



# Integrated Kiwi Quality Management

Research Proposal for:

- New Zealand Kiwifruit Marketing Board
- HortResearch

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## ATO-DLO

The Agrotechnological Research Institute ATO-DLO is an organisation for fundamental and applied-scientific research for agriculture and horticulture, trade and export and for the industries manufacturing food and non-food products on the basis of agro-raw materials. The target of the institute's multidisciplinary research is to enhance the added value of agroproducts and to develop new technologies, applications and markets for agro-raw materials. The institute covers the whole production and distribution column, from the primary raw material up to and including the half-finished and end-products.

ATO-DLO's key issues are:

- Development of (non-food) industrial processing technologies and products, based on renewable agro-raw materials
- Development of food processing technologies and products
- Improvement of storage, transport, quality, food safety and integrated chain control of agricultural and horticultural produce
- Development of planning and logistical systems, packaging concepts, optical measurement methods and process control algorithms

A vast range of research disciplines is integrated on the basis of programmes and project groups:

- (bio-)chemical and physical process technologies
- industrial microbiology
- biotechnology, cell and molecular biology, and molecular physics
- physiology and biophysics
- biochemistry and organic chemistry
- polymer chemistry and technology
- sensory analysis
- agrologistics and modelling
- technical engineering.

ATO-DLO is able to offer contract research on a commercial basis. For the purpose of protecting client's interests, major parts of ATO-DLO's research are confidential.

The strength of ATO-DLO's research is based on the strong integration of disciplines covering all parts of the logistic chain from the moment of harvest up to the moment of consumption. From a quality point of view such integrated approach is indispensable to optimize the quality of kiwis reaching the consumer. The quality of kiwis imported into Europe is not always optimal. Several reasons can be given to explain the quality loss, such as non optimal chain control, non optimal transport conditions, non optimal packaging, large batch variability, the occurrence of disorders and so on. ATO-DLO can attribute to an optimization of kiwi quality in several ways.

**Fruit Quality Inspection:** It is of major interest to be able to tune a logistic chain by adapting it to batch specific demands. This can be realized when the physiological base of the relation between initial ripening stage and storability is determined. For this, different biochemical and molecular analysis can be done. By developing a physiological based model describing the quality behaviour of kiwis, the consequences of different initial ripening stages can be predicted. When such model is available, batch devoted handling becomes reality, minimizing quality losses during storage, transport and packaging. ATO-DLO has ample experience in developing such physiological based simulation models describing quality decay.

**Storage:** ATO-DLO has a wide experience in the field of optimized static air and controlled atmosphere storage for different types of products. The different storage facilities are all available at ATO-DLO including computerized flow-through systems. Combining the expertise on product behaviour and on measurement and process control has already been proved to be successful in developing dedicated storage control systems. By combining the control system with product oriented quality models the storage conditions can be optimised based on the expected product behaviour. In this way the consequences of dynamic storage conditions in terms of product quality can be predicted.

**Transport:** The optimal transport conditions for Kiwis are very critical. The sensitivity of kiwis for ethylene, for instance, can substantially be influenced by small changes in gas composition, temperature and time. In reefer containers there are always some local differences in climatic conditions (e.g. hot and cold spots). It is very important to know the magnitude of these differences, depending on circulation and ventilation rates, the CA concept applied, box isolation, etc., in order to be able to control the climatic conditions inside the container properly. ATO-DLO has the facilities and knowledge to measure, model and to control the climatic conditions inside containers. Based on these methods, the optimal conditions (gas composition, temperature, humidity) can be approached as close as possible. The conditions can, furthermore, be adapted to regulate on-vessel ripening of kiwis.

**Packaging:** To overcome several post-harvest problems, more sophisticated and/or new packaging systems of New Zealand kiwis may be used as a tool for maximizing quality retention throughout the whole distribution chain. ATO-DLO offers knowledge and consulting services in the field of modified atmosphere packaging and so-called intelligent and active packaging systems. Some kiwi-related elements in this research are:

- controlled release of bio-active agents (natural fungicides; ethylene blockers)
- integration of adsorbents for specific gases or water in packages (or added material)

**Marketing:** ATO can also support industries in the marketing of the package-product combination. Aspects of study are optimised promotions, efficient store assortment, efficient consumer response and supply chain management. Consumer panels can be used to support this marketing research. ATO-DLO has many contacts with important retailers in the Netherlands to support the New Zealand kiwi industry in distinguishing themselves from other kiwi producing countries.

**Shelf Life:** The complete history of kiwis will eventually be reflected in the shelf life remaining for the consumer. ATO-DLO has several quality experts which are used to work with (tropical) fruits and vegetables. Besides applying all kinds of instrumental determinations, quality can be assessed by expert and consumer taste panels. Besides, ATO-DLO has developed several objective quality evaluation apparatus (for instance based on computer imaging) and is capable to model the shelf life and the acceptability as the ultimate result of the preceding logistic chain.

ATO-DLO has the possibility to apply several techniques for measuring kiwi related aspects throughout the logistic chain. Besides the ones already mentioned, ATO-DLO is able to apply all possible standard or specific biochemical and molecular biological analyses, and to apply HPLC and GC techniques. Furthermore, we are able to monitor the production of ethylene and fermentation products using a new developed very sensitive laser technology. Analysis of the ethylene biosynthetic pathway is already routinely performed for different fruits and ornamentals at ATO-DLO

**Specific topics:**

Besides the already mentioned possibilities to optimize (parts of) the logistic chain some more fundamental or dedicated research topics can be formulated such as:

- **the molecular regulation of cell-wall degradation**, which is essential to understand firmness losses throughout the chain as a response to the surrounding conditions.
- **the control mechanism of fruit ripening**, which is necessary to control ripening during the season and to develop rapid ripening regimes to produce “ready to eat” fruit.
- **a nondestructive on-line sorting system of kiwis based on appearance and/or firmness**, which can be applied direct after harvest, after storage or after shipment to increase batch homogeneity and thus to realize batch devoted handling.
- **the application of essential oils to prevent Botrytis**, which can be applied during storage, transport or in packages to reduce quality losses.
- **shelf life prediction based on temperature time indicators**, which can make the invisible quality visible to the end user in terms of remaining shelf life.

In the end all available knowledge can be collected in one integrated simulation model. In this way the complex knowledge can be made accessible for use in practice. The consequences of initial ripening stage and the conditions occurring throughout the logistic chain can be predicted and translated in terms of kiwi quality available for the end user. Such simulation model can be used to optimize logistic chains to any place in the world, and in this way support you in your marketing strategy for kiwis.