Fresh Food Dual-Channel Supply Chain

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The fresh dual-channel supply chain can be divided into a retailer dual-channel model, producer dual-channel model, and mixed dual-channel model. In the retailer dual-channel model, the producer sells products wholesale to the retailers. In addition to the traditional offline sales channels, retailers plan to open new online sales channels. For example, Hema Fresh, 7 Fresh, and Super Species adopt the retailer dual-channel supply chain model. In the producer dual-channel model, producers also intend to establish an extra online channel for sales alongside the original retailer's offline sales channels. The mode of direct supply from the production base or community group belongs to the producer dual-channel model, which is adopted by enterprises such as Dolly Farm and Pagoda. A mixed dual-channel model means that the producer sells fresh food wholesale to the retailer at first. Then, the retailer sells it through online and offline channels, and the producer also plans to sell it online. For example, RT-Mart carries out both offline and online channels, while COFCO, one of its suppliers, has built its online sales channel named Womai.com.

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1. Background

Due to growing concerns for environmental problems and food quality, consumers pay more attention to the carbon emission and freshness of fresh food. The booming e-commerce also accelerates the development of the dual-channel supply chain. In the dual-channel supply chain of fresh food, the carbon emission and freshness of fresh food are becoming important factors affecting consumers' purchase demand.

Greenhouse gas emissions have attracted the attention of countries around the world and become the focus of the international community [1]. The European Union aims to reduce its carbon emissions by 40% from 1990 levels by 2030. Some environmental labels (such as carbon labels) have been introduced internationally to guide consumers' green purchase [2][3][4]. Carbon labels specify the amount of carbon emission emitted or reduced during the product's life cycle. China is using internationally accepted certification methods to establish its carbon labeling system to guide Chinese consumers to achieve low-carbon consumption. The implementation of carbon labels will have a major impact on the retail sector, putting huge pressure on product manufacturing and supply chains. At the same time, the public is paying more and more attention to environmental issues. With the gradual popularity of the concept of low-carbon consumption, many environmentally conscious consumers choose to buy products according to carbon emissions or even buy environment-friendly products with higher prices [5]. As a result, the carbon emissions of commodities will affect market demand.

The perishability of fresh food and consumers' preference for low carbon emission and freshness make it harder to make decisions for enterprises in the fresh food supply chain when making decisions. Furthermore, poor decision-making will make the supply chain expensive. Meanwhile, a convenient online shopping experience brings about the transfer of consumers' purchasing channels, and it also impacts the offline channels and affects each company's economic interest.

2. Consumer Preference

With the development of a low-carbon economy, consumers' preference for low-carbon products has become an important factor affecting supply chain operation. The impact of consumers' environmental awareness on market demand is called carbon emission sensitive demand [6]. Consumers' awareness of environmental protection is increasing, and more and more consumers are paying attention to the carbon emission of products when making purchase decisions.

Consumers' low-carbon preference behavior has attracted extensive attention from many scholars. Seyfangs analyzed the impact of consumers' low-carbon preference behavior on market demand and price and constructed a scientific demand function that is influenced by low-carbon emission [7]. Du et al. constructed a carbon emissions-dependent demand function and analyzed the impact of consumers' low-carbon preference on carbon emissions and supply chain performance. They found that the profit of the supply chain and consumers' preference for low-carbon consumption increase with the greater reduction of carbon emission in the supply chain [4]. Zhou et al. discussed the coordination of the low-carbon supply chain under an advertising and emission reduction cost-sharing contract under the condition that retailers have concerns for fairness and consumers have low-carbon preference [8]. Liu et al. evaluated the impact of carbon emission reduction's cost sharing on supply chain profits using a theoretical model incorporating changes in consumer preferences. The results showed that consumers' preference for low-carbon products makes the members of the supply chain share the cost of carbon emission reduction, which increases the order quantity and supply chain's profit, and encourages the supply chain enterprises to cooperate [9]. Wang et al. studied the impact of cap-and-trade regulation and consumers' low-carbon preference on the supply chain in a dual-channel supply chain [10]. Zhang and Yu explored the impact of consumers' reference low-carbon effect and the goodwill of a low-carbon product on the balanced emission reduction decisions and profit of dual-channel supply chain members, and they realized supply chain coordination by using cost-sharing contracts in a dual-channel supply chain [11].

In the fresh food industry, consumers' preference for freshness is an important factor affecting the operation of the supply chain. Scholars have also done some studies on consumers' preference for freshness. Cai et al. considered a fresh product supply chain whose market demand is sensitive to freshness [12]. Herbon explored the impact of the heterogeneity of consumers' preference for freshness on supply chain profits and consumer welfare [13]. Yang et al., based on considering consumers' preference for freshness, made a comparative study on the optimal decision and profit under the traditional retail model, O2O model, and dual-channel model [14]. Considering that consumers have a preference for freshness, Zhang and Ma studied the optimal equilibrium strategy of a fresh dual-channel supply chain under different return modes [15].

