

# The use of high precision gas mixtures for Modified Atmosphere Packaging (MAP).

An MCQ Gas Blender 100 Series Application



## Introduction

- What is MAP?

The commerce globalization and the constantly increasing demand for food pushed in recent years the goods shelf life improvement to become a central research topic developed world wide. Interaction between oxygen and food usually causes chemical oxidation and aerobic microorganisms growth, the major causes of food spoilage. Chilling the goods can help in slowing the deterioration of stored foods but it's the oxygen concentration reduction in the atmosphere surrounding the product that considerably increases the shelf-life. The oxygen reduction and others atmosphere modifications are performed by techniques as known as Modified Atmosphere Packaging (MAP).

- MAP in constant development

MAP techniques are now the major packaging method used on a wide range of fresh or chilled foods (more detailed information will be discussed further). Even if the majority of

products share the same spoilage causes, each food has its own optimal MAP configuration that maximizes the shelf life enhancement. This is the main reason that leads the scientific community to a constant research for new and more refined solutions. The optimization of MAP processes mostly relies on the atmosphere surrounding the foods, focusing today research on different gas mixtures experimentation.

- MCQ solution

MAP development lab-applications thus require working with high precision gas mixtures and quick and easy mixture management methods. For all these applications, MCQ proposes the use of the Gas Blender 100, an instrument specifically designed for in lab experimentation that allow the user to create three component dynamic gas mixtures and that offers an intuitive way to manage them with the MCQ Gas Mixer Manager software.

## Map Applications

Major MAP applications regard the storage and quality preservation of fresh and cured meat [1-3], seafood products [4-6], fruits and vegetables [7-10] and other generic foods [11-16]. The products are usually minimally processed thus the MAP solves the main role in their shelf life extension. The common modified atmospheres are composed by oxygen, nitrogen and carbon dioxide mixed together in different proportions depending on the product and the needs of manufacturer and the consumer. Less common but still used are those applications that involve carbon monoxide [2,17,18], nitric oxide [19] and nitrous oxide [20,21] as modified atmosphere gaseous components.

## MCQ Gas Blender 100 Series



**Table 1. Atmosphere used in MAP**

| Product            | Atmosphere composition                                    |
|--------------------|---|
| Bakery             | 80% N <sub>2</sub> 20% CO <sub>2</sub>                    |
| Fruit / vegetables | 87% N <sub>2</sub> 8% CO <sub>2</sub> 5% O <sub>2</sub>   |
| Bacon              | 70% N <sub>2</sub> 30% CO <sub>2</sub>                    |
| Poultry            | 20% N <sub>2</sub> 70% CO <sub>2</sub> 10% O <sub>2</sub> |
| Cooked poultry     | 70% N <sub>2</sub> 30% CO <sub>2</sub>                    |
| Fresh meat         | 40% N <sub>2</sub> 30% CO <sub>2</sub> 30% O <sub>2</sub> |
| Cured meat         | 65% N <sub>2</sub> 35% CO <sub>2</sub>                    |
| White Fish         | 30% N <sub>2</sub> 40% CO <sub>2</sub> 30% O <sub>2</sub> |
| Fatty Fish         | 50% N <sub>2</sub> 50% CO <sub>2</sub>                    |
| Cheese             | 30% N <sub>2</sub> 70% CO <sub>2</sub>                    |
| Pasta              | 100% N <sub>2</sub>                                       |
| Pasta (with meat)  | 25% N <sub>2</sub> 75% CO <sub>2</sub>                    |

## • Oxygen

The presence of oxygen (and in small amount, of carbon monoxide) primarily contributes to maintain the fresh meat oxygenated, giving the product the bright red color commonly associated with a good freshness degree. Oxygen also stimulates the growth of aerobic bacteria, inhibiting the growth of anaerobes at the same time.

## • Nitrogen

Nitrogen often replaces oxygen in the packaging process in order to prevent product rancidity and other spoiling factors connected with aerobic organisms growth. Nitrogen is also

used as a filler gas because of its low solubility in water and lipid compared with that of carbon dioxide, thus preventing pack collapse.

## • Carbon dioxide

Carbon dioxide is the major anti-microbial factor in MAP but many factors contribute to its real effectiveness. Gas concentration, storage temperature and especially the original population of microorganisms inside the product can affect the validity of the CO<sub>2</sub> option. Depending on the targeted product, the use of CO<sub>2</sub> can turn out to be a good choice for many MAP application as well as a major cause of spoilage.

## • MAP Gas Mixtures

In table 1 some of the most common foods and their related optimized MAP conditions are shown. Obviously as the knowledge about the MAP increases, different modified atmospheres that granted better performances are implemented and used, making these values to change accordingly.

## Map Experimentation

### • Common experimental set-up

Many laboratories in which MAP experimentation is undertaken are equipped with an array of mass flow controller single channelled, connected with an external control unit usually unprovided of any software interface for the gas mixture management. This kind of hardware configurations can be troublesome and may present mixture composition issue (instrument precision tends to lower especially when working with low flow rate). Moreover this kind of configuration doesn't allow a fast modification of the gas mixture parameters and usually require a lot of lab room.

