumers' knowledge about aquaculture and its positive effects on the image of farmed fish is also discussed as a pathway for maintaining and improving aquaculture's positive image in the future.

3.4 Do European consumers care about fish origin?

Presenting author: Filiep Vanhonacker

Department of Agricultural Economics, Ghent University, Belgium

Co authors: Wim Verbeke (1), Themistoklis Altintzoglou (2) and Joop Luten (3)

(1) Department of Agricultural Economics, Ghent University, Belgium

(2) Nofima Marin, Tromsø, Norway

(3) Nofima Marked, Tromsø, Norway

Abstract:

The purpose of the present study is to gain insights into the relevance and market potential of fish origin (farmed or wild), as a response to the growing relevance of aquaculture as a fish production method and of farmed fish as a food product. Cross sectional data were collected through a consumer survey in three European countries, that are clearly differentiated in fish consumption figures and in affiliation with fish production. In total, 1,319 valid questionnaires were gathered in Belgium, Norway and Spain, in November-December 2007. The study describes personal and food characteristics, as well as consumer attitudes and knowledge related to fish origin. We were particularly interested in whether or not it is possible to profile and distinguish (self reported) farmed fish from (self reported) wild fish consumers.

The study results indicate that European consumers have little knowledge or awareness regarding the origin of the fish they consume. This results in uncertainty in consumers' perception of farmed fish in particular. These findings are in line with previous findings and suggest that the consumers' perceptions of aquaculture and farmed fish are based more on emotions than on rational considerations. For example, it suffers from a negative image transfer from past processes and from intensive terrestrial livestock production. Nonetheless, the perception consumers have about farmed fish is positive in general. Fish origin did not appear as a primary information cue, although some variation was found between consumer groups with a different profile. Further, consumers of predominantly farmed fish did not have a very distinct profile, which corroborates with the only modest significance of fish origin as a product specific information cue during fish purchase and consumption decision criteria.

3.5 Consumer reactions to functional foods and foods with nutrition and health claims

Presenting author: Wim Verbeke
Ghent University, Gent, Belgium

Abstract:

This paper reports on consumers' reactions towards the concept of functional foods and on their interest in different combinations of carrier product, functional ingredient and claims. Specifically, it reports consumer interest in calcium enriched fruit juice, omega 3 enriched spread and fibre enriched cereals, each combined with a nutrition claim, health claim and reduction of disease risk claim as specified in Regulation EC (No) 1924/2006.

Cross sectional data were collected from consumer samples in Belgium in 2001, 2004 and 2006. In 2001 and 2004, consumer reactions towards the concept of functional foods were measured. In 2006, consumers' reactions to the carrier product, functional ingredient and claim combinations were assessed as perceived convincingness of the claim, credibility of the product, attractiveness of the product and intention to buy the product, while accounting for differences in product familiarity, attitudinal and demographic characteristics.

Belgian consumers were found to be quite sceptical towards the concept of functional foods and to have particular concerns as to whether the products can deliver on their promises. Consumers' willingness to compromise on taste for health was found to be low and to have decreased over the period 2001-2004.

Generally, health claims outperformed nutrition claims in terms of consumer interest and both of these claim types outperformed reduction of disease risk claims. Comparing consumer reactions across product concepts revealed clear preferences for fibre enriched cereals as compared to the other two concepts, i.e. preference was in favour of a familiar product with a natural type of enrichment (cereals are believed to be naturally rich in fibre). The interaction effects between claim type and product concept indicated that reduction of disease risk claims are perceived very well in omega 3 enriched spreads, particularly in terms of perceived convincingness of the claim, while not appealing to consumers in the other product concepts. Positive attitudes towards functional foods and familiarity with the concrete functional product category boosted the claim type and product ratings, whereas perceived control over own health and perceiving functional foods as a marketing scam decreased all product concept's interest scores.