3. Fresh Food Supply Chain Decision Making

Fresh food is easy to rot and spoil. Many scholars have studied the influence of fresh products' freshness on supply chain decision making and supply chain coordination. For example, Cai et al. [12] and Ma et al. [16] studied the decision-making and coordination strategy of a three-level supply chain, which consists of a producer, third party logistics (3PL), and distributor, given that price and freshness affect the market demand of fresh food. Zhu et al. took into account the impact of food freshness and sales efforts on consumer demand and realized supply chain coordination through cost-sharing contracts [17]. Feng et al. regarded the demand of perishable products as a multivariate function of their unit price, freshness, and inventory level, and they studied the optimal unit price, cycle time, and ending inventory level to maximize the total profit [18].

Many scholars have also studied pricing, ordering, and preservation strategies in the case of carrying out fresh-keeping efforts. Hsu et al. introduced the retailer's fresh-keeping efforts into the supply chain decision model and studied the retailer's optimal order strategy and fresh-keeping effort level [19]. Dye and Hsieh, based on Hsu's research, constructed a fresh agricultural product inventory model with the change of deterioration rate over time, and they studied the optimal replenishment strategy and fresh-keeping effort level of retailers [20]. Zhang et al. studied pricing and investment in fresh-keeping technology in the case of centralization and decentralization, and they realized supply chain coordination by revenue sharing and cooperative investment contract [21]. Yang et al. studied the optimal pricing and fresh-keeping effort decisions in a fresh food supply chain under three sales models (retail model, dual-channel model, and O2O model) and made a comparative analysis [14].

4. Multi-Channel Supply Chain

The research on the multi-channel supply chain mainly focuses on channel pricing, channel coordination, and profit decision [22]. Chen et al. studied the pricing strategy, supply chain cooperation strategy, and profit strategy in a dual-channel supply chain with two alternative manufacturers [23]. In the case that manufacturers use the same and different wholesale prices for traditional retailers and online retailers, Erjiang et al. discussed the channel coordination strategies adopted by manufacturers to alleviate channel conflicts [24]. Opening online sales channels in addition to traditional sales channels may not bring greater profits to the whole supply chain. Therefore, many scholars have conducted comparative studies on different channels, which provide references for enterprises in channel selection. By comparison, Keen et al. comprehensively analyzed the impact of three sales modes on the profits of the overall supply chain, including a traditional retail mode, online direct sales mode, and dual-channel sales mode, and they found that only the dual-channel sales mode could maximize the profits of the supply chain [25]. Moutaz et al. studied the channel selection and pricing decision of manufacturers. The analysis showed that unit variable costs is the most critical factor for channel selection in a vertically integrated supply chain. In the case of the existence of independent retailers, the scale of consumer groups dominated by retail will become the main factor in channel selection [26].

In recent years, different dual-channel supply chain models extended by the development of e-commerce have become the focus of academic research. Introducing online sales channels and implementing a dual-channel

supply chain strategy are effective to expand sales channels and market space for most enterprises, especially manufacturers and retailers of consumable products. According to the relevant models of dual-channel supply chain research, the dual-channel supply chain is divided according to the channel structure and the channel control subject. The details are shown in Table 1.

Table 1. Classification of dual-channel supply chain model.

Classification Method	The Specific Classification	Reference
Channel structure	(1) Pure online sales channels (2) Pure offline sales channels (3) Retailer dual-channel (retailer online sales + offline sales) (4) Supplier dual-channel (supplier online sales + retailer offline sales) (5) Mixed dual-channel (supplier online sales + retailer online and offline sales)	Cai et al. [27] Ji et al. [28] Chen et al. [29] Yang et al. [14]
Channel control subject	(1) Manufacturer (supplier, manufacturer) leading (2) Retailer leading (3) Manufacturers and retailers are evenly matched	Wang et al. [30] Ata Allah et al. [31] Yu et al. [32]

References

1. Liao, Z.; Zhu, X.; Shi, J. Case study on initial allocation of Shanghai carbon emission trading based on Shapley value. J. Clean. Prod. 2015, 103, 338–344.
2. Hicks, R.L. Can Eco-Labels Tune a Market? Evidence from Dolphin-Safe Labeling. J. Environ. Econ. Manag. 2002, 43, 339–359.
3. Song, M. Low-carbon production with low-carbon premium in cap-and-trade regulation. J. Clean. Prod. 2016, 134, 652–662.
4. Du, S.; Zhu, J.; Jiao, H.; Ye, W. Game-theoretical analysis for supply chain with consumer preference to low carbon. Int. J. Prod. Res. 2014, 53, 3753–3768.
5. Liu, B.; Li, T.; Tsai, S.-B. Low Carbon Strategy Analysis of Competing Supply Chains with Different Power Structures. Sustainability 2017, 9, 835.
6. Ghosh, D.; Shah, J. Supply chain analysis under green sensitive consumer demand and cost sharing contract. Int. J. Prod. Econ. 2015, 164, 319–329.
7. Seyfang, G. Community action for sustainable housing: Building a low-carbon future. Energy Policy 2010, 38, 7624–7633.