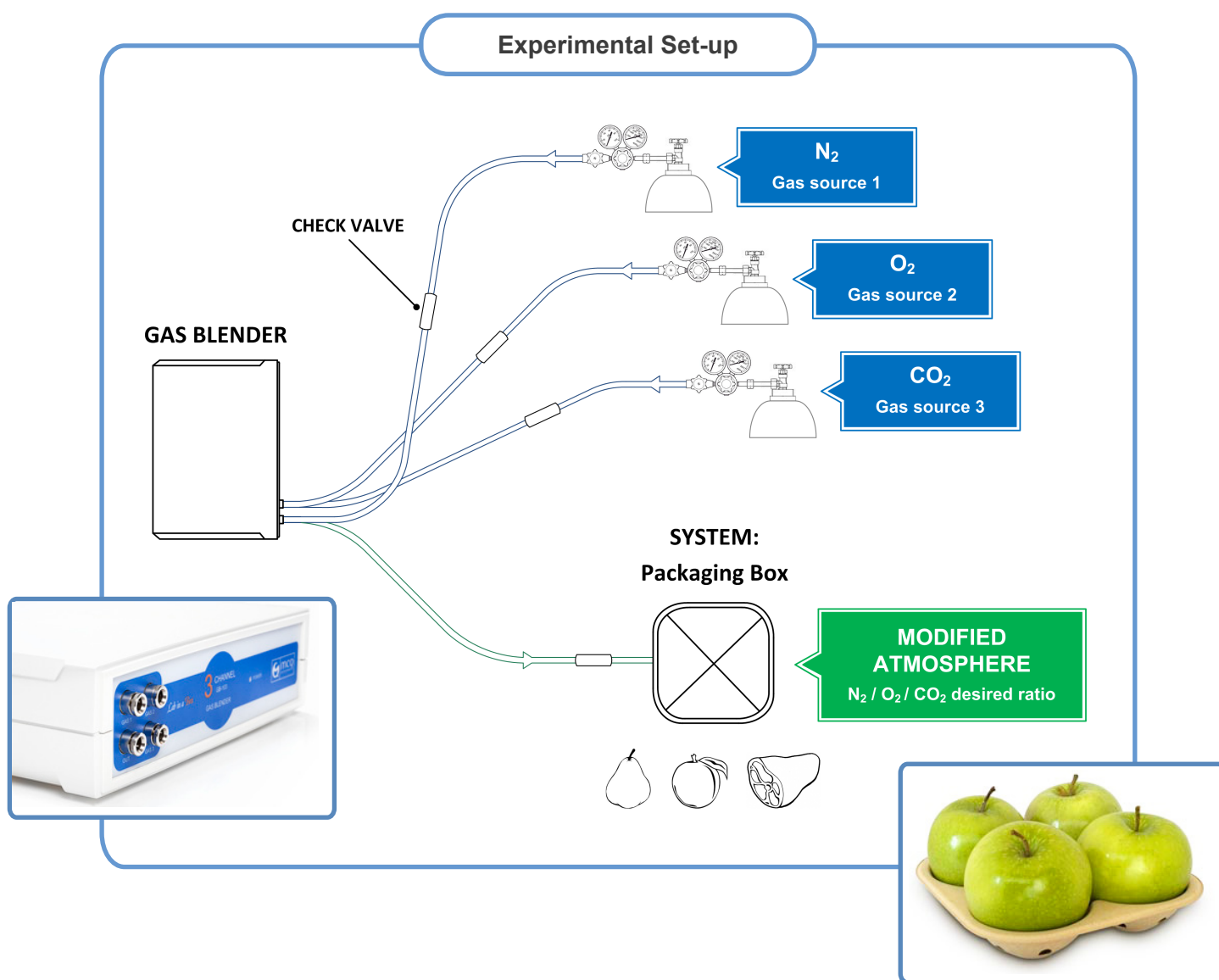
### • GAS Blender 100 experimental set-up

The Gas Blender 100 Series is the improved solution proposed by MCQ to solve these common issues. Designed following the Lab in a Box concept, the MCQ Gas Blender 100 is a high precision instrument, easy to configure and adaptable to many different lab-applications, that offers

more efficiency and an innovative quick and easy way for mixtures management, all in a compact case. The Gas Blender 100 works with 3 components gas mixtures, each gas media connected to a dedicated instrument channel for which MCQ guarantees high accuracy (1.0% of set point), high repeatability (0.16% of reading value) and the fastest response time for set point value change (50ms) now available in the market. The instrument works with dry, non-aggressive gases and the channels are always

## Hardware configuration

An example of MCQ Gas Blender 100 Series hardware configuration is represented in the scheme below. The gas in use must be dry, non-aggressive gases. The instrument works with pure or mixtures gas media (the example shows pure gases for simplicity). The gas cylinders are connected to the instrument through 6 mm diameter tubes and a check valve is installed along each line as backflow prevention



calibrated with native gases following customer's request. For the gas mixture management the MCQ Gas Mixer Manager is also provided. Easy to use, compatible with any common desktop or laptop personal computer, MCQ Gas Mixer Manager allows taking a complete control over the instrument and its functions. This software is a useful tool created by MCQ that allows working with dynamic gas mixtures immediately.

device. Each gas is connected and controlled by a dedicated channel of the Gas Blender 100. Another 6 mm tube finally connects the instrument to the working system (a packaging box suited to maintain a modified atmosphere) in which the experiment takes place. The relative amount of O<sub>2</sub> and CO<sub>2</sub> in the coming out mixture can be adjusted with ease, monitored and modified by the user with the MCQ Gas Mixer Manager software.

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