This study indicates that whether consumers are interested in nutrition and health claims depends on the claim type and the combined carrier product nutrient concept. Consumers are least attracted by reduction of disease risk claims, i.e. the most difficult claims to substantiate and get approved in light of the current EU legislation.

4.1 Feed for fish and fish as food

Keynote speaker: Janneche Utne Skåre

Aquaculture Protein Centre, Norwegian school of Veterinary Science, Oslo, Norway

Abstract:

Fish contains nutrients that are positive for human health. However, fish also contains contaminants and other undesirable compounds.

Thus, fish contain high quality proteins, vitamin D, B12 and the minerals iodine and selenium and is a natural source of the marine n 3 fatty acids EPA, DPA and DHA. Fatty fish and certain fatty seafood products are the most important natural sources of marine n 3 fatty acids and vitamin D in the Norwegian diet. A large body of documentation shows that fish as food is beneficial to human health, and there are strong indications that consumption of fish slow down and prevent cardiovascular disease. Furthermore, fish is found to positively affect foetal and neurological development. The marine n 3 fatty acids are assumed to be responsible for the health promoting effects of fish.

However, consumption of certain fish species may be associated with high intake of various environmental contaminants and other undesirable compounds. The potential highest risk is posed by dioxins and dioxin like PCBs and methyl Hg. Fish and other seafood are the most important sources of dioxins and PCBs for Norwegians. These contaminants may cause various adverse health effects of which the most serious are impairment of reproduction and development. Cancer development and impaired immune system are other potential toxic effects from exposure to these contaminants.

The composition of nutrients and contaminants in farmed fish, salmon, trout, cod and halibut varies according to the raw ingredients and components of the feed used. Thus, the quality of the fish with regard to occurrence and levels of nutrients and contaminants may vary considerably depending on the feed composition. This again may indeed affect the potential beneficial health effects of fish as food.

This presentation will discuss how the possible health promoting effects of farmed fish consumption depend on the feed quality wrt nutritional composition and content of undesirable contaminants.

4.2 Effects on performance and product quality in Atlantic salmon fed diets reduced in organic pollutants

Presenting author: Åshild Krogdahl

Aquaculture Protein Centre, Norwegian School of Veterinary Science, Oslo, Norway

Co authors: Jan Olli (1), Bente Ruyter (2), Turid Mørkøre (2), Harald Breivik (3), Aimo Oikari (4), Alexei Krasnov (2), Olav Thorstad (5), Gunnar Berge (5) and Torbjørn Åsgård (2)

(1) AVS Chile SA, Casilla 300, Puerto Varas, Chile

(2) *The Norwegian Institute of Food, Fisheries and Aquaculture Research (Nofima), Ås, Norway*

(3) *Neperdo™ Biomarine, Porsgrunn, Norway*

(4) *University of Jyväskylä, Jyväskylän yliopistoy, Finland*

(5) Pronova, BioPharma, Lysaker, Norway

Abstract:

Oily fish, including cultivated Atlantic salmon are, due to their content of omega 3 fatty acids, considered healthy for human consumption. However, the oil of these fishes, whether wild or cultivated, contains levels of persistent organic environmental pollutants (POPs) of concern for both fish and human health. Advice regarding fish consumption has therefore been complicated by reports that some species are burdened with potentially harmful levels of POPs, such as dioxins, PCBs and brominated flame retardants (BFRs). As a way to reduce these POPs in farmed fish, a molecular distillation process efficiently removing POPs from fish oils has been developed. Potential beneficial effects in farmed fish from reducing the POPs in the feed oil were tested in a study lasting from post smolt size to slaughter size at Gildeskål Research Station (GIFAS), Norway. The fish were given feeds containing purified or not purified fish oil, four replicates per treatment. The effects on growth, health and fillet quality were studied. There was a tendency for better growth and feed utilisation in the group receiving feed containing purified oil. This was particularly the case during periods of high growth when both the growth rate and feed utilisation rate were significantly better for the fish that received the feed containing purified oil. The salmon that received the feed containing purified oil appeared to experience reduced stress during handling at slaughter, measured as a delayed pH reduction after killing. Other stress markers showed the same tendencies. All the fish in the trial maintained a good red colour and firmness. There was a tendency that fish that received the feed containing purified oil had a firmer texture. The difference in texture was most pronounced after freezing. The proportion of salmon with soft texture was then halved in comparison to the fish that received unpurified oil.

4.3 A fish called ambiguity: risks and regulations of the use of fish in the food production chain

Presenting author: Leo van Raamsdonk

RIKILT, Institute of food safety, Wageningen, the Netherland

Abstract:

The use of fish as an ingredient of human daily diet is frequently considered as beneficial for human health. The production of fish is also believed to have a smaller ecological footprint than animal proteins from land animals. As in every aspect of life, however, a benefit always has its drawbacks. In this presentation some of the ambiguous aspects of the same medallion will be presented.

Rules for the use of fish exist in several Regulations of the EU, which includes the recycling of fish byproducts in aquafeed, and limits for the contents of certain toxic compounds.

Risk is frequently defined as *change x effect*. The first parameter for assessing risk depends both on the frequency of applying fish as an ingredient in feed and food and on the level of contamination. The tolerable limits for some contaminants depend on the intended application of the fish materials. The severity of the effect was usually considered when establishing tolerance limits, but economic interests were also accounted for.

Accumulation as a result of recycling byproducts is usually not included in the establishment of tolerance limits, with one exception. The feeding of fish byproducts to farmed fish of the same species is prohibited because of the BSE legislative requirements. A first problem is the definition of the term species. Furthermore exemptions do exist.

In this presentation EU legislation will be discussed, some methods for risk assessment will be presented and some indication of the effect of recycling will be given.

4.4 Reducing POPs in farmed Atlantic salmon; strategies of feed composition and Norwegian National surveillance programme 2003 2008

Presenting author: Marc Berntssen
NIFES, Bergen, Norway

Co authors: Anne Katrine Lundebye, Kåre Julshamn and Amund Maage
NIFES, Bergen, Norway

Abstract:

Salmon is known to contain a relatively high level of environmental contaminants such as dioxins, PCBs, brominated flame retardants and organochlorine pesticides (OCPs) that can be potentially hazardous to consumers. While being a potential source of contaminants, oily fish is also an important source of health promoting nutrients such as the very long chain omega 3 (VLC n3) fatty acids, fat soluble vitamins such as cholecalciferol (vitamin D₃), and essential elements such as selenium and iodine. The overall health effect of consumption of oily fish such as Atlantic salmon is a trade off between beneficial and potentially harmful compounds.

While fish oils are the main source for POPs, fish meal is the main source for elements. There are three main approaches that singularly or in combination can reduce the level of POPs in farmed salmon, namely a) sourcing of fish oil (EU project "DAPAFF"), b) replacement of marine ingredients with vegetable ingredients (EU project "Aquamax"), and c) decontamination of fish oils (NFR BIP project "Clean oil"). The combined use of partial replacement of marine ingredients with vegetable ingredients and decontamination of fish oil with a commercial two step technique based on active carbon followed by steam short path deodorization is the most effective way to reduce POPs, while maintaining levels of favorable VLC n3. Fat soluble vitamins (A, D, E, and K) are also removed from the fish oil during the decontamination process and salmon feeds will need to be fortified with vitamins to compensate for this loss. The levels of dioxins and dioxin like PCBs in Atlantic salmon reared on decontaminated feeds are similar to those found in lean farmed fish such as Atlantic cod, tilapia, and pangasius or terrestrial food of animal origin such as beef.