8. Zhou, Y.; Bao, M.; Chen, X.; Xu, X. Co-op advertising and emission reduction cost sharing contracts and coordination in low-carbon supply chain based on fairness concerns. J. Clean. Prod. 2016, 133, 402–413.
9. Liu, M.L.; Li, Z.H.; Anwar, S.; Zhang, Y. Supply chain carbon emission reductions and coordination when consumers have a strong preference for low-carbon products. Environ. Sci. Pollut. Res. 2021, 28, 19969–19983.
10. Xiaoyan, W.; Minggao, X.; Lu, X. Analysis of Carbon Emission Reduction in a Dual-Channel Supply Chain with Cap-And-Trade Regulation and Low-Carbon Preference. Sustainability 2018, 10, 580.
11. Zhang, Z.; Yu, L. Dynamic Optimization and Coordination of Cooperative Emission Reduction in a Dual-Channel Supply Chain Considering Reference Low-Carbon Effect and Low-Carbon Goodwill. Int. J. Environ. Res. Public Health 2021, 18, 539.
12. Cai, X.; Chen, J.; Xiao, Y.; Xu, X.; Yu, G. Fresh-product supply chain management with logistics outsourcing. Omega 2013, 41, 752–765.
13. Herbon, A. Dynamic pricing vs. acquiring information on consumers' heterogeneous sensitivity to product freshness. Int. J. Prod. Res. 2013, 52, 918–933.
14. Yang, L.; Tang, R. Comparisons of sales modes for a fresh product supply chain with freshness-keeping effort. Transp. Res. Part E Logist. Transp. Rev. 2019, 125, 425–448.
15. Zhang, K.; Ma, M. Differential Game Model of a Fresh Dual-Channel Supply Chain under Different Return Modes. IEEE Access 2021, 9, 8888–8901.
16. Ma, X.; Wang, S.; Islam, S.M.N.; Liu, X. Coordinating a three-echelon fresh agricultural products supply chain considering freshness-keeping effort with asymmetric information. Appl. Math. Model. 2019, 67, 337–356.
17. Zhu, Q.; Li, X.; Zhao, S. Cost-sharing models for green product production and marketing in a food supply chain. Ind. Manag. Data Syst. 2018, 118, 654–682.
18. Feng, L.; Chan, Y.L.; Cárdenas-Barrón, L.E. Pricing and lot-sizing polices for perishable goods when the demand depends on selling price, displayed stocks, and expiration date. Int. J. Prod. Econ. 2017, 185, 11–20.
19. Hsu, P.H.; Wee, H.M.; Teng, H.M. Preservation technology investment for deteriorating inventory. Int. J. Prod. Econ. 2010, 124, 387–393.
20. Dye, C.Y.; Hsieh, T.P. An optimal replenishment policy for deteriorating items with effective investment in preservation technology. Eur. J. Oper. Res. 2012, 218, 106–112.
21. Zhang, J.; Liu, G.; Zhang, Q.; Bai, Z. Coordinating a supply chain for deteriorating items with a revenue sharing and cooperative investment contract. Omega 2015, 56, 37–49.

22. Liang, X.; Jiang, Q. Pricing strategy of manufacturer in dual-channel considering competition between online retailers and offline retailers. Control.Decision 2019, 34, 1501–1513.
23. Chen, Y.C.; Fang, S.-C.; Wen, U.-P. Pricing policies for substitutable products in a supply chain with Internet and traditional channels. Eur. J. Oper. Res. 2013, 224, 542–551.
24. Peng, G.; Tian, X.; Chen, Q. Online Cooperative Promotion and Cost Sharing Policy under Supply Chain Competition. Math. Probl. Eng. 2016, 2016, 1–11.
25. Keen, C.; Wetzels, M.; De Ruyter, K.; Feinberg, R. E-tailers versus retailers. J. Bus. Res. 2004, 57, 685–695.
26. Khouja, M.; Park, S.; Cai, G. Channel selection and pricing in the presence of retail-captive consumers. Int. J. Prod. Econ. 2010, 125, 84–95.
27. Cai, G. Channel Selection and Coordination in Dual-Channel Supply Chains. J. Retail. 2010, 86, 22–36.
28. Ji, J.; Zhang, Z.; Yang, L. Comparisons of initial carbon allowance allocation rules in an O2O retail supply chain with the cap-and-trade regulation. Int. J. Prod. Econ. 2017, 187, 68–84.
29. Chen, J.; Liang, L.; Yao, D.-Q.; Sun, S. Price and quality decisions in dual-channel supply chains. Eur. J. Oper. Res. 2017, 259, 935–948.
30. Wang, Q.; Zhao, D.; He, L. Contracting emission reduction for supply chains considering market low-carbon preference. J. Clean. Prod. 2016, 120, 72–84.
31. Taleizadeh, A.A.; Alizadeh-Basban, N.; Sarker, B.R. Coordinated contracts in a two-echelon green supply chain considering pricing strategy. Comput. Ind. Eng. 2018, 124, 249–275.
32. Yu, B.; Wang, J.; Lu, X.; Yang, H. Collaboration in a low-carbon supply chain with reference emission and cost learning effects: Cost sharing versus revenue sharing strategies. J. Clean. Prod. 2020, 250, 119460.