National surveillance of both feed and farmed salmon, performed by NIFES on behalf of the Norwegian Food Safety Authority, indicate that above mentioned strategies are implemented to control and reduce POP loads in the Atlantic salmon production chain. Data from the Norwegian fish feed monitoring programme show that the levels of sum dioxins plus dioxin like PCBs in salmon feeds declined from 3.57 WHO TEQ pg/g in 2001 to 1.45 WHO TEQ pg/g in 2008. For the group of brominated flame retardants, polybrominated diphenyl ethers (PBDE), mean sum PBDE₇ values were 2.52 ng/kg in 2003 and 1.02 ng/kg in 2008. Similar trends were observed in commercially farmed Norwegian Atlantic salmon. The mean dioxin level in farmed Atlantic salmon on the Norwegian market was 0.58 WHO TEQ pg/g (0.25 1.19, N=45) in 2002 whereas it was 0.34 WHO TEQ pg/g (0.16 0.54, N=51) in 2008.

4.5 Beware of Unintended Consequences: A cautionary tale

Presenting author: Marie Cooper

Norwegian Institute of Food, Fisheries and Aquaculture Research, Tromsø, Norway

Co author: Ragnar Olsen

Norwegian School of Fishery Science, University of Tromsø, Tromsø, Norway

Abstract:

Fortification of animal feeds with the aim of improving the nutritional value of foods for humans has been suggested. Our experience with the fortification of aquaculture feeds for farmed cod prompts us to sound a cautionary note. Blood vessel melanosis or black stripe in the muscle of farmed cod is a phenomenon that was first observed in the 1980s. We have been able to show that black stripe results from chronic overexposure to dietary trace metals, particularly copper. Aquaculture feeds are routinely supplemented with standard vitamin and mineral mixes. This is done on a “better too much than not enough basis” with the dual intentions of avoiding deficiencies and enhancing growth and productivity of cultivated fish. In our experiments farmed cod were raised from fertilised eggs on diets containing feeds with and without supplements or with supplements containing specified amounts of copper and zinc. We saw that farmed cod do not benefit from the addition of trace metal and mineral supplements to fish meal based diets. Fish on feeds without trace metal supplements grew at the same rate as those receiving supplements (attaining average wt 2kg in 2yr). Furthermore, whilst no harm due to the addition of supplements was seen in living fish, the presence of excess copper in the diet resulted in black stripe in 80% of the fish whilst removal of either copper and/or all extra trace metals produced fish with no black stripe. Black stripe impacts on both the market value and consumer acceptability of the cod. It is clear from the table below that feeds based on fish meal contain sufficient trace metals to meet the estimated requirements of marine fish.

It is essential to establish that fortification strategies have no detrimental effects on the health and welfare of the food animal and further, do not negatively affect the perceived quality of the food product.

	Copper	Zinc	Iron	Manganese
Feed with no supplement	3.13 ± 0.39	157.47 ± 1.2	140.33 ± 23.4	18.4 ± 3.6
Commercial Feed with standard supplement	19.40 ± 2.2	218.4 ± 4.6	85.9 ± 21.5	NA
Estimated Requirement	3 - 5	20 to 30	30 to 150	2.4 to 13

4.6 Effects of dietary mineral supplementation on quality of fresh and salt cured fillets from farmed Atlantic cod

Presenting author: Hilde Herland
Nofima Marin, Tromsø, Norway

Co authors: Ragnar L. Olsen (1) and Marie Cooper (2)
(1) Norwegian School of Fishery Science, University of Tromsø, Tromsø, Norway
(2) Nofima Marin, Tromsø, Norway

Abstract:

Intensive farming of Atlantic cod is being developed to increase the supply of and provide cod throughout the year. The fish are usually given a fish based formulated feed containing mineral and vitamin supplements. Supplements are added to avoid deficiencies.

Studies performed on farmed animals have shown that mineral and trace metal supplementation may affect slaughter quality. Several studies have been performed on pigs and it has been shown that adding certain trace metals and minerals to the *pre* slaughter diets of pigs improves important quality parameters such as water holding capacity (WHC) and colour of pig meat

The aims of this study were to investigate effects of dietary mineral supplementation on physical, chemical and sensory quality parameters of fresh farmed cod fillets, as well as on the quality of salt cured farmed cod.

The conclusions from this work are that the addition of mineral supplement to the feed of farmed cod altered the chemical and physical quality. The content of some minerals and trace metals were higher in fillets from cod fed a supplemented diet and the protein content was slightly lower. The fillet colour was also affected as the fillets from cod fed supplements were slightly more yellow and had a lower Whiteness. The chemical and physical differences could not be detected by sensory analysis. The quality of salt ripened cod was reduced due to increased yellowness, probably caused by the increased level of copper in the muscle of cod receiving the diet with a complete mineral supplement.

4.7 Intensive artificial feed lacking nutrients significant for growth and development?

Presenting author: Hanne K. Maehre

Norwegian college of fishery science, University of Tromsø, Tromsø, Norway

Co authors: Kristin Hamre (1) and Edel Elvevoll (2)

(1) National Institute of Nutrition and Seafood Research (NIFES), Bergen, Norway

(2) Norwegian college of fishery science, University of Tromsø, Tromsø, Norway

Abstract:

Objective: Cod larvae are dependent on live feed during the first period post hatch. The most common feed source in cod larvae production is rotifers, but feeding on zooplankton has been shown to give higher survival rate, enhanced growth and less skeletal deformities of larvae. The nutritional quality of the feed is likely to play a crucial role. Feed components suggested to have an impact are, for instance, the long chain polyunsaturated fatty acids (LC PUFAs) eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). A high content of free amino acids (FAA) and peptides are also believed to be of importance due to limited differentiation of the digestive system in the larvae. In addition, the content of some minerals is believed to be important.

Materials and methods: Zooplankton collected at Lofilab AS (Steine, Norway) and two different intensive feeds collected at Troms Marin Yngel AS (Tromsø, Norway) were subjected to analysis of proximate composition (water, lipids, proteins and ash), fatty acid composition, amino acid composition and minerals. All samples were freeze dried prior to analysis and all comparisons were performed on a dry weight basis (DW).

Results: Zooplankton contained lower amounts of lipids and proteins than did the two intensive feeds, while ash content, reflecting the mineral content, was higher. The content of LC PUFAs was higher in zooplankton than in the intensive feeds, the sum of EPA+DHA being twice as high as in the intensive feeds, 39% vs. 20%. Total amino acids were relatively similar between the intensive feeds and zooplankton, but the relative amount of FAAs was higher in zooplankton. The main difference in amino acid composition was that while zooplankton was rich in taurine, 8.4 mg/g DW, the intensive feeds were almost devoid of it. Zooplankton was richer in all of the minerals analysed, except phosphorus. The intensive feeds were devoid of selenium.

Conclusion: Zooplankton contained more of all of the components believed to be important in the development of cod larvae than did the intensive feeds. The observed differences in biochemical composition between zooplankton and the two intensive feeds could, either separately or in combination, be a part of an explanation of the overall enhanced performance of larvae fed on zooplankton.

4.8 Verification of the Identity of Organic Feeds for Laying Hens by Fatty Acid Fingerprinting

Presenting author: Alba Tres

(a) RIKILT, Wageningen University and Research Centre, Wageningen, The Netherlands

(b) Nutrition and Food Science Department, University of Barcelona, Barcelona, Spain

Co authors: Maikel Rozijn, Henk van der Kamp, Martin Alewijn and Saskia van Ruth
RIKILT, Wageningen University and Research Centre, Wageningen, The Netherlands

Abstract:

Verification of the identity of high value and/or special food and feed products is of great interest for producers, consumers and regulatory authorities. Multivariate statistics allow treatment of a high number of variables together. The fingerprint of feeds are used in order to obtain models that allow their correct identification. The aim of this study was to develop multivariate statistical models that allow verification of the organic origin of feeds supplied to laying hens, based on their fatty acid profiles. Sets of feeds given to hens for the production of organic (24), free range (12), and barn eggs (12) were analysed for their fatty acid profiles by gas chromatography. Principal Component Analysis (PCA) and Partial Least Squares Discriminant Analysis (PLS DA) were applied to the data. Performance of the models was evaluated by leave 1 out cross validation. The PCA showed clustering of feed samples: organic feeds were grouped together, whereas feeds used for regular egg production showed more variation. PLS DA predicted correctly the identity of organic feeds, but for regular feeds, predictions were more challenging.

4.9 Carryover of melamine in rainbow trout (*Oncorhynchus, mykiss*) in muscle

Presenting author: Francesca Fasano

Istituto Zooprofilattico Sperimentale PLV con annesso CreAA, Torino, Italy

Co authors: Paola Brizio (1), Concetta Elia (2), Laura Gasco (3), Daniela Marchis (1), Marino Prearo (1), Stefania Squadrone (1) and Maria Cesarina Abete (1)

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(3) *Facoltà di Agraria, Università degli Studi di Torino, Torino, Italy*

Abstract:

Melamine is a nitrogen rich compound that could mimic proteins in some tests. As the protein concentration in food and feed is measured by analysis of nitrogen content, melamine was fraudulently added to protein supplements used in feed such as wheat gluten, corn gluten and rice gluten to artificially inflate protein levels. In some countries melamine was also found in fish feed and fish meal. Since the price of fish meal depends on the protein content, there is a possibility of adulterating this ingredient of fish feed with melamine to artificially increase protein levels. As melamine excretion in fish is relatively slow, this chemical might accumulate in fish tissues and thus present a potential problem for human intake.

We developed a method based on HILIC (Hydrophilic interaction chromatography) chromatography coupled with a triple quadrupole tandem mass spectrometer, using an ESI (ElectroSpray Ionization) source to quantify the amount of melamine present in fish tissues. Control fish tissues were fortified to produce samples containing melamine in a range between 10 ng/g and 250 ng/g. Every sample was spiked with internal standard melamine ¹³C3. Samples were then extracted and purified by SPE cartridges. The method proved to be sensitive and specific. The use of the isotopically labeled standard is of importance to compensate for both the matrix effects and/or possible variations in the instrument signal.

The method developed was used to quantify melamine residues in muscles of rainbow trout that were fed with enriched diet of melamine at different concentration levels (12,5 g/kg and 25 g/Kg). Trout were treated for a given time (4 weeks) followed by a withdrawal period (4 weeks). Melamine was found in trout tissues at about 100mg/kg, but concentration values detected were not proportional to the melamine dose fed. During the trial we didn't observe a significant increase in mortality of trout but a general symptomatology including ataxia and melanosis were observed.

This trial was designed in order to evaluate the carry over and the palatability degree of melamine in fish. Rainbow trout were fed with high melamine levels to find it at high concentration in muscles as a high concentration of this molecule in muscles was needed, in order to easily develop an efficient method.

4.10 An *in silico* model for the prediction of muscle:plasma partition coefficients of feed contaminants

Presenting author: Aneliya Haritova

Trakia University, Department of Pharmacology, Faculty of Veterinary Medicine, Stara Zagora, Bulgaria

Co author: Johanna Fink Gremmels

Utrecht University, Utrecht, The Netherlands

Abstract:

Dioxins, non dioxin like compounds, as well as phthalates are released into the environment from several commercial applications and industrial sources. Humans and animals are exposed to background levels of these compounds¹. In farm animals and fish these compounds are absorbed following ingestion of contaminated feed supplies, distributed in all tissues and accumulated in meat, liver, fatty tissue and milk. Tissue disposition can be modelled by methods generally applied in physiologically based pharmacokinetics (PB PK)^{2,4} and allow a prediction of the degree of bioaccumulation of these compounds in tissues of different animal species. The relation between concentrations of contaminants in plasma and in tissues can be described by the following equation: $Pt:p = (Cf_t/Cf_p)(f_{up}/f_{ut})$, where f_u is unbound fraction in plasma (p) or tissue (t), and Cf_t/Cf_p represents the difference between tissues and plasma caused by the differences in lipophilicity.

On the basis of the estimations with the applied model, dibenzo p dioxins, dibenzofurans, coplanar and mono ortho substituted biphenyls and non dioxin like polychlorinated biphenyls having an octanol:water coefficient >5, show a tendency for partition into muscle tissue in higher concentrations than in plasma. Other organic halogenated compounds such as polycyclic aromatic hydrocarbons and phthalates, which have a $Po:w$ higher than 5, show a similar distribution as dioxins. A lower tendency for disposition in muscle tissue can be predicted for phthalates (dimethyl phthalate, diethyl phthalate and diisononyl phthalate) with low $Po:w$ coefficient (between 1.6 and 2.42) which is in line with the observed disposition pattern in fish.³ Various fish species differ in the lipid content in their muscle tissue, which explains the wide range of values for the partition coefficient. For example, in comparison to cod, the muscles of trout and salmon are expected to contain a higher concentration of these organic contaminants. Following the same assumptions higher concentrations of these organic contaminants can be predicted in dark muscles as compared to the light muscles of fish. Although, the influence of water temperature on excretion is not incorporated in this disposition model, it can be added for the prediction of the elimination half life at steady state conditions. In conclusion, in combining substance specific physico chemical parameters with the kinetics of tissue distribution, the applied method allows a rapid prediction of contaminant concentrations in muscles of mammals and fish.

1. EFSA, 2005, *The EFSA Journal* 284, Annex I and Annex II, 1 – 77;

2. Levitt, 2010, *BMC Clinical Pharmacology* 2010;

3. McFall et al., 1985, *Chemosphere*, 14, 1561–1569;

4.11 Examination of antimicrobial resistance in salmonella spp. Isolated from feed mills, chicken and pig abattoirs

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Abstract:

Application of antimicrobial drugs in food producing animals raised the question of bacterial resistance development, possible transmission of resistant strains to the consumers through the food chain and the development of hardly treatable alimentary infections. It has long been recognized that infectious agents are most effectively spread in commercial production situations via either contaminated animals or contaminated feed. Feed are shown to occasionally harbor *Salmonella* originating from ingredients or the processing environment. Monitoring antimicrobial resistance should cover different stages from the entire farm to fork chain. Animal feedstuffs are potential vehicles for transmission of resistant *Salmonella* that could colonize the intestinal tract of animals.

The aim of this study was to examine antimicrobial resistance of *Salmonella* strains, isolated from feed, chicken and pig carcasses. Examination of antimicrobial susceptibility was done by the disc diffusion method. Feed was sampled during surveillance of *Salmonella* in feed mills. A total of 1160 feed samples were examined and *Salmonella* was detected in 0.43% of these samples. Carcass swab sampling was carried out in seven poultry (240 samples) and two pig abattoirs (282 samples).

Salmonella was detected in 14.37% poultry samples and 2.84% pig samples. *S. Enteritidis* and *S. Typhimurium* were isolated from feed samples and resistance to amoxicilline, doxycycline was found. *S. Enteritidis*, *S. Typhimurium* and *S. Essen* were isolated from chicken slaughterhouses and resistance to amoxicilline, gentamicine, doxycycline, chloramphenicol, streptomycin and sulfametaxazole was found. *S. Typhimurium*, *S. Senftenberg* and *S. Bredeney* were isolated from pig slaughterhouses and resistance to amoxicilline, doxycycline and sulfametoxazole was found in *S. Typhimurium* isolates.

In our study resistance patterns in *Salmonella* strains isolated from feed, chicken and pig carcasses were similar, resistance to beta lactam and tetracycline drugs are the commonest. *Salmonella* can develop resistance in animal intestines during antimicrobial treatment but there is another possible source of resistant strains, feed. This findings need to be further analyzed